HERTFORDSHIRE WATER STUDY 2017

Infrastructure & Resources, Sub-catchment Solutions
(2021 – 2051)

MARCH 2017

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1 EXECUTIVE SUMMARY

Arcadis Consulting (UK) were commission by Hertfordshire Council in 2015 to undertake a strategic assessment of water infrastructure to provide project partners, including local districts and the Water Utility Companies, with evidence to support planning for growth over the next 35 years.

The primary objectives of the study were to identify how future growth is likely to affect water infrastructure systems, what changes are potentially needed to facilitate this growth and how could new systems impact the environmental. The secondary objective was to identifying a range of options to meet local and strategic infrastructure needs, including a wider policy options.

A partnership was developed to underpin consultation and collaboration throughout the project, comprising the key local administrative authorities (County Council, District Councils, Hertfordshire LEP), the Water Utility Companies (Thames Water, Anglian Water and Affinity Water) and the Environment Agency.

To achieve these objectives the scale and location of growth, both known (within Local Plans) and anticipated, was clarified through consultation and the consolidation of multiple sources of population and housebuilding projections. A range of scenarios were used to define key future timeframes and clarify uncertainty within the assessment. High-level numerical and hydraulic modelling was used to derive an understanding of current and future system capacity, and the potential impacts of projected growth.

Following this evaluation district summaries were derived to provide a geographical understanding of infrastructure 'need', demonstrating associations between growth projections and potential water infrastructure deficits. This was followed by the creation of 'sub-catchments', defined to provide a strategic view of potential future requirements, which incorporate neighbouring districts based on the need to address common water infrastructure issues. Where there are significant infrastructure challenges and / or growth pressures, strategic solutions have been proposed, looking to enhance sustainability, improve long-term resilience and promote innovation.

The greatest challenges that threaten the exploration of these sub-catchment solutions are growth uncertainties and the water infrastructure regulatory framework. Increasing confidence in growth will be an instrumental in securing funding and enabling the Water Utility Companies to minimise investment risks within the planning process. Where potential solutions could extend over multiple Asset Management Plan (AMP) periods the Water Utility Companies will need to rely on more robust growth figures to support the preparation of long-term investment plans.

The outcomes of the study should help assist with the preparation of Local Plans, clarify some of the uncertainty associated with growth expectations, help facilitate the participation of the Water Utility Companies in local planning and support strategic bids for growth related funding. The options explored should be used to assist in the planning of future water infrastructure systems and inform the next round of water resource plans and long-term strategies.

A 5-point action plan was derived to provide a framework to convert the broad outcomes of this study into an implementation strategy. It is primarily comprised of activities to help address the uncertainty of growth, promote increased collaboration between the partners and formulate further investigations, necessary to add a greater level of detail for specific regions (where necessary) and support the upcoming AMP7 planning.

2 STUDY PARTNERSHIP

The Hertfordshire Water Study Partnership (‘The Partnership’) was formed as a study steering group, consisting of key organisations responsible for facilitating urban development, managing water utility and protecting the water environment. The Partnership was launched in September 2015, comprising local planning authorities, regional planning authorities, Water Utility Companies (i.e. public water companies) and the Environment Agency *(shown in Figure 1)*.

Within Hertfordshire, sewerage and wastewater treatment is jointly managed by Thames Water Utilities Ltd (Thames Water) and Anglian Water Services Ltd (Anglian), while water supply is provided by both Thames Water and Affinity Water Ltd (Affinity Water).

Cambridge Water Company, who serve some customers in a small area in north Hertfordshire, did not participate in this project.

Local development planning is undertaken by the 10 district councils within Hertfordshire, with regional planning provided by the county council. Broxbourne District Council, located within Hertfordshire, did not participate in this project. Chiltern District Council, within the neighbouring county of Buckinghamshire, did participate in the study as they share a range of common planning issues with Hertfordshire and is predominantly served by the Maple Lodge Sewerage Treatment Works (STW) catchment (which serves a large proportion of Hertfordshire).

Arcadis Consulting UK Ltd (Arcadis) facilitated collaboration within the partnership through active consultation and engagement. The Partnership provided an efficient mechanism for gathering data and information, consulting on outcomes and agreeing study assumptions. It also facilitated a greater level of transparency across partners for all aspects of development and water utility planning.

Figure 1 - Partnership Members

3 WATER VISION FOR HERTFORDSHIRE

A proposed Vision for Hertfordshire to underpin the aims and objectives of this project has been developed to help steer the identification of options and strategies. The vision has been encapsulated as follows:

‘A water resilient, sustainable and secure Hertfordshire, where all administrative organisations, water authorities and local environmental groups collaborate to provide efficient water infrastructure and preserve the quality of the water environment for the benefit of everyone, especially its chalk rivers and the valuable ecosystems they host.

An integrated and diverse wastewater infrastructure that will help remove obstacles to planned growth and contributes to local economic prosperity, whist helping to maintain healthy groundwater supplies. Innovative and water sensitive developments, designed to deliver sustainable benefits to their local water and regional water environment, former part of a wider holistic water management strategy to ensure Hertfordshire is an exemplar of integrated planning, effective catchment management and environmental protection.’

3.1 Principles of the Vision

3.1.1 Collaborative Infrastructure Planning

Collaboration is essential to realise this vision, driving efficiencies, opening access to more resources and allowing informed decisions to be made. Partnerships provide a clear mechanism by which all stakeholders can contribute to catchment planning activities and influence key decisions regarding costs, benefits, design and delivery of solutions and strategies. Ensuring that a broad spectrum of stakeholders is engaged, links the water environment with the local economy, creating a better understanding of the true value of water.

Integrating planning systems would facilitate better informed decisions over areas of investment, linking infrastructure and environmental needs across different authorities and catchments.

3.1.2 Cost-effective & Robust Drainage Systems

The continual upgrade and improvements in drainage infrastructure in the traditional fashion (e.g. installing bigger pipes / pumps tanks etc.) is likely to inevitably become unsupportable in time, without seeking novel and innovative sustainable techniques.

The Defra white paper, Water for Life (2011)[1], noted that only 1% of public sewers were replaced each year between 2000 and 2008, while Water & Wastewater Treatment research[2] suggested that only 0.2% of sewers on average were renovated or replaced per annum more in more recent years. If this rate of replacement continues any new wastewater pipeline installed today would need to last for over 500 years before it is replaced. This demonstrates that the continued reliance on largely traditional engineering methods to

[1] Defra – Water for Life Policy Paper, 2011 (Link)

[2] Water & Wastewater Treatment – Timebomb in UK Sewerage, 2012 (Link)

maintain an effective and modern wastewater network is likely to be short-sighted and represents a high-risk strategy.

This does not mean that traditional methods must be replaced with new approaches, but rather that they should be supplemented with a much larger range of options at a variety of scales. A more resilient system will only be achieved with a more diverse mix of drainage elements.

3.1.3 A Sustainable & Resilient Water System

The 'Water Sensitive Catchment' model may be taken to represent a goal towards one which we should all be striving for as a 21st century society. Such a catchment would integrate the key values of environmental management and protection, supply security, flood control, public health, amenity, liveability and economic sustainability, amongst others. It would also be motivated by intergenerational equity with regards to natural resources and ecological integrity, as well as by concern that communities and environments are resilient to climate change. Such a system requires a highly flexible institutional regime and the need for local authorities to take a leading role is essential.

This vision for Hertfordshire is built upon the four key principles of resilience, sustainability, security and prosperity, as shown below

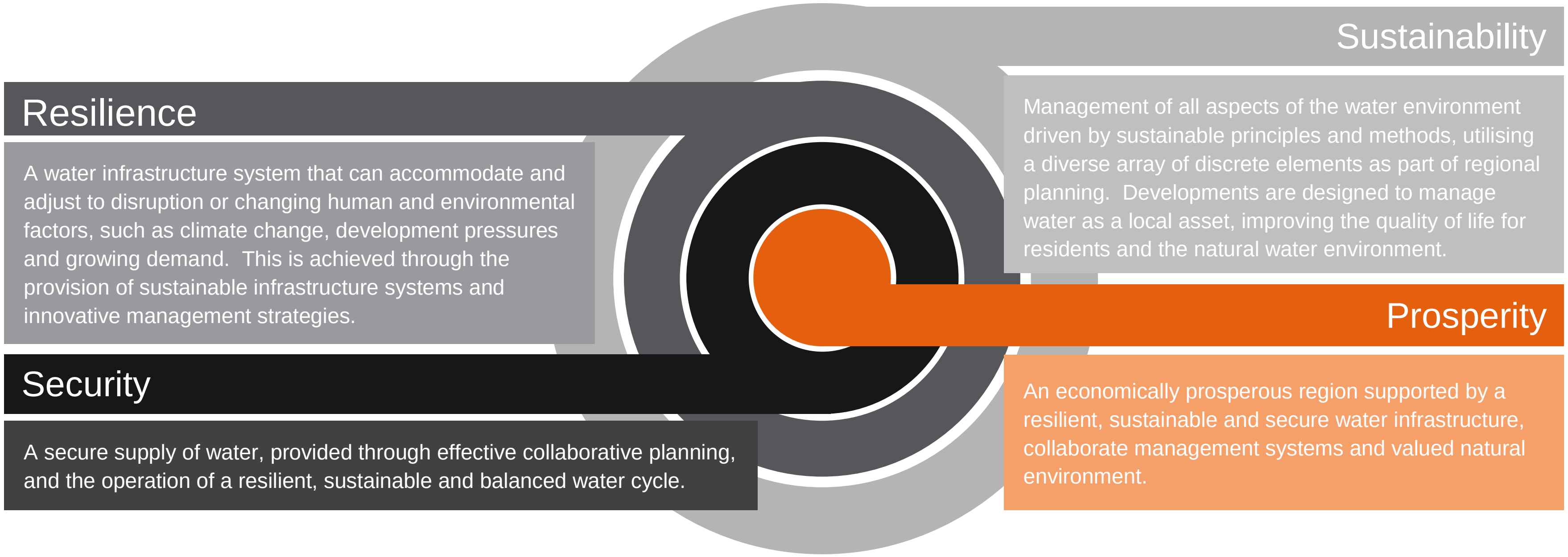


Figure 2 – Water Vision for Hertfordshire

4 BACKGROUND

4.1 Overview

The Hertfordshire Water Study 2017 was commissioned in 2015, completed in early 2017. The outcome of the study will provide a technical evidence base and overarching framework to support local planning and facilitate a better-informed approach to managing wastewater infrastructure and water resources. Continued pressure from population growth now and from future forecasts will exert considerable pressure on existing network systems, the Water Utility Companies and the natural environment. The success of development planning is crucially dependent on critically timed decisions being made throughout the planning process. Without the adequate and timely provision of water infrastructure, housing and jobs can be delayed or at worse lost altogether as a result of developers looking to alternative locations where provision is more certain and available at a lower cost.

Failure to adopt a proactive approach to the management and provision of infrastructure could affect local development, suppress economic prosperity and adversely impact the natural environment. Such implications could include:

- **Decreasing environmental quality** such as habitat degradation and ultimately loss (e.g. dried up rivers and streams, potentially changing ecological function such as when water is transferred into a chalk catchment from a non-chalk catchment)
- **An increase in the cost of infrastructure** to the developer, affecting the viability of a development and reducing the potential to realise a wider range of benefits
- **Increasing costs to the consumer** as more energy is required to transport water over greater distances or greater levels of treatment are required to achieve higher standards of water quality requirements
- **Increased risk of flooding** when either water is transferred across different runoff catchments or as the result of an increase in impermeable areas from new developments
- **A delay in the delivery of housing** and provision of jobs
- **Reduced water pressure** for existing residents
- **Increased risk of disruption** to supply at times of peak demand

The study has been based on three key strategic outcomes, as shown in Figure 3.

- **Resilience** (Supply, service, economy etc.)
- **Sustainability** (Reuse, environmental benefit, quality)
- **Security** (Ensuring water security for Hertfordshire)

Figure 3 – Key Study Strategy Concepts

All relevant development and water utility planning information and data across Hertfordshire and Chiltern was collated to inform and evaluate the strategic wastewater infrastructure and water supply requirements over a 30-year period, from 2021 (defined as the baseline) to 2051.

For the purpose of simplicity any references made in this report to 'study boundary' or 'Hertfordshire' (when discussing geographical areas and options) should be considered to include Chiltern and exclude Broxbourne.

The evaluation undertaken aims to provide study partners with a strategic understanding of the probable effects of forecast population growth on the capacity of the wastewater infrastructure and availability of water resources. This is outlined in terms of the likely scale of investment required and the options available to address any potential shortfalls. The full scope of the study is detailed in Section 5.

The primary objectives of this study have been to:

- Identify how current and future wastewater infrastructure and water resource availability could **affect future growth** levels
- Identify potential **changes to wastewater infrastructure and water supply** required to support the scale of development projected
- Identify potential **environmental impacts** of projected development on water quality and quantity
- **Provide a range of outline options** to meet strategic and local infrastructure needs, and an indication of the scale of investment
- Set out a **range of wider non-infrastructure policy options and water management approaches**

The results of the evaluation have been assessed and presented at three key spatial levels:

- District Level
- Sub-catchment Level
- Regional Level

The sub-catchments level aims to provide an understanding of related key challenges, infrastructure, development and options not restricted to administrative boundaries. Further detail is provided on the identification and derivation of sub-catchments in Sections 4.6.

4.2 Urban Growth & Development

The expansion of existing settlements and the growth in population of Hertfordshire is significantly influenced by the sustained expansion of London over the last hundred years, supported by better road and rail links to the city. During the 20th century, as the area of Greater London grew, Hertfordshire and its economy expanded, attracting greater investment and sustained levels of development. This investment facilitated, amongst other things, the development of Letchworth as the world's first garden city[3] and Stevenage as the first town to undergo significant redevelopment under the New Towns Act 1946.

Throughout the second half of the 20th century and onward into the 21st century this growth continued. Minor settlements have developed into larger commercial centres, some merging with neighbouring settlements to create larger conurbations. In more recent times this level of growth has not been sustained as economic uncertainty has impacted on house building levels. The Global Financial Crisis of 2007-08 had a marked influence on market housing provision in the county, echoing previous recessions, as can be seen in Figure 4.

[3] A Garden City is a method of urban planning through self-contained communities surrounded by "greenbelts", containing proportionate areas of residences, industry, and agriculture.

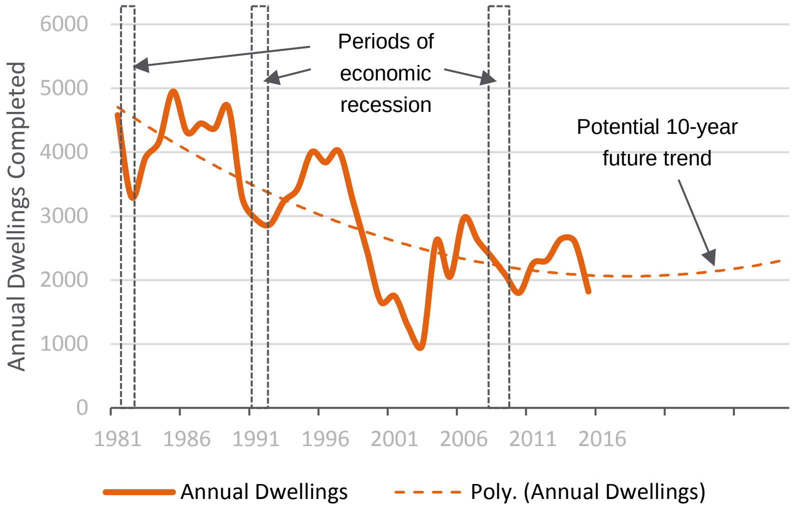


Figure 4 – Annual Housebuilding completions for Hertfordshire since the late 1960s.

Looking forward, future growth levels in Hertfordshire are expected to be higher than in the recent past. The general trend (as shown in Figure 4) along with recent population projections indicates that house building is anticipated to be on the rise, reversing the downward trend between the mid-90s and early 2000s.

In terms of population, current UK projections indicate an up to 14% increase by 2039[4]. However, in Hertfordshire this could be up to 24% over the same period[5], demonstrating the potential pressure to provide adequate housing above the national average.

The Dacorum et. al Water Cycle Study (2010) scoping study covered the southwest of the study area, including St Albans, Three Rivers, Dacorum, Watford and Welwyn Garden City districts. It concluded that the Water Utility Companies had strategies in place to accommodate potential increases in demand for a growth level of nearly 30,000 houses by 2031, also accounting for limited water resources and climate change. These strategies partly relied on increased water efficiency in both new and existing dwellings.

The study found that for a predicted growth of 62,000 houses the Water Utility Companies may need to reassess the long-term plans for the area. It suggested that additional import of water from outside the Hertfordshire, and a rearrangement of existing strategic infrastructure, could be necessary during peak demand periods to ensure the security of uninterrupted supply.

4.3 Water Industry Infrastructure Investment & Planning

4.3.1 Water Utility Companies

Water Utility Companies are responsible for providing customers with water (supply) and sewerage services (disposal and treatment). Customers may receive water supply from one company and sewerage services from another. The Competition Commission ensures that a healthy competition exists between the various water utility companies so as the mutually benefit suppliers, customers and the wider economy

Thames Water provide sewerage and treatment services across the majority of Hertfordshire, extending up to Buntingford and Bishops Stortford. They only supply water to a small region in the south, covering Hatfield and Potters Bar.

[4] National Population Projections: 2014-based Statistical Bulletin *(Link)*
[5] Hertfordshire Local Information System *(HertsLIS) (Link)*

Anglian Water provide sewerage and treatment services and supply for the northerly and easterly areas of Hertfordshire, including the towns of Letchworth Garden City and Hitchin.

Affinity Water provide water supply across the whole of Hertfordshire, except the small parts served by Thames Water.

4.3.2 Regulation

The water industry operates on five-yearly investment cycles called AMP periods. Through this process prices are set by Ofwat (the Water Utility Company regulator) at the beginning of each period and the level of investment that Water Utility Companies can make are determined. Water Utility Companies plan and implement large-scale investment programmes in order to maintain their assets over this period and meet their legal environmental and water quality obligations. A large proportion of the necessary investment is obtained through competitive financial markets, either through borrowing or direct investment by shareholders, in additional to profits accrued from customer charges. As a result, Water Utility Companies must operate to achieve a profit to reward investors.

Sustained financial investment is essential and largely driven by Ofwat to ensure the infrastructure serving customers and providing their water supply has sufficient capacity to accommodate future growth and wastewater flows. Throughout the planning process for this continual investment Water Utility Companies follow a twin-tracked approach, aiming to balance supply and demand projections. Water Resource Management Plans (WRMPs), which conform to UK legislation and Environment Agency guidelines, form the planning framework to ensure that there is sufficient water supply whilst maintaining an adequate and healthy quantity of water in the environment over a 25-year period.

To manage supply, an alliance of the six southeast Water Utility Companies (including Affinity Water), the Environment Agency, Ofwat, Consumer Council for Water, Natural England and Defra, was formed to develop long-term plans for securing water supplies in the south east. The aim of this group, the Water Resources in the South-East Group (WRSE), is to develop a regional water resources strategy which will contain a range of options to find the best long-term solutions for customers and the environment in the southeast of England.

4.3.3 Wastewater Management

Thames Water 5-Year Plan – AMP6 (2015 to 2020)[6]

Thames Water will be looking to maximise capacity in sewers by promoting more widespread use of sustainable drainage practice in the region. They will work in partnership with local authorities and prospective developers, with a target of disconnecting 20 hectares of drainage from the sewer network.

Significant investment will be made to improve 18 of the larger STWs, plus setting aside additional funding for smaller works, in those areas where growth is less certain.

Anglian Water 5-Year Plan – AMP6 (2015 to 2020)[7]

Anglian Water will target reductions in the risk of sewer flooding from overloaded sewers, blockages and operational problems by implementing the use of a variety of cost-effective measures. These include increasing sewer capacity, sewer rehabilitation, retrofitting SuDS and public behavioural change campaigns to help reduce blockages. Schemes to reduce CSO activity will be considered and prioritised as part of the long-term sewerage planning process.

[6] Thames Water – Our 5-Year Plan for 2015 to 2020, 2016 (Link)

[7] Anglian Water – Our Plan 2015 to 2020 (Link)

Anglian Water have set a commitment of 25% of sewerage capacity schemes to incorporate SuDS solutions.

Thames Water Long-term Strategy (2015 – 2040)[8]

The treatment strategy is to improve gradually both the capacity and the reliability of our major STWs drawing upon risk-based targeted investment. Looking further ahead, the strategy involved exploring synergies with the Thames Water WRMP strategy (*See Section 6.3.1*), aiming to limit the need for new STWs through reduced overall demand.

Continued investment in catchment improvement and management projects aimed at reducing the quantity of pollutants entering water sources (e.g. introducing new landscaping features such as grassed areas and ditches) is also a priority.

The sewer network strategy is to take a fully integrated and active approach. A major part of this will involve cost-effective measures to reduce the input of rainfall to sewers. In many areas, the most cost-effective solution to under-capacity in sewers will be to extend or improve the network. However, the strategy does prioritise more sustainable ways to manage rainfall and prevent it entering sewers in the first place.

Delivering more sustainable schemes will involve working alongside the Environment Agency and local authorities to promote and install SuDS, encouraging rainfall to soak into the ground rather than running into sewers. In addition, SuDS will be utilised to reduce the potential for spills to the environment at CSOs wherever possible, for which several trial SuDS projects are already under-way.

Thames Water aim to manage their networks more actively, with the installation and progressive use of real-time control and telemetered monitoring systems.

Anglian Water Long-term Strategy (2015 – 2040)[9]

Anglian Water aim to increase resilience and reliability by adapting to the combined challenges of climate change and growth, key priorities for their customers and stakeholders. Climate change and growth will necessitate a major challenge to maintaining water supplies.

Anticipation of investment for growth will require infrastructure needs to be planned well in advance to enable services to be maintained and to mitigate adverse effects on the environment.

Anglian Water consider climate change the biggest risk facing their region in the long-term. Improving efficiency and flexibility will be essential to manage major uncertainties.

Thames Water Maple Lodge (Chalfont St. Peter Area) Drainage Strategy / Chesham Drainage Strategy[10]

This Thames Water Drainage Strategy focusses on the foul sewerage system, specifically in the Chalfont St. Peter catchment, including Chalfont St. Giles and the eastern part of Amersham, which encompasses part of the wider Maple Lodge STW catchment.

The foul sewerage system has been overwhelmed in recent times in some locations, following prolonged and heavy rainfall combined with high groundwater levels. This has resulted in numerous properties suffering from sewer flooding. The root causes of sewer surcharges are numerous and the resolution of the issues complex,

[8] Thames Water – Our 25-Year Strategy for 2015 to 2040, 2016 (Link)
[9] Anglian Water – Strategic Direction Statement 2010-2035 (Link)

[10] Thames Water – Maple Lodge (Chalfont St Peter Area) Drainage Strategy, 2016 (Link)
Thames Water – Chesham Drainage Strategy, 2016 (Link)

requiring all stakeholders responsible for drainage in the catchment to work together to resolve them.

This drainage strategy also addresses future challenges to the Chalfont St. Peter, Chalfont St. Giles and Amersham sub-catchments of the Maple Lodge STW catchment.

4.3.4 Water Resource Management

The WRMPs use plan-based forecasts, based on information for population and dwellings from local authorities. The planning framework for Hertfordshire is comprised of the statutory planning documents prepared by local authorities, called Local Plans. These plans feed into Water Utility Companies growth forecasts, used to evaluate infrastructure capacity and investment. The Local Plans also take into account information from the following studies:

- **The Infrastructure Delivery Plan**, which forms part of the evidence base for a Local Plan
- **The Strategic Economic Plan (SEP)**, prepared by the Hertfordshire Local Enterprise Partnership (LEP), prioritises investment to support housing and economic growth
- **The Hertfordshire Infrastructure and Planning Partnership (HIPP)**, which aims to identify infrastructure requirements across Hertfordshire

The time horizons used during the evaluations for this study are 2021, 2031 and 2051 (*See Section 6.1.1*). Local authority planning typically extends 10 to 15 years into the future, which at present provides some clarity of development until the 2030s. For the Water Utility Companies, infrastructure planning covers the current AMP cycle (AMP6, 2015-2020) and next AMP cycle (AM7, 2020-2025), beyond which long-term strategic planning takes over. Any growth identified in a Local Plan beyond the end of the next AMP cycle (2020-2025) is unlikely to be associated with any water infrastructure investment planning or commitments, due to the inherent focus on the current and / or next AMP cycle.

4.4 The Water Environment, River Quality & Ecology

4.4.1 Hertfordshire Water Environment

The porous nature of the chalk which predominantly underlies Hertfordshire behaves like a sponge, retaining percolated rainwater and supplying rivers. This chalk sponge is referred to as the groundwater aquifer. When the aquifers have sufficient quantities of water the rivers flow, conversely when there is less water, river flows are reduced or vanish all together.

The Environment Agency Environment Agency currently classifies both surface water and groundwater resources within the majority of Hertfordshire as over-licensed or over-abstracted, effectively meaning that there is no surplus water available for any further increase in supply. This highlights the importance of the conservation of water in both new and existing domestic dwellings, as well as commercial properties.

Most chalk rivers have winterbourne stretches, these often run dry or partially dry in late summer, due to a seasonal low rainfall no longer recharging the aquifers. Normal recharge of the underlying aquifer occurs during the winter months when the majority of rainfall accumulates on the surface, due to low evaporation rates and interception cover. The summer sees a dramatic change in vegetation cover and temperature so groundwater levels can vary significantly across the seasons and the prevalence of dry or wet weather.

4.4.2 Ecological Quality of Chalk Streams

Water abstraction and urban runoff is linked to water quality and the ecology of local watercourses. Chalk streams are predominantly fed from groundwater aquifers, meaning that the water is of high clarity and good chemical quality. It is this quality that allows these streams to support complex ecosystems and natural communities, creating a unique and globally recognised environmental asset. The unique combination of geology and climate means that chalk streams possess characteristic features that support a varied and unique abundance of wildlife habitats and species.

Ensuring urban development and growth can continue in a sustainable and resilient manner is essential to both minimise its impact of water quality and support ongoing schemes to improve their ecology. Affinity Water will be undertaking river restoration and habitat enhancement work on several chalk streams, working alongside the Environment Agency and local river catchment partnerships, to improve riparian ecology and associated habitat diversity. Such improvement initiatives are key to managing and potentially mitigating the impact of further development in Hertfordshire.

4.4.3 Water Abstraction

The number of abstractions has risen steadily in-line with the increasing demand for water in Hertfordshire. There are currently 275 abstractions in the Upper Lee catchment, licensed to abstract over 465 Megalitres (Ml) of water per day. Nearly three quarters of licenses are for groundwater abstraction of which 88% is directed towards public water supply.

Groundwater abstractions have contributed to reduced flows along several chalk rivers in Hertfordshire, leading to increased periods of dry bed conditions along winterbourne sections. River stretches that are routinely affected by seasonal drying out account for roughly half the course of the river Beane and river Mimram. Any extension of such periods can have a direct impact upon local wildlife and biodiversity. The secondary effects of prolonged periods of low flow and no-flow conditions can include amongst other detrimental impacts the accumulation of fine sediment (silt) on the river bed. This can directly and adversely affect the diversity of aquatic vegetation and structure, thus impacting the fine balance that co-exists within these fragile and unique natural ecosystems.

Affinity Water are proactively working to help protect these chalk streams ecosystems by reducing the amount of water it abstracts from groundwater sources in the region of 69.8 Megalitres per day (Mld) by the end of AMP7 (2025). There are longer-term challenges that must be faced relating to how the abstraction and supply of water can be balanced to meet the needs of a growing population and counter the pressures of climate change.

The Environment Agency closely monitors current abstractions to gain a greater insight into the water-balance of catchments and forecast how much water may be available for future use. The Environment Agency prepares and oversees Catchment Abstraction Management Strategies (CAMS) to make sure there is enough water resource for society and the natural environment, the findings of which are published in abstraction licensing strategies.

The three strategies which cover the study area are:

- The Upper Lee Abstraction Licensing Strategy (February 2013).
- Colne Abstraction Licensing Strategy (February 2013)
- The Upper Ouse and Bedford Ouse Abstraction Licensing strategy (March 2013)

The CAMS are discussed in more detail in Section 6.3.1.

4.5 Future Challenges

The primary challenges in providing adequate water infrastructure and maintaining water availability into the future include, but are not limited to, the following:

- **Increasing water demand**, due to an ever-growing population and increasing levels of personal and societal affluence.
- **Reduced availability of water for supply**, due to the forecast influence of climate change on supply and storage
- **Maintaining the quality of water** for supply and handling the impact of additional development on water quality
- **Increasing cost of asset maintenance and upgrade**
- **Increased pressures of climate change** on all existing drainage infrastructure

It is probable that many of these scenarios will result in a further tightening of any environmental controls and regulations already in place to ensure the continuous protection of the water environment and its resource dependent ecosystems. This may in turn drive higher levels of investment, affecting the long-term viability of development and success in achieving planning objectives.

Figure 5 – Future Water Challenges in Hertfordshire.

4.5.1 Growing Demand

Hertfordshire has one of the highest water consumption rates in the UK, with domestic water use recorded as averaging out at 166 litres per head per day (l/h/d), compared to the overall national average of 147 l/h/d in 2011. Given the potential limitations on water availability within the county, current sources of supply are unlikely to be capable of meeting future requirements without intervention.

This level of demand, if not directly addressed, may increase reliance on water imports in the future. This could have major consequences for the long-term management of water resources across the country, potentially forcing operational costs (and water charges) to rise to support any mandatory investment in new infrastructure.

At a more local scale, the provision of an increased water supply would apply greater pressure on Water Utility Companies to increase levels of abstraction. Increased abstraction rates will reduce water availability to the natural environment and negatively impact many aspects of the local natural environment and the associated ecosystems throughout Hertfordshire. In particular, any change will acutely affect chalk rivers unless effective planning and preventative actions are implemented now.

4.5.2 Water Availability

The catchment is an area of water stress, where average daily water use is amongst the highest in the country. Groundwater and rivers supply water for local people, and 90% of water abstracted is used for this purpose.

Groundwater in the Upper Lee Catchment is of great importance as it is used to supply drinking water and supplement local waterbodies. The three main groundwater bodies in the Lee Catchment are as follows:

- The Upper Lee Chalk (Poor Chemical Status)
- The North Mymms Tertiaries
- The Greenwich Tertiaries and Chalk (Good Chemical Status).

All the waterbodies above are classified as being at risk and are deemed highly susceptible to contamination.

A large proportion of the public water supply is abstracted from groundwater sources, with little made available from permanent surface water reservoirs. The seasonal recharge of groundwater from rainfall is essential to ensuring a resilient supply of water. The prevalence of dry weather and drought conditions would be a critical impediment to maintaining supply and demand in the future.

The UK Climate Projections (UKCP09)[11] provide the most reliable and up-to-date probable indication of climatological and atmospheric conditions in the future. Based on the medium emissions scenario, average summer rainfall in Hertfordshire, is projected to decrease by 10% by the 2020s and up to 18% by the 2050s.[12]. Under the highest emissions scenario summer rainfall is projected to decrease by up to 34%

Following the dry winters of 2010 / 11 and 2011 / 12[13], groundwater levels remained well below average and were approaching extremely low levels by March 2012. As a result, Affinity Water, alongside fellow Water Utility Companies operating across the south east of England, imposed a temporary use ban[14].

Greater demand for resources, combined with a changing climate, could mean that this is a scenario that reoccurs more frequently in the future. Changing weather behaviour and climatic cycles could also see a negative response in the natural environment where persistent lower groundwater levels can disrupt vulnerable ecosystems.

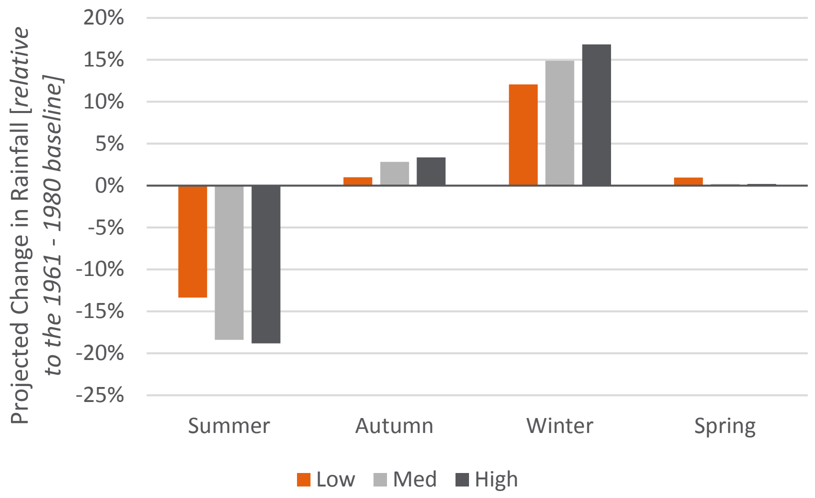


Figure 6 – UKCP09 2050 Hertfordshire Seasonal Precipitation Predictions, 50% probability level (central estimate)

4.5.3 Increased Rainfall

According to UKCP09 projections, as discussed in Section 4.5.2, decreased summer rainfall largely matched with a comparable increase in winter rainfall. Average winter rainfall is projected to increase by around 10% during the 2020s and by up to 15% by the 2050s, based on the medium emissions scenario. Under the

[11] UK Climate Projections (Link)
[12] UKCP09 deals with uncertainty around the levels of greenhouse gas emissions by presenting 3 possible emissions scenarios - low, medium and high - all of which are assumed to be equally plausible

[13] Met Office: England and Wales drought 2010 to 2012 (Link)
[14] The Temporary Use Ban is a temporary restriction implemented for customers throughout a specified are who are required not to use the water supply for number of non-essential purposes.

highest emissions scenario summer rainfall is projected to increase by up to 29%.

Although the projected winter increase in rainfall effectively offsets the summer decrease in rainfall, groundwater levels remain likely to fall. The volume of rainfall is projected to increase but shorter winters (through to potentially occur in future) will mean it will fall more intensely over shorter periods. Aquifers are recharged most effectively by prolonged steady rainfall, outside the vegetation growing season. Rainfall delivered over a shorter period might lead to a long-term reduction in recharge of some groundwater aquifers, worsening the drought and supply issues discussed in Section 4.5.2.

In addition, most development typically increases rainfall runoff rates into local watercourses through piped conveyance systems. As a result, rainfall is not retained within the catchment for long, thereby reducing the amount of water available to recharge the groundwater aquifers and increasing the pressure on drainage systems. There is a growing requirement to invest in drainage within urban areas to manage the increasingly high magnitude low frequency storm events.

4.5.4 Water Quality

The biggest detrimental impact on the water environment as a result of population growth and additional development within Hertfordshire could be a reduction in water quality. This will manifest itself as a result of increases in discharge from the development areas themselves and from the CSOs and STWs, that will be consequently serving a greater population. Chalk streams and chalk groundwater aquifers can be highly sensitive and reactive to such impacts.

Chalk streams throughout Hertfordshire bear the scar of a long legacy of damaging anthropogenic activities including the impoundment and redirection of stream channels for the milling industry and the unrelenting abstraction of water for potable supply. The effects of which are so profound in certain areas that some chalk streams have all but practically disappeared.

Much of this historical damage has been remediated or is currently in the process of remediation, through a range of management and improvement schemes. Reverting previous and existing detrimental activities through such schemes can be inherently challenging, and can be limited by the availability of necessary resources and allocated investment.

As low energy systems, chalk rivers have been less able than other river types to reassert their channel structure and re-establish damaged or lost habitats. To maintain the quality and quantity of Hertfordshire chalk rivers, the extent, approach and investment in habitat restoration projects will need to be aligned with the forecast increase in pressures in the county.

Groundwater

Groundwater provides most of the public water supply in Hertfordshire, so maintaining its quality for potable use is paramount. Any reduction in the quality of abstracted raw water[15] requires greater levels of treatment at Water Treatment Works (WTW), in turn potentially requiring additional investment in more complex and demanding treatment processes. At present, the

[15] Natural water found in the environment which has not been treated, including rainwater, groundwater, water from infiltration wells, and water from bodies like lakes and rivers.

quality of many of the Water Framework Directive (WFD) groundwater bodies in Hertfordshire is classified as poor.

The pressure of urban development is likely to affect chalk rivers, such as the Mimram, in two key ways:

- Increased levels of abstraction from the chalk aquifer will threaten river flow levels, leading to increased seasonal winterbournes or permanently dry river beds.
- Development of greenfield land interrupts the natural recharge of the aquifer as runoff from urban areas is typically routed directly to main river channels, and flushed rapidly downstream.

This dual impact of urban development on the availability of water in the chalk aquifer is a crucial contributory mechanism to the reduction of water availability, quality and ecological status of the chalk streams.

4.5.5 Regulatory & Environmental Protection Pressures

Regulation relating to the environment is constantly evolving and systems should be resilient to change. A growing population, combined with climate change and the need to protect our rivers could affect future availability of water supplies. This could affect growth plans, so ensuring development uses water sustainably and safeguards groundwater quality is vitally important.

The Environment Agency set the standards for water quantity and quality entering the environment from STWs through to site specific permitting. Within Hertfordshire, with population growth the volume of water treated at STWs will increase. To ensure quality is maintained in the future the Environment Agency could increase the licenced water quality standards. This could result in increased investment from Water Utility Companies at STWs in order to manage discharges.

There is added uncertainty regarding changes in regulations and legislation because of the decision to seek an exit from the EU and this will need to be a consideration in all planning going forward.

4.6 Developing Sub-Catchment Solutions

Hertfordshire is a large county with four major settlements (>50,000 residents), 22 towns and scattered rural villages. The area is served by 38 main STWs, hundreds of Sewer Pumping Stations (SPS) and numerous other water infrastructure ancillaries, both public and private. This study aims to identify a range of options to meet the strategic and local infrastructure needs across the county, as outlined in Section 4.1. To develop a robust plan and vision for Hertfordshire, given the inherent complexity and scale of water infrastructure, the catchment has been split into distinct regional 'sub-catchments'.

These sub-catchments provide an understanding of key challenges, infrastructure demands, development levels and infrastructure options at key regional scales, allowing critical and strategic decisions to be made. The sub-catchments have been defined based on the following key factors:

- **Drainage infrastructure** (consolidating areas with comparable issues, risks and opportunities)
- **Geographical context** (following natural and artificial watersheds, transcending administrative boundaries and responsibilities)
- **Settlement boundaries**

The sub-catchments have been defined in lieu of administrative boundaries specifically to ensure that options can be proposed based on infrastructure, water and environmental needs.

More detail on the definition and nature of the sub-catchments can be found in Section 9.

5 SCOPE

5.1 What is Included

The study aims to unlock some of the assumptions around expected growth within the study area and its likely impacts on the water infrastructure. It will also explore strategic solutions to address potential future deficits for three growth scenarios (low, medium and high) over three time periods (2021, 2031 and 2051) for both wastewater and water resources.

The primary outcome of the study is the development of a robust evidence base which provides statutory plan makers with the information to prepare plans and strategies. The specific outcomes and conclusions of the study will need to be evaluated and used to inform planning activities, not be transcribed directly into Local Plans as verified statements and / or figures.

This study forms the first phase of a two-phase project. The Phase 2 element(s) will help convert the outcomes of Phase 1 in specific options that can be costed and planned, dependent on administrative district requirements, in terms of additional detail. The expected elements of any Phase 2 work include the following:

- Modelling at a finer level of detail to clarify specific issues and opportunities
- Evaluation of options at smaller scales, potentially parts of larger sub-catchments
- Exploration of a wider range of options for specific scenarios
- Detailed investigation of specific options, looking to clarify likely scale, investment and implementation programme

Suggested investigations for Phase 2 have been discussed in Section 12.4.6 and Appendix H.

The primary outcomes of Phase 1, as presented in this report, include the following:

- Assist in any local and county level assessment of existing and reasonably foreseeable water infrastructure constraints or challenges
- Assist with any assessment of environmental constraints
- Clarify and address areas of uncertainty and explore options for resolving issues that arise regarding the local planning process
- Assist local authorities, public sector agencies, service providers and Water Utility Companies in medium-term and long-term future service planning
- Assist and facilitate Water Utility Companies participation in the local planning process and increase awareness of planning authorities in the water resource and wastewater management process
- Assist with bids for growth related funding
- Inform the implementation of local plans in the context of the LEP strategic economic plan
- Inform the next round of water resource management plans and long-term strategies for water resource use and management

5.2 Exclusions

There are several specific exclusions in this study, as follows:

- Flood risk management
- Water quality (other than relates to the provision of infrastructure and infrastructure capacity)
- Site specific concerns to a site boundary level, this level of detail will be addressed in future projects
- Infrastructure maintenance issues (other than identifying where these are an issue)
- Agreed levels of service of Water Utility Companies to their customers

- Costing of options and solutions
- Proposal of programmes for implementation

5.3 Technical Challenges

A range of technical challenges had to be overcome and / or clarified throughout the study, due to a range of factors including lack of consistent datasets, geographic scale of the assessment and uncertainty within key growth and hydraulic assumptions.

The primary challenges, which have affected the nature and extent of the outcomes of the study, are as follows:

- Deriving the location for medium-term and long-term growth (2031 onwards) was undertaken by applying a rational approach, used to agree development strategies *(See Section 5.4.1)*. The indicative growth areas identified by this approach were broadly comparable to initial expectations of the districts but were subject to extensive debate, regarding other non-water infrastructure constraints and / or expectations
- The countywide scale of the study required extensive simplification of the sewerage system and the assessment of capacity, to facilitate the evaluation of need. The inherent complexity of real-world systems introduces significant uncertainty at smaller scales for which the simplification has removed key details. Clarifying capacity at these scales for areas of focus will need to be addressed further during Phase 2 investigations
- It proved impossible to use targeted hydraulic modelling to effectively calibrate the numerical modelling outputs, as originally specified as part of the project methodology (*See Appendix D*). As a result, the outcomes are largely based on the numerical modelling exercise (See Section 6.2 and Appendix C) which has limited the level of confidence in the Classification of Need, specifically relating to sewer ancillaries and STWs
- The assessment of STW capacity in Phase 1 was necessarily simplistic, due to different treatment processes employed at each works. Without extensive operational information and the development of a specific treatment capacity numerical model, infrastructure need has only been assessed based on an effective overall capacity (i.e. specific increase in effective population served). This provides a good understanding of general capacity but cannot identified where specific treatment processes are be under greater stress than others, and may require upgrade works earlier than the Classification of Need has recommended

5.4 Key Limitations & Uncertainty

5.4.1 Derivation of Indicative Growth Areas

The derivation of indicative growth areas was based on open consultations with the district councils, matching their latest local plans with the study methodology (*See Section 4.5.1 and Section 6.1.5*). The locations and figures used in this study should be considered a snapshot providing broad growth expectations, valid as of early 2016. Since this time, some plans been further developed, including updates to anticipated sites for the 2021 scenario. Any changes like this made since early 2016 will not have been incorporated into the evaluations.

To mitigate this it has been recommended, as part of the Water Vision for Hertfordshire (*See Section 3*) and within the conclusions and next steps sections (*See Section 12.1.2 and Section 12.4.3*), that development planning is consolidated into a holistic GIS system. This would provide all stakeholders and infrastructure management authorities with access to up-to-date information at all times, thereby preventing potentially abortive evaluation work and facilitating a live real-time understanding of infrastructure needs.

5.4.2 Numerical & Hydraulic Modelling

The numerical and hydraulic modelling undertaken (*See Section 6.2.2*, Section 6.2.3*, Appendix C and Appendix D*) focused on evaluating a broad spatial context for infrastructure needs as well as where and when investment is deemed to be needed. It does not provide specific predictions or definitive certainty over the capacity, performance or available headroom for any wastewater infrastructure or water resource component or function. The predictions made in this study have been based on a range of pragmatic assumptions, supported by definitive figures where possible, used to identify broad sub-catchment scale trends.

The evaluation of key wastewater ancillaries, including STWs, has been based on a combination of data sources to derive estimates of capacity, in order to identify the scale of investments likely to be needed. More detailed information on the discrete processes and functions of each ancillary will require further investigation to clarify the scale and type of investment required for individual ancillaries.

6 APPROACH

An overview of the key elements of the project methodology, showing how consultations were fed into the modelling, the derivation of Classification of Need and the proposal of a range of options, can be seen in Figure 7.

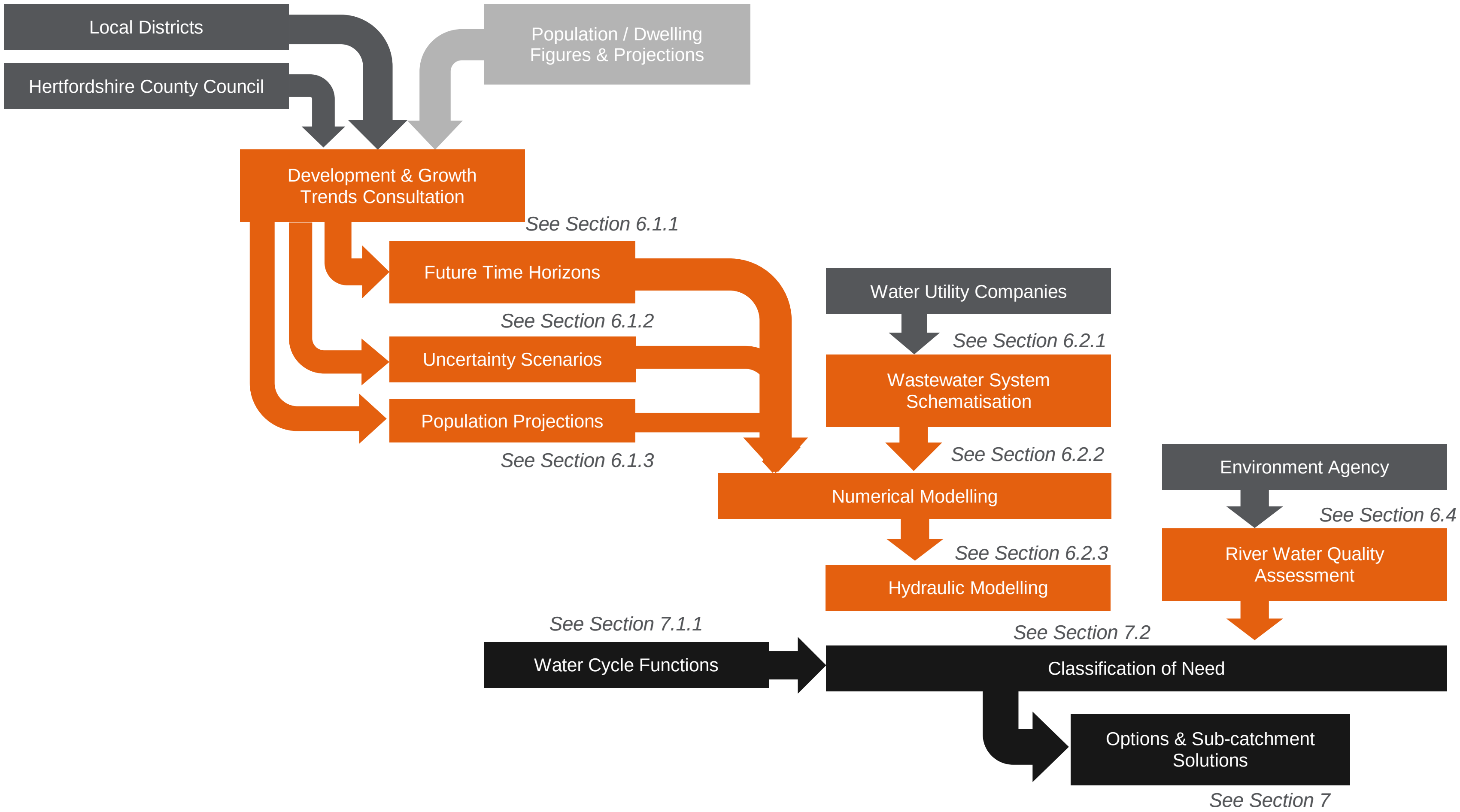


Figure 7 - Study Methodology

6.1 Development & Growth Trends

6.1.1 Future Time Horizons

The future horizons set for this study are as follows:

- **2021** - A 'baseline' from which future infrastructure requirements will be benchmarked against, considered to be representative of the nature of urban development up to 2021, is relatively well defined and aligns with the current Water Utility Company AMP6 investment cycle (2015-2020)
- **2031** – A medium-term projection, aligned with current local plan timescales and Water Utility Company long-term planning
- **2051** – A long-term speculative projection

Within the 2031 and 2051 future horizons, three uncertainty scenarios have been developed, which are discussed further in Section 6.1.2.

6.1.2 Managing Uncertainty

The evaluation of future catchment conditions is inherently uncertain due to the variability of population, climate variability and socioeconomic issues. To accommodate this uncertainty three scenarios have been developed aimed at providing more robust and risk-based conclusions to assist the decision-making process.

The three uncertainty scenarios are as follows:

- **Low** (i.e. unlikely to be less than)
- **Medium**
- **High** (i.e. unlikely to be higher than)

This approach has been used to derive populations, wastewater flows, sewage treatment and ancillary performance projections, and ultimately the Classification of Need. A graphic example of how study data has been projected in relation to the time horizons and uncertainty scenarios is represented in Figure 8.

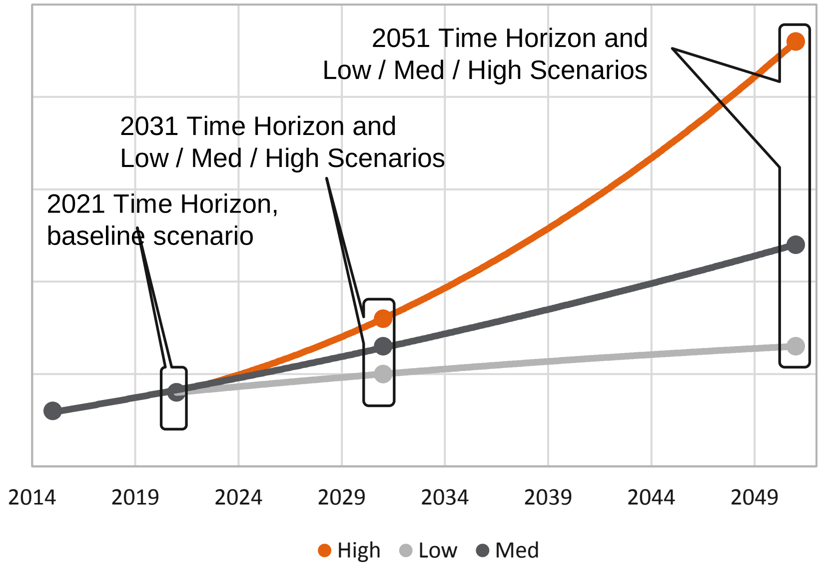


Figure 8 – Example of Future Time Horizons & uncertainty scenarios

6.1.3 Population Projections

To establish a robust and risk-based approach to understand probable future resident population, reference was made to several different data sources, including previous, current and projected figures. This enabled population projections for each district to be estimated, covering a range of likely outcomes as facilitated by the uncertainty scenarios (*See Section 6.1.2*).

More detail of the derivation process can be found in Section.

To derive a robust set of population figures and potential locations for development, as expected to occur up until 2051, a range of data sources and key assumptions have been used. The derived population projections are essential data inputs to the modelling stage of the study (*See Section 6.2*).

The key elements that have been considered are population figures (*See Section 6.1.3*), growth strategies (*See Section 6.1.4*) and indicative growth areas (*See Section 6.1.5*). A graphical representation of the processes undertaken to derive these key elements is shown in Figure *9*.

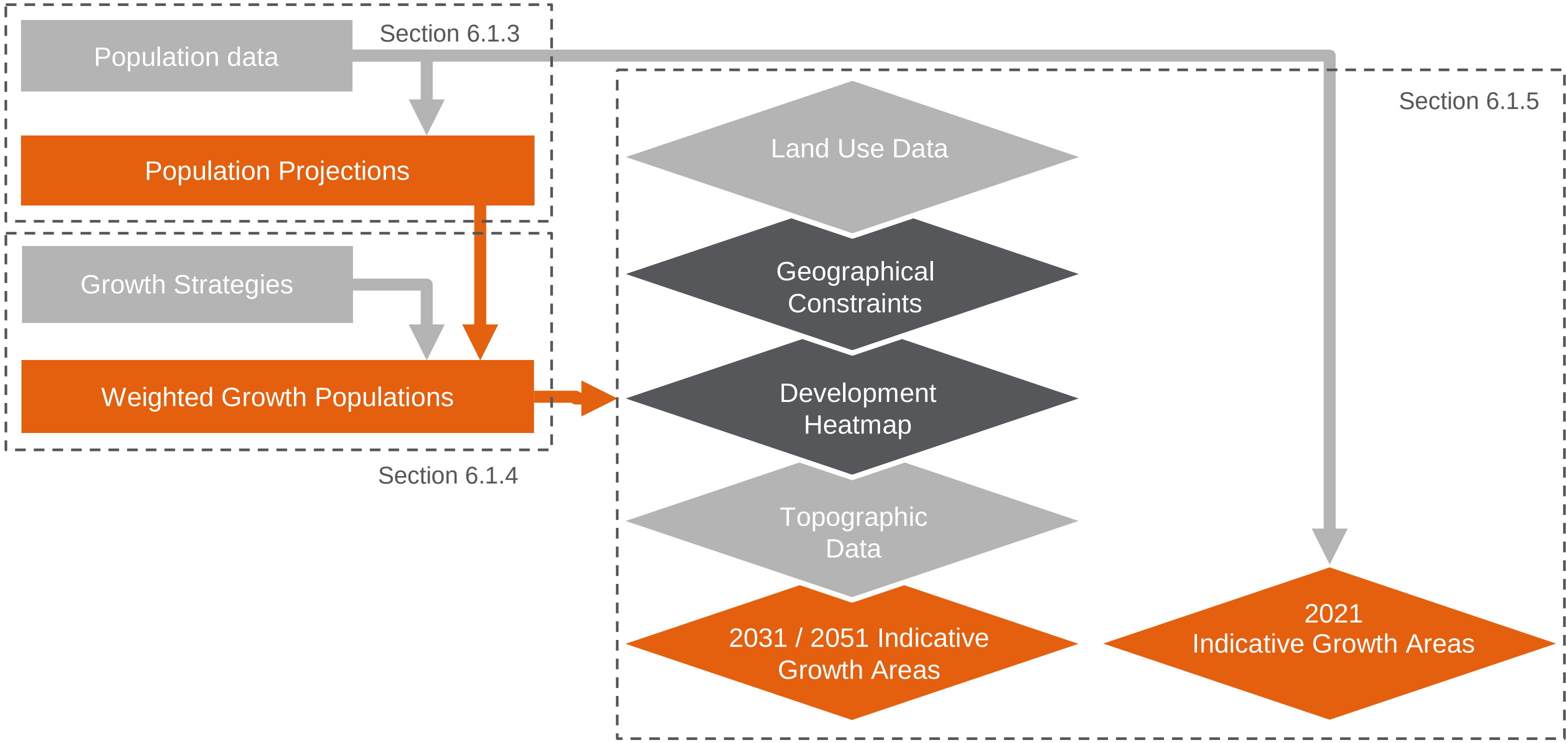


Figure 9 – Derivation of Planned & Projected Development for the Study Area until 2051

The key sources information used to derive the population projections are listed below:

- **Office of National Statistics (ONS) NOMIS Figures** - Historical annual population figures for each district covering a period from 1981 to 2014 (data published September 2015)
- **ONS Occupancy Rates (Household Projections Published Tables)** - Household back cast and forecast five-year projections for England and each district covering a period from 1912 to 2037. (data published September 2012)
- **ONS Sub-National Population Projection (SNPP) Figures** – Projected resident populations for each district covering a period from 2012 to 2037. (data published on 26 June 2013)
- **Strategic Housing Market Assessment (SHMA) / Objectively Assessed Needs Figures** - Annual dwelling numbers for each district covering a period from 2015 to 2037. Dwelling figures were converted to resident population using the ONS Occupancy Rates
- **Completions** – Annual dwelling completion futures provided by the district authorities. Dwelling figures were converted to resident population using the ONS Occupancy Rates. (data obtained up until 2015)
- **Local Plans & Trajectories** – Annual dwelling figures for each district, identified as part of their local plans, covering a variety of periods but typically not exceeding 2030. Dwelling figures were converted to resident population using the ONS Occupancy Rates

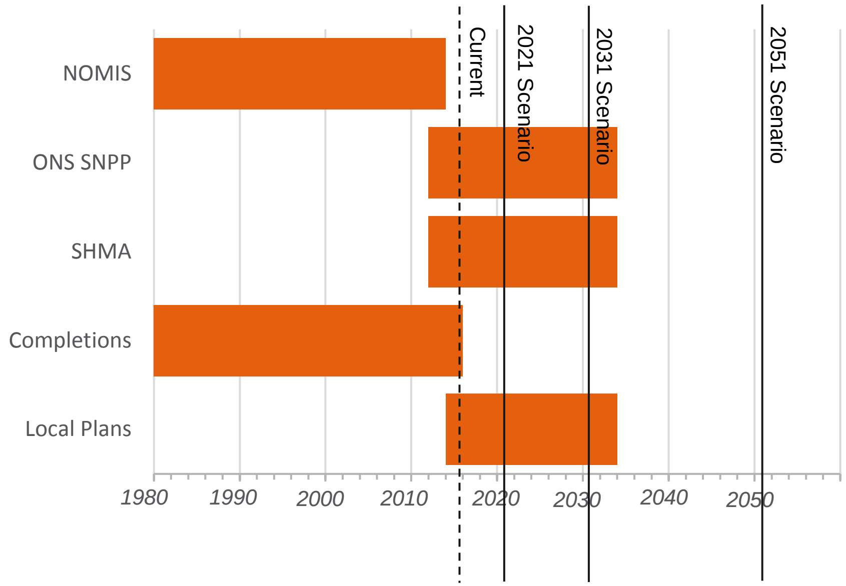


Figure 10 – Timeframe of the Population Data Sources Used

All population data obtained was consolidated and plotted for each district. Numerical projections were derived for each data source based on a simple linear trend of the latest 10 years' worth of data for each source. All forecast data (i.e. based on calculated projections, not recorded figures) has been benchmarked to the current population (2015), as defined in the ONS NOMIS data.

The figures obtained and used to derive population forecasts are based on the most relevant available data in early 2016, representing an effective data snapshot. These figures will be subject to continual change during future local plan revisions, as such these variations will need to be accounted for during any decision-making based on the results of this study.

Scenario & Time Horizon Populations

The definition of the discrete scenario populations was calculated based on the difference between the 2021 baseline figure and future figures, linearly projected from the source data to represent the inherent uncertainty across the different data sources into the future. Plume plots were created for each scenario and used to identify the projected populations, an example of which is shown in Figure 11.

A more detailed breakdown of the population derivation can be found in Appendix E.

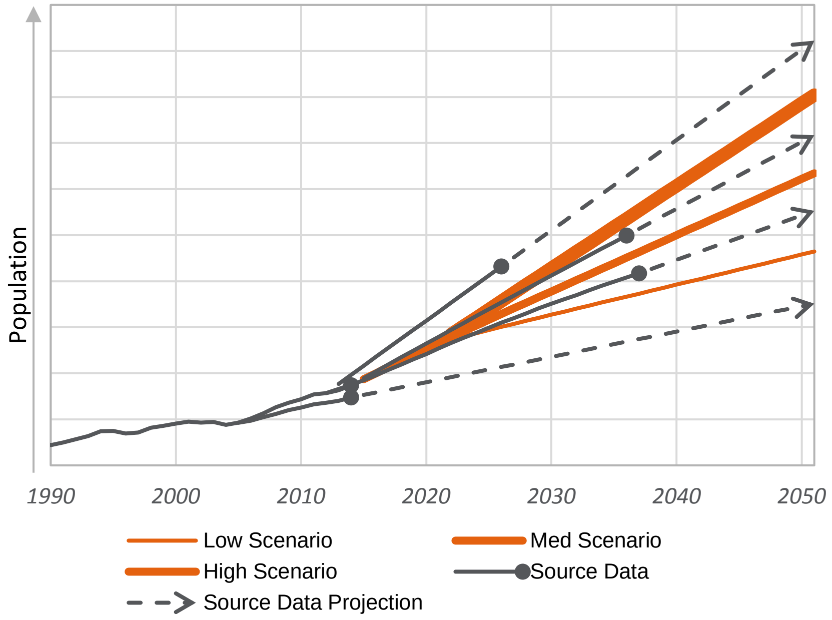


Figure 11 – Example Population Projection Plume Plot

Derived Population Trend

The general trend for each district and the study area as a whole shows relatively consistent growth, diverging uniformly from 2021 up to 2051. The variability between the three uncertainty scenarios also remains relatively constant into the future.

A number of districts requested that the 2021 Baseline scenario be set to the OAN figures. The OAN figures are considered conservative, with elevated growth rates up to 2021 above the average rate from 2021 to 2051. These elevated growth rates are comparable to the High Scenario growth rate up until 2051 which ensures that evaluation of infrastructure requirements within AMP6 and AMP7 will be conservative.

Based on the available data the anticipated population growth for the Herefordshire greater than the national average, based on the ONS UK Principal Projection figures, as shown in Figure 12. The UK average growth is comparable to the Low Scenario from 2021 onwards, with the Med and High Scenarios demonstrating higher rates of growth. This underlines the challenges facing Hertfordshire compared to the country as a whole.

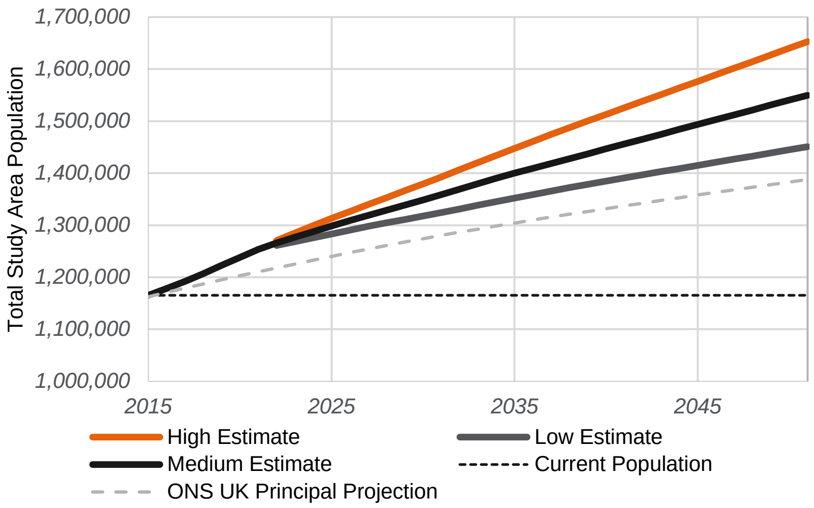


Figure 12 – Population Growth Projections for Hertfordshire

Note: ONS UK Principal Projection figures proportionally adjusted to match the Hertfordshire population scale, fixed to 2015 for reference.

6.1.4 Growth Strategy

A spatial context was applied to the population projections based on the application of some industry standard growth strategies. These strategies were defined to cover unplanned development for the 2031 and 2051 future horizons.

More detailed information on the definition of growth strategies and their use in weighting the application of population can be found in Appendix F.

This process was inherently subjective and does not represent policy or agreed strategies for growth, neither for the districts nor Hertfordshire County Council. The outcomes from this exercise only serve to provide a broad spatial context from which the population projections can be used in the numerical and hydraulic modelling to assess water infrastructure, as detailed in Section 6.2.

The net growth strategy (a combination of expectations from all districts) for Hertfordshire following consultation can be seen in Figure *13*.

For transport / growth corridors, an evaluation of current, planned and aspirational transports links was undertaken with reference to the Hertfordshire 2050 Transport Vision[16].

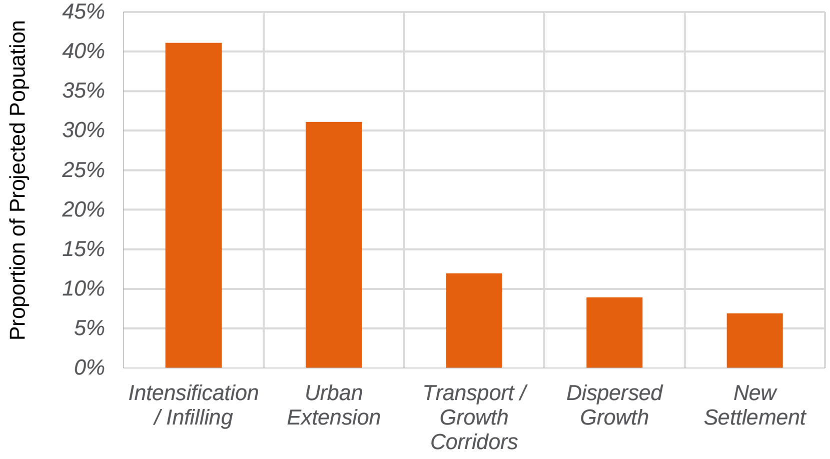


Figure 13 – Study Area Net Growth Strategy

The key transport elements used to identify the location and extent of growth corridors are as follows:

- **Motorways** – M25 and M1
- **Major Railway stations**
- **Major non-motorway road links** – A41, A4080, A414, A505, A10 and A602
- **Proposed new / improved road links** – Hemel Hempstead, St Albans and Hatfield link road, Borehamwood, St Albans and Harpenden link road and Hatfield bypass

A plan showing the key transport elements discussed above can be found in Appendix F.

[16] Hertfordshire County Council - Hertfordshire 2050 Transport Vision Stage 2 Technical Report, 2015 (Link)

6.1.5 Indicative Growth Areas

Defining a spatial context for future un-defined development (growth beyond Local Plans and sites already identified for 2021) is uncertain due to continual amendments to local plans, regulatory constraints, environmental issues and socioeconomic factors. However, a method to convert projected growth figures into geographically defined growth areas was essential to facilitate the evaluation of water infrastructure (*See Section 7 and Section 8*).

All growth areas identified for 2031 and 2051 are indicative, for the purpose of evaluating the likely implications of long-term growth on water infrastructure. It should not be assumed that development will occur within these areas, which are shown in the plans in Section 8.

Of the growth strategies detailed in Section 6.1.4, dispersed growth and intensification / infilling did not require specific geographical areas. For these strategies, the population for each scenario was applied to existing settlement areas on a pro-rata basis. The new settlement strategy only relates to East Hertfordshire district for which its current preferred location was specified.

Growth Heatmap

To provide the necessary geographical context for the remaining growth strategies a grid-based approach was used. A grid of appropriate size covering the entire study area was created to form a heatmap, based on the relative likelihood that development would occur in each cell.

The likelihood (expressed as a percentage) was derived from the cells' relative proximity to either existing settlement boundaries (for urban extension strategy) or one of the identified motorways, roads or railway stations (for the growth / transport corridors strategy). Grids within proximity to both existing urban areas and one of the growth corridors typically demonstrated the highest likelihood.

Definition of Geographical Areas

Following the development of the heatmap, topographic data for the study area was used to consolidate clusters of grids that together had a combined high likelihood of growth (*See Figure 20*). This ensured that the likely extent and boundaries of indicative growth areas aligned to the natural watersheds, as would a typical for a gravity drainage system.

The indicative growth areas *(shown in Figure 14)* represent a broad indication of the likely locations of development. It does not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario. The outcome of the indicative growth areas selected was disseminated to the districts during consultation to provide an opportunity to eliminate specific areas where development would not take place for reasons that could not be included within this methodology.

More detailed information on the derivation of the indicative growth areas can be found in Appendix F.

Indicative Growth Areas

Existing Settlements

District Boundaries

Study Boundary

Note:

The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

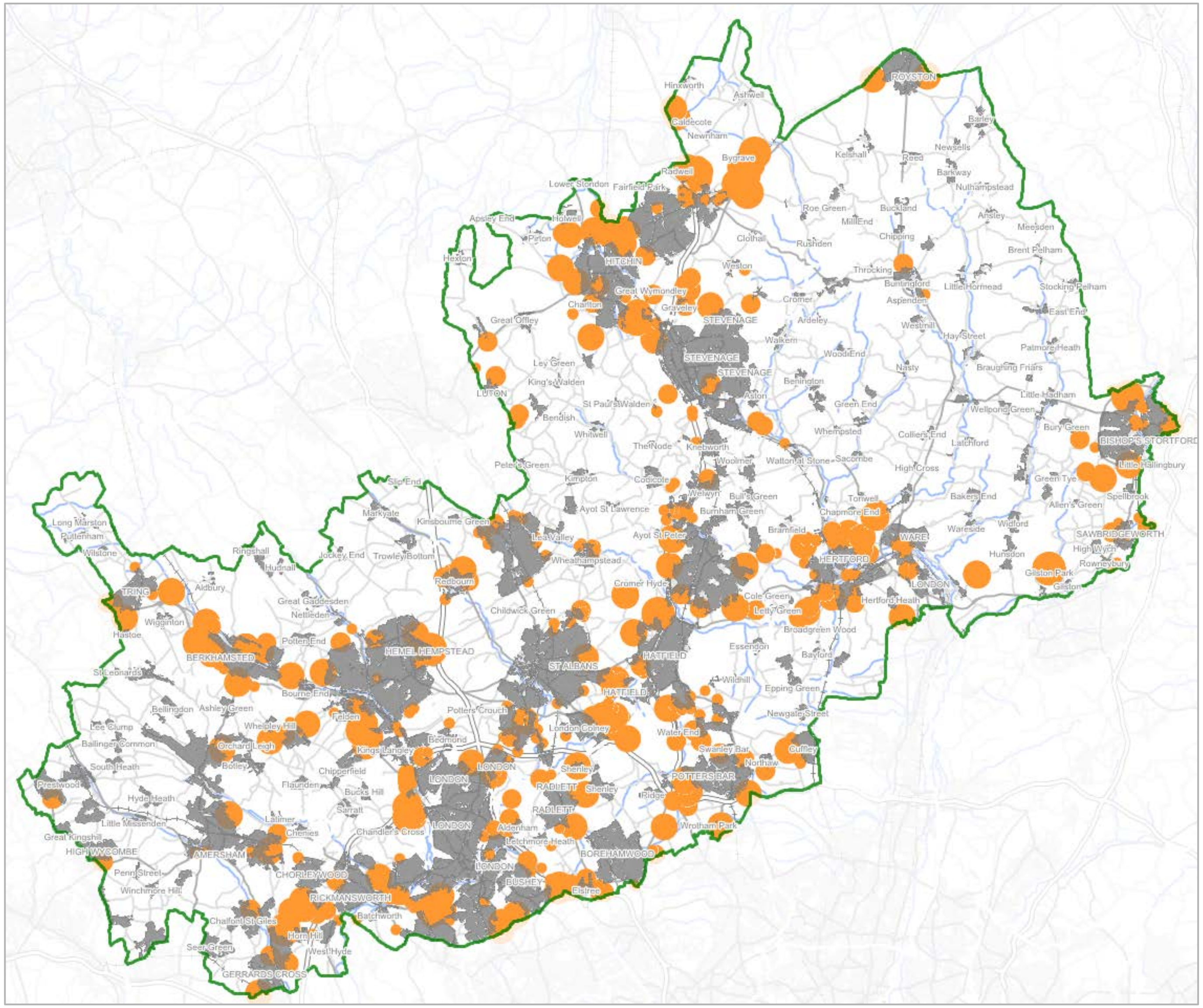


Figure 14 – Plan of all Indicative Growth Areas Derived

6.2 Wastewater Infrastructure

6.2.1 Wastewater System

The wastewater system covers all aspects of the collection, transportation, storage, treatment and release of wastewater, originating from a combination of domestic, industrial, commercial or agricultural activities. Typically, wastewater comprises foul flow and sewer infiltration (i.e. water flowing into piped networks from the environment), with intermittent flows generated by rainfall runoff.

The key components selected for evaluation in this study are as follows:

- **Trunk sewers** – The main skeletal network of sewer pipes, typically > 300mm diameter, which convey wastewater to the STW for treatment
- **STW** – Process of removing contaminants from the wastewater, typically through physical, chemical, and biological processes to produce environmentally safe to be released treated wastewater (treated effluent)
- **SPS** – Pumping stations necessary to 'lift' and transport wastewater over short or large distances, where wastewater cannot be conveyed to the STW under the influence of gravity alone. Only SPSs located on the trunk sewer network have been evaluated for this study
- **Combined Sewer Overflows (CSO)** – Flood relief structures located at critical points within combined sewer networks (systems which collect foul and rainfall runoff flows) to divert excess storm flows to the environment (e.g. a watercourse)

To evaluate the performance and headroom (capacity to accommodate greater levels of flow) of the wastewater system a network schematic was derived, focusing on the key components (as listed above). For each of the components, effective catchments have been derived to identify which areas of the study area are served by which components. This has allowed performance and capacity, calculated and evaluated at each time horizon and uncertainty scenario, to be represented at a relatively small scale.

Wastewater System Schematisation

Sewer network data covering Hertfordshire was obtained from Thames Water and Anglian Water and used as the basis to define the network schematic. This schematic has been used as the basis for understanding the performance and capacity of the current network.

An overview of the wastewater system schematic can be seen in Figure 16.

6.2.2 Numerical Modelling

To assess wastewater infrastructure performance and headroom a numerical model was developed. This model was based on the wastewater network and was used to calculate a range of standard flow and volume metrics that could provide an understanding of the key components of the wastewater system, as outlined in Section 6.2.1, shown in Figure 16.

The scale of variations of these figures across the time horizons, compared with the current capacity of the system, was used to calculate the effective performance of the key components of the wastewater cycle and define the Classification of Need (*See Section 7.2*).

Additional operational information obtained from the Water Utility Companies was used to supplement the understanding of ancillary capacity, performance and typical flows rates.

More detailed information on how capacity and performance were derived can be found in Appendix C.

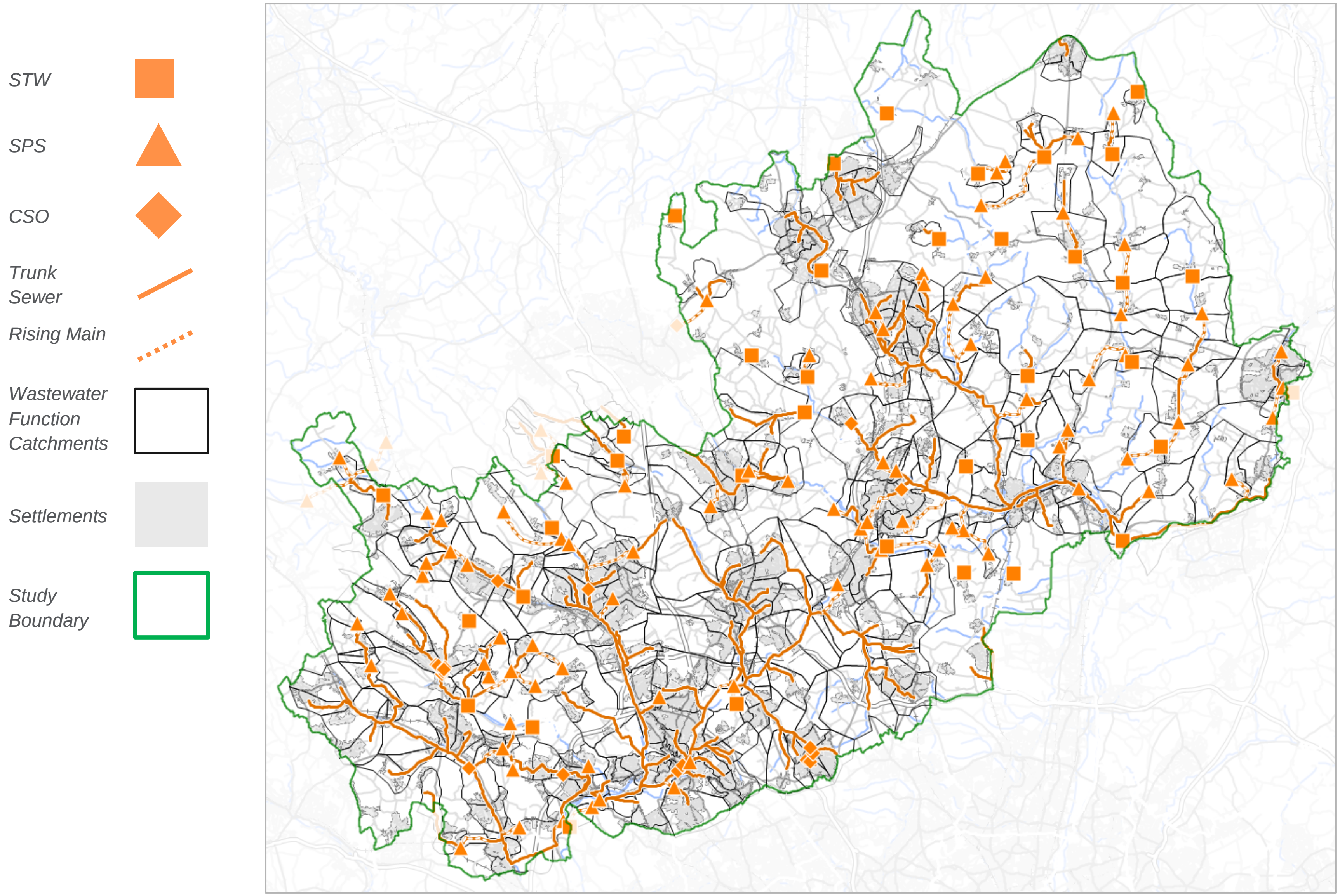


Figure 15 – Wastewater System Schematic

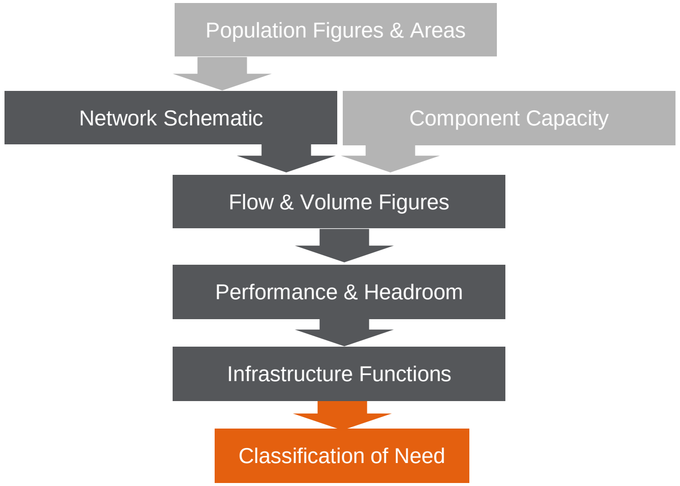


Figure 16 – Numerical Modelling Outline Process

6.2.3 Hydraulic Network Modelling

Targeted hydraulic modelling was also undertaken to support the calibration and validation of the broader numerical model. The scale of the study area precluded the use of hydraulic modelling at a catchment scale, due to time constraints, cost and logistics.

This modelling strategy shifted the emphasis from explicitly detailed modelling of many STW catchments to the development of a high-level statistical analysis method, calibrated using detailed modelling of a small set of representative STW catchments. The modelling results have been used to confirm the general level of confidence in the numerical model and calibrate certain elements of it.

More detailed information on how hydraulic modelling was used to calibrate the numerical modelling can be found in Appendix D.

6.2.4 Water Utility Company Asset Planning

During the evaluation of capacity and performance, identification of recommendations and development of options, reference has been made to current Water Utility Company infrastructure short-term and long-term planning (*See Section 4.3.3 and Section 4.3.4*).

6.2.5 Wastewater Function Catchments

Prior to the evaluation of the district summaries (See Section 7) and the sub-catchment solutions (*See Section 8*) the projected Classification of Need for each wastewater function (sewer network, ancillaries and STWs) was mapped. This process provides a spatial context for the potential extent and time frame for interventions and investment going forward.

More detail on the development of the network schematic and wastewater function catchments can be seen in Figure 15 and found in Appendix A.

6.2.6 Sewer Network & Ancillaries

The evaluation of sewer network and ancillary performance and capacity has been based on a set of key flow calculations and capacity indicators. These have been detailed and explained in Appendix C.

6.2.7 Strategic STWs

Maple Lodge STW

The evaluated current treatment capacity is 427,000 PE (population equivalent) against a catchment PE estimate of 553,000, based on information provided by Thames Water in 2016.

Evaluation of the treatment consent within the Dacorum et al (2010) Water Cycle Study concluded growth could potentially result in DWF consent being exceeded by 2025, under scenario 2 (highest estimate of growth). Based on scenario 1 (lower estimate of growth) the consent was determined to be sufficient up to 2030, and potentially up to the 2040s (based on the general trend).

The conclusions of the previous investigations are broadly matched in this study.

Rye Meads STW

The Rye Meads Water Cycle Study (2009)[17] concluded that water resources and supply infrastructure capacity should not significantly constrain growth if demand management and resource development measures planned in AMP4 were completed as proposed.

The evaluated treatment capacity was 405,000[18] PE against a catchment PE estimate of 388,000, based on information provided by Thames Water in 2016. This study indicates that the STW is close to its theoretical maximum capacity based on estimates made in 2009. An upgrade to the biological treatment stage during the current AMP period (2015-2020) will provide additional capacity to approximately 40,000 people.

The previous study, which considered the various treatment process in more detail, resulted in a more conservative assessment of capacity (as discussed above). As a result, the previous assessment has been used to supplement the evaluation of Classification of Need for Rye Meads STW (as can be seen in Figure 17).

Classification of Need

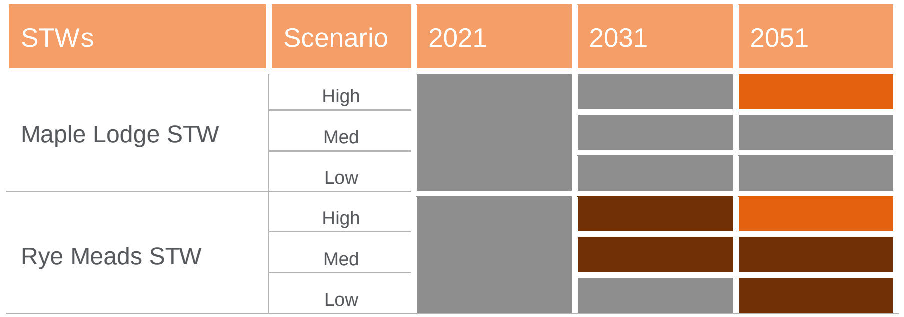


Figure 17 – Strategic STW Classification of Need

The Classification of Need colour coding is as follows:

- Strategic Investment
- Strategic Investment (Defined based on review of supplementary information)
- Focused Planning
- Routine Investment

Note: For Rye Meads STW the colour coding for Strategic Investment defined based on review of supplementary information will be shown the same as for the evaluated strategic investment for the district summaries (*See Section 8*).

[17] Rye Meads Water Cycle Study (2009)

[18] Dacorum Borough Council, St Albans City and District Council, Three Rivers District Council, Watford Borough Council, Welwyn Hatfield Borough Council Water Cycle Study (2010) Water Cycle Study

6.3 Water Resources

To provide an indicative assessment of pressures on water resources within the study area a high-level assessment has been carried out to identify areas where investment is necessary and where the supply of water is an issue. Relevant documents were reviewed, including the Affinity Water WRMP 2015-2020[19], Anglian Water WRMP 2014[20], the Catchment Abstraction Management Strategies (CAMS) and local authority development plans for each of the districts.

Due to the inherent complexity of water supply systems it was not deemed appropriate to undertake any specific modelling, numerical or hydraulic.

The information outlined in these documents conflicted with each other in terms of the areas they provided conclusions for, with the WRMP referencing outputs in terms of Water Resource Zones (WRZs) and CAMS referencing outputs in terms of river catchments. A desktop review of said documents was undertaken to identify and ascertain infrastructure need, that subsequently involved the consolidation of assessment areas.

Significant deficits are predicted for water supply in the medium-term across most of Hertfordshire. Given the limitations on the water availability and abstractions (*Section 4.5.2*), increasing demand (*See Section 4.5.1*), and a changing climate (*See Section 4.5.3*), local sources of supply are unlikely to be capable of fulfilling future need without strategic intervention. Assessment of current water resources suggest there is no 'spare' or additional water available for abstraction at times of low flow (without the need to import water from other regions).

6.3.1 Water Supply

Affinity Water WRMP (2015-2040)

The Affinity Water WRMP covers the period from 2015 to 2040. The whole study area is located within the Central Supply Region, which abstracts 60% of the water supply from groundwater sources (with boreholes abstracting from chalk and gravel aquifers), 40% from surface water sources and relies on supplementary imports from neighbouring Water Utility Companies (Thames Water, Anglian Water and Cambridge Water).

During periods of surplus, water is exported from the Central Region to South East Water and Cambridge Water. The Central Region has an average Distribution Input of 840 Ml/d.

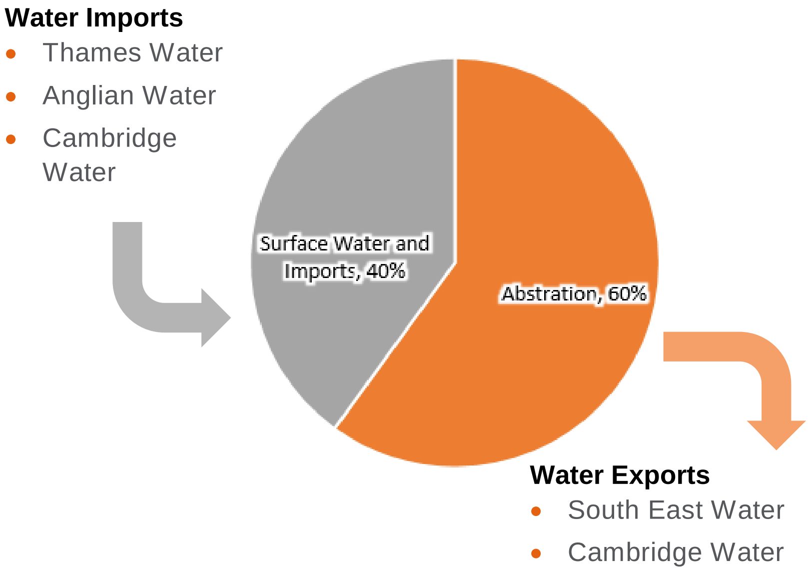


Figure 18 – Key Water Sources for Hertfordshire

[19] Affinity Water – Water Resource Plans (Link)

[20] Anglian Water – Water Resources Management Plan, 2014 (Link)

Water Resource Zones

The Central Supply Region is further subdivided into Water Resource Zones (WRZs) which allow water to be transferred between zones to provide operational flexibility.

Within the Central Region the WRZs have been configured to facilitate the assessment of likely sustainability reductions, agreed with the Environment Agency where water abstractions are considered to be having a detrimental impact on environmental ecosystems. Sustainability reductions result in closure of or reduction in abstraction at local water sources and subsequently investment is required in those areas to ensure demand is met.

Water Output

The deployable output (DO), the term used to define how much water can be abstracted reliably from a source during a dry year and delivered into supply, has be derived for each WRZ and the change from the previous WRMP (2009). DO is measured in mega litres per day (Ml/d) and is evaluated as an average over the whole year as well as during critical periods when demands are at their highest.

The previous WRMP assessed groundwater DO values based on 2005 / 06 groundwater levels, which were recorded during a relatively dry year. Following another dry year in 2011 / 12 groundwater levels were reassessed as part of the current WRMP.

In general, across the various aquifers within Hertfordshire, the 2005 / 06 water table levels were assessed as more extreme than the 2011 / 12 levels, although a few sources were lower. The outcome of this assessment resulted in a net decrease in abstraction licenses granted in WRZ 1, WRZ 2 and WRZ 5.

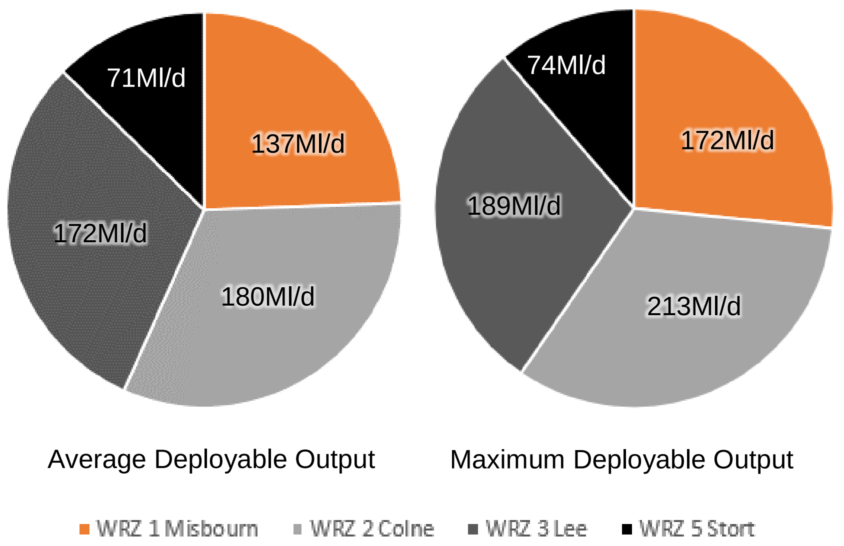


Figure 19 – Water Supply for Hertfordshire

This reduction in abstraction will require continual investment to ensure demand is met. In WRZ 3 there has been an increase in abstraction due to improved source performance and new abstraction licences.

Water Transfers

Affinity Water has arrangements with neighbouring Water Utility Companies for the bulk supply and import of treated water.

Affinity Water share their operational boundary with Anglian Water and Cambridge Water in the Central region, at WRZ3 and WRZ5, and with Essex and Suffolk Water for WRZ5.

Catchment Abstraction Management Plans (CAMS)

The Environment Agency monitors existing water abstractions to understand the complex water balance within catchments and what water may be available for future use. The Environment Agency prepares CAMS to ensure there is enough water for people and the environment, the results of which are published in abstraction licensing strategies.

There are three main strategies which cover Hertfordshire:

- The Upper Lee Abstraction Licensing Strategy (February 2013).
- Colne Abstraction Licensing Strategy (February 2013)
- The Upper Ouse and Bedford Ouse Abstraction Licensing strategy (March 2013)

The majority of Hertfordshire is within the Colne CAMS and the upper Lee CAMS, with a smaller proportion located in the Upper Ouse CAMS and Bedford Ouse CAMS.

The broad strategy within the CAMS for Hertfordshire is that no further consumptive licences will be granted for groundwater or surface water sources, as further abstraction would result in an unsustainable impact on the environment. Water may be available to 'buy' (known as licence trading) the entitlement to abstract water from an existing licence holder. The only catchment where water is available is the Cherwell, Thames and Wye catchment and this covers a very small portion of Hertfordshire (northern corner of Dacorum).

6.3.2 Water Demand

The impact of development on water resources does not solely depend upon the number of dwellings constructed, with demographic changes (i.e. changes in population and occupancy rates) influencing the impact of each new dwelling. Behavioural changes, such as changes in per capita consumption (PCC), in both new and existing dwellings, can also affect the impact of development on water resources.

To assess the impact of growth on water resources, an estimate of the demand per household is required (i.e. PCC). Demand for water has been sourced from Affinity's WRMP and summarised in Figure 20. The PCC figure is forecast through to 2040 and the PCC per household (litres per day) is estimated to steadily fall up to 2040. This is largely due to planned measures to increase metering and water efficiency measures.

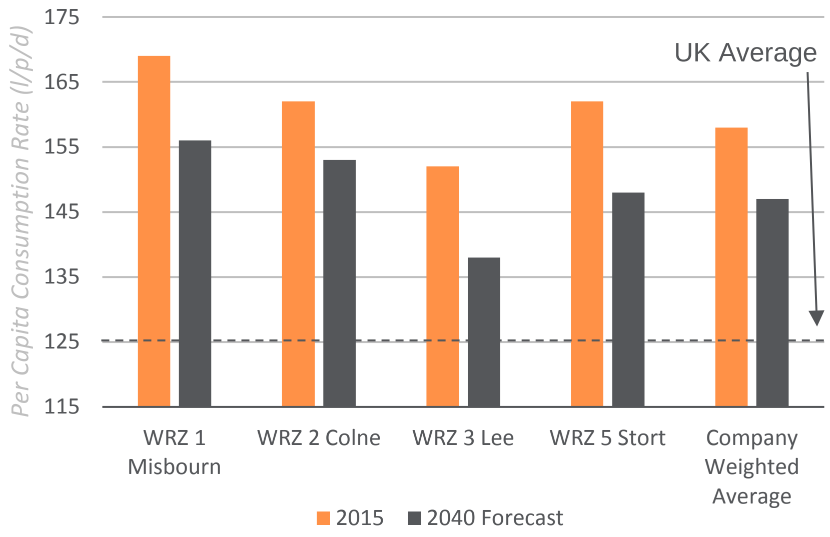


Figure 20 – Per Capita Consumption Rates

Company average projections show that even with the increase in population, water demand falls. This forecast reduction in the consumption per person is related to an increase in the proportion of metered customers, due to Affinity Waters Optant metering programme and wider use of more efficient appliances and fittings.

Over the WRMP period efficiency measures have been predicted to decrease total water usage for Hertfordshire. However, due to the quantum of population growth projected there is still an upward trend in usage and the overall water demand is predicted to increase by an average of 40% within the study area by 2051.

6.3.3 Water Supply-Demand Balance

An assessment by Affinity Water concluded that the Central Region, which covers all of Hertfordshire, does not have sufficient water for the whole of the 25-year planning period to meet customers' need for water. The baseline supply and demand assessments show that without the planned sustainability reductions, there are deficits in four water resource zones. The total deficit at the end of the planning period (2040) without sustainability reductions or mitigation measures for the whole company is forecast to be 111.20Ml/d.

Evaluating Classification of Need

The Classification of Need for each WRZ has been derived from the projected population figures.

WRZs with the highest estimated population increase have been assumed to require Focused Planning and Strategic Intervention. Where anticipated growth is predicted to be less, relative to the whole study area, Routine Investment has been assumed. This only represents a high-level assessment and the WRMP should be referred to for specific information on water supply and demand.

6.4 River Water Quality

The WFD, Thames River Basin Management Plan (RBMP) and Anglian RBMP have identified a range of significant water management issues that limit the potential usage and benefits of managing the water environment in a sustainable way, the key elements listed as follows:

- **Physical modifications** - physical changes to rivers, lakes and estuaries (e.g. flood defences and weirs) that alter natural flow characteristics, cause excessive accumulation of fine sediment in surface water bodies and the degradation and loss of wildlife habitats and recreational uses
- **Pollution from wastewater** – sewer discharges (from CSOs, STW and due to foul flooding) can contain large quantities of contaminants, with population growth and changes in rainfall patterns increasing the pressure on the sewer networks
- **Pollution from towns, cities and transport** - rainwater draining from roofs, roads and pavements into watercourses
- **Changes to the natural flow and depth of water** - caused by human activity (such as abstraction) or during drought conditions, which adversely affects the health of aquatic ecosystems

The quality of river water has been evaluated with reference to the WFD Water Bodies 2015 status data[21], as part of the RBMP Cycle 2[22]. The classification status of all waterbodies within the study area has been used to derive a relative understanding of quality to assess the combined potential impact of growth in the region.

The current WFD classification status for a number of water bodies indicates some could be sensitive to increased discharges from the wastewater system (due to future growth), listed in *Table 1*.

Waterbody	Classification Status
Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC)	Bad
Cat Ditch	Bad
Lee (from Luton Hoo Lakes to Hertford)	Poor

[21] UK Government – WFD Classification Status Cycle 2, 2015 (Link)

[22] UK Government - River Basin Management Plans: 2015 (Link)

Bulbourne	Poor
Gade (from confluence with Bulbourne to Chess)	Poor
Colne (Confluence with Chess to River Thames)	Poor
Purwell	Poor
Beane (Source to Stevenage Brook)	Poor
Beane (from confluence with Stevenage Brook to Lee)	Poor
Quin	Poor

Table 1 - WFD Water Body Classifications

For each waterbody, the classification status has been determined and a confidence ranking assigned, based on the spread of individual classifications for different water management issues (e.g. ecological / chemical).

Within each WBMA the predicted change in flow for each CSO and STW have been consolidated and weighted based on their current classification status, as per the WFD classification status (See Table 1). The final weighted figures were converted into a Classification of Need which have been applied to the appropriate wastewater function catchments (See Section 6.2.5).

7 STRATEGIC INFRASTRUCTURE ASSESSMENT

7.1 The Water System

The evaluation of options for water infrastructure and resources has been undertaken based on the principle of improving overall balance within the hydrological cycle, aiming to provide more resilience and security, through a holistic and sustainable attitude to water management (as outlined in Section 3). To ensure that options and strategies are balanced, and to support the evaluation process, a set of Water Cycle Functions have been derived, as shown in 7.1.1.

The hydrological cycle is an interconnected natural system defined by the key processes of precipitation, evapotranspiration, infiltration, percolation and surface flows. This system is dynamic and changes to one element of it (through urbanisation and other human influences) at almost any scale will affect the balance of flow, and can cause damaging impacts to the water environment.

A schematic showing the main processes and linkages between the natural and artificial water cycles can be seen in Figure 21..

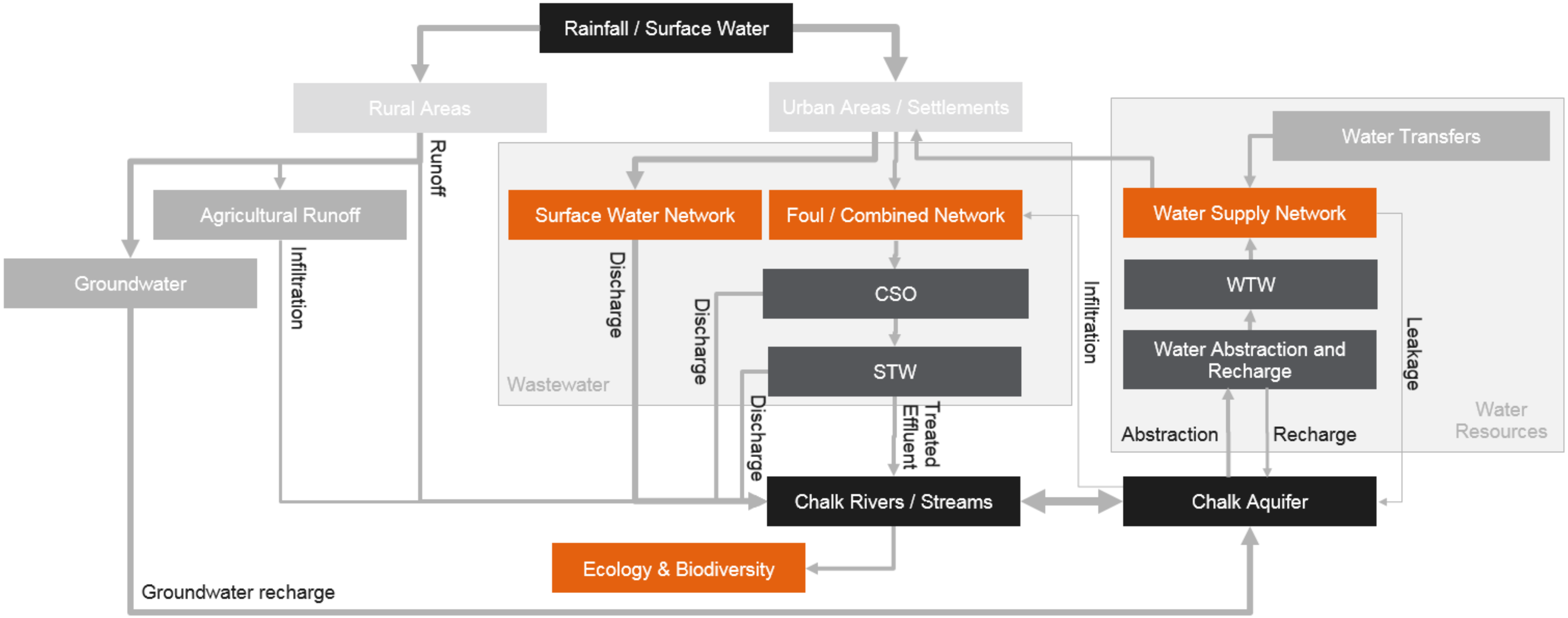


Figure 21 – The Natural & Artificial Water System

7.1.1 Water Cycle Functions

A set of water cycle function symbols have been developed and are used throughout the report to indicate the expected benefits that could be delivered with each option. These should help to demonstrate opportunities that may improve specific elements of the water cycle and indicate where an integrated mix of strategies are necessary to address deficiencies across the entire water cycle

The conceptual framework of the water cycle, developed to underpin this study, can be seen in Figure 22.

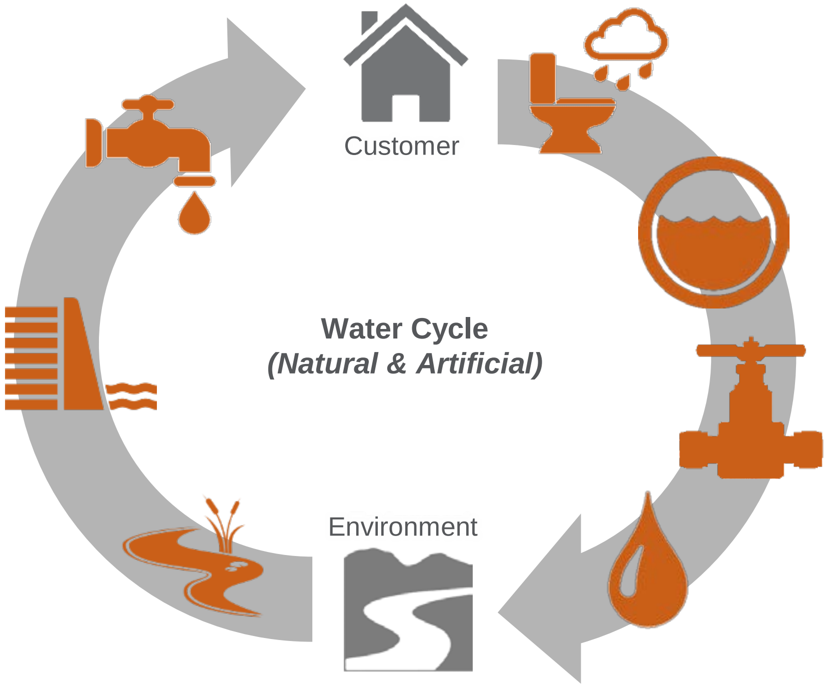


Figure 22 – Conceptual Water Cycle Framework

	Water Cycle Functions	Description
	Wastewater Flows	The volume / rate of foul and combined (foul & rainfall runoff) entering the public sewer system, including residential, commercial and industrial flows, highway and urban runoff (which isn't drained into a surface water cycle) and infiltration.
	Wastewater Network	The trunk combined / foul piped drainage system, including online storage facilities, covering collection components within the catchments through to the STWs
	Wastewater Ancillaries	Major SPSs within the wastewater network
	Wastewater Treatment	All wastewater treatment facilities across the study area, specifically with regards to their function treating, storing and discharging treated effluent back to the environment.
	Water Resources	Abstraction and water availability, largely from groundwater sources for potable water supply
	Water Quality	Ground and river water, both related to water being abstracted and for ecological quality
	Water Supply	Covering water demand and distribution infrastructure

Table 2 - Water Cycle Functions

7.2 Classification of Infrastructure Need

To facilitate the evaluation of catchment and water infrastructure requirements a classification method was devised to prioritise and focus the development of solutions and overall investment. The classification is based on the probable requirement for infrastructure improvement and enhanced water resource management activities, based on the outcomes of the modelling and other assessments.

The classification is inherently subjective and should only be used as a reference. The ranges and boundaries between classifications have been set based on standard industry practices and transposed from comparable classifications used within other planning documents, where relevant.

The method is aimed at helping prioritise areas that may require greater investment, identify the likely scale of mandatory improvement works and provide insight into expected planning times to deliver such solutions.

7.2.1 Classification Definition

The Classification of Need is split into three key classes, as shown in Figure 23. The three classes cover the full spectrum of likely situations, ranging from limited small-scale intervention (which could be delivered through the current investment framework) through to large-scale strategic improvement works.

The nature of likely interventions required for each water infrastructure function across each of the classes will cover a range of scales, investments and methods.

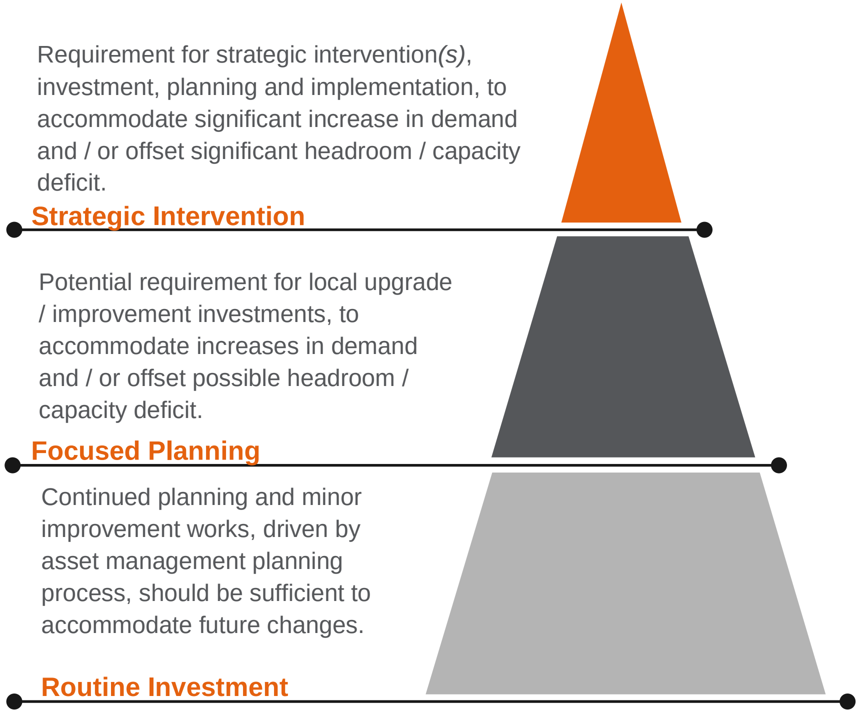


Figure 23 – Classification of Need Definition

7.2.2 Wastewater & Water Resource Definitions

A broad overview of the type of planning and engineering required for each class and wastewater function can be found in Appendix D.

These classes will apply to capacity and performance for all the uncertainty scenarios and time horizons evaluated. Looking to the future, the evaluated class can shift from one level to another, depending on evolving catchment dynamics.

7.3 Identification of Water Infrastructure Options

The identification of ‘options’ to address water infrastructure needs across the study area was undertaken based on the three key principles of sustainability, resilience and security, which underlie the overall Vision for Hertfordshire (See Section 1). The range of options evaluated and presented have been selected with the broad aim of addressing all water cycle functions (See Section 7.1.1), an essential concept to help balance the overall water cycle.

A ‘bottom-up’ approach was used to drive the evaluation, selection and promotion of solutions across the study area. A long-list of options (*See Section 7.3.1 and Appendix G*), ranging from industry standard methods to more innovative approaches, have been aligned with individual district needs (*See Section 8*), used to inform sub-catchment solutions (*See Section 9*) and underpin a high-level strategy for Hertfordshire (*See Section 12.3.1*).

The approach is shown graphically in Figure 24.

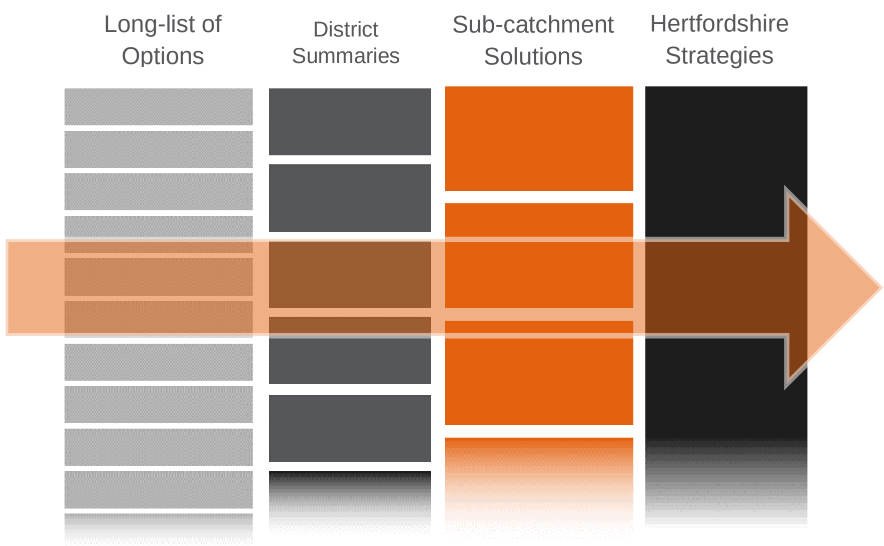


Figure 24 - Identification of Options at All Scales

7.3.1 Long-list of Options

The long-list of options developed to inform this study has been collated from a broad range of industry approaches, including traditional engineering approaches (i.e. sewer upsizing, storage tanks etc.), novel sustainable approaches (i.e. SuDS, surface water attenuation basins etc.), best practice design and more conceptual techniques (i.e. groundwater re-injection[23], eco towns etc.).

---

[23] The process of injecting *(or recharging)* water into the ground in a controlled way, by means of special recharge wells or trenches

Options

Initially a long-list of over 130 potential options was prepared, of which the most relevant 23 options are shown in Table 3.

For each option a Multi-Attribute-Decision-Analysis (MADA) score has been calculated, based on feasibility, affordability, sustainability, performance and risk. A MADA scoring process enables options to be comparatively evaluated based on financial worth and non-financial attributes, both qualitative and quantitative. This helps to promote options that are likely to deliver the greatest cost-benefit, in terms how it could solve specific problems and the likeliness that it could be implemented.

Option	Type	Description	MADA Score
Sewer Upsizing	Infrastructure	Sewer re-laying to increase conveyance capacity	High
Foul Flow Attenuation	Infrastructure	Provision of storage facilities within foul network to attenuate flow within the catchment	Low
Surface Water Separation	Infrastructure	Separation of rainfall runoff from combined sewer systems through the re-connection of roof drainage and / or highway gullies to either a surface water or SuDS system	High
Opportunistic SuDS	Infrastructure	Implementation of SuDS components (e.g. swales / rain gardens) as part of urban regeneration programmes, such as highway resurfacing and re-development of public land	High
SuDS Incentivisation & Integrated Planning	Policy & Planning	The use of financial or other incentives to promote the use of SuDS components as integral parts of new drainage systems	High
Blue-Green Planning	Policy & Planning	Linking green infrastructure planning (e.g. planning of urban wildlife corridors / public amenity spaces) with water management, to explore opportunities to develop multi-use projects and implement SuDS components	High
SPS Upgrade	Infrastructure	Upgrade up pumps within SPSs to increase their effective capacity	Medium
New SPS	Infrastructure	Construction of a new SPS to improve the conveyance of flow around a network	Medium
Catchment Transfer SPS	Infrastructure	Construction of a new SPS and rising main to transfer flows from one catchment to another, providing more headroom to accommodate increased flows	Medium
CSO Improvement Works	Infrastructure	Provision of new screening arrangements to improve water quality by reducing the discharge of foul solids and contaminants to the environment (e.g. fine mesh screen / UV treatment)	Low

Option	Type	Description	MADA Score
Catchment Permitting	Regulatory	Permitting of discharges based on the net impact on the catchment as a whole, rather than permitting individual discharge locations, to provide more flexibility in operating sewerage systems and adapting them to future change	Medium
STW Optimisation	Infrastructure	Utilisation of additional treatment processes to optimise the operation and quality for water discharges	Low
STW Site Storage	Infrastructure	Provision of increased storage on site to accommodate higher flows, associated with both increased foul flows and rainfall runoff	Medium
New STW	Infrastructure	Construction of a new STW to significantly reduce the pressure on the existing STW, providing more headroom to accommodate increased flows	Medium
Education Initiatives	Policy & Planning	Engagement and education of customers and the public to improve attitudes towards water use and conservation	Medium
Water Meters	Policy & Planning	Metering of water use to provide customers with more control over their usage	High
Rainwater Harvesting Systems	Infrastructure	Domestic and commercial water collection systems, served by local rainfall runoff to reduce consumption rates	High
Water Efficiency Measures	Policy & Planning	-	High
Water Transfers	Policy & Planning	Commercial arrangement with neighbouring Water Utilities Companies to secure additional water supply during times of deficit	Medium
Surface Water Attenuation Systems	Infrastructure	Engineered or SuDS-based systems to attenuate surface water within catchments, prior to discharge to watercourses	Medium
Strategic Water Storage Facilities	Infrastructure	Strategic storage or water for supply	Medium
Large-scale Aquifer Storage & Recovery	Infrastructure	Construction of groundwater aquifer reinjection systems to help manage water availability	High
Natural Catchment Management	Policy & Planning	Management framework for ecosystem services provided by the waters a natural catchment, offering a way to integrate the different administrative, planning and regulatory systems and multiple demands on the catchment	Low

Table 3 - Long-list of Option

7.3.2 Focus on Sustainability

To underpin any efforts to improve resilience, ensure security and support the economic prosperity for the region *(See Section 3)*, delivering water infrastructure improvements within the principals of sustainable development is essential. The options evaluated in this study are aimed at seeking a more sustainable balance between growth and environmental impact, which has always been a major social challenge that can require changes to national law, urban planning and transport, local and individual lifestyles and ethical consumerism.

Two of the integral elements of sustainability are research and innovation. The 'business as usual' attitude to addressing the challenges facing water management in Hertfordshire moving into the future will only serve to add additional financial and managerial burdens for the various stakeholders. Collaboration is the key to unlocking the potential value of research and innovation in developing new sustainable drainage initiatives.

There are already a wide variety of potential sustainable approaches to water management available in the industry, some based on concepts that have been around for most of modern human history (e.g. storage basins) and other more novel approaches only just gaining traction (e.g. bio-retention wetlands). All potential options can demonstrate a varied level of sustainable benefit, depending largely on which element within the water cycle they address.

Typically, the most sustainable outcomes are delivered by addressing an issue at its source. This can be termed as 'root cause' analysis. The deeper the root cause within the causal chain (e.g. increasing foul flows resulting in increased spills to the watercourse at a STW) the more widespread benefits would be by intervention at the root cause. Many of the typical solutions used to address issues with water infrastructure performance or capacity can be too focused on the issue, not its root cause. This is normally driven by either a lack of knowledge which prevents the true cause being identified or due to the financial and practical constraints.

8 DISTRICT SUMMARIES

For each district an evaluation of the broad infrastructure needs across each time horizon (2021, 2031 and 2051) has been presented (*Section 8.1 to Section 8.10*). This evaluation is based on the spatial assessment of Classification of Need (*See Section 7.2*) for each water cycle function (*See Section 7.1.1*), with variation across the uncertainty scenarios (Low, Med and High) demonstrated on the plans to help highlight uncertainty.

The graphically represented Classification of Need includes the wastewater networks, wastewater ancillaries and water quality. Wastewater treatment and water resources have been tabulated for each district.

These sections provide a district-level understanding of the potential water infrastructure requirements necessary to support the projected growth, delivered within existing settlements and the indicative growth areas derived to facilitate the modelling *(See Section 6.2)*. The information and plans are aimed at providing the districts with information to support site selection and identify where planning may need to be more closely aligned to Water Utility Company investments.

Specific options and capacity evaluations, recommended to address water infrastructure need at the small to medium scale, have also been outlined to provide effective information to support Water Utility Company planning activities.

The District Level Strategic Improvement Requirement sections are structured as follows:

- **Overview** – Provides a high-level review of the likely water infrastructure needs required to support development, plus potential issues and options available
- **Sewage Treatment** – Outlines the capacity of the STWs serving the district and the likely scale of investment, shown as a Classification of Need (Only major STW and / or STWs predicted to required focused planning or strategic intervention are presented)
- **Water Resources** – Outlines water availability for the WRZs the district is located within, shown as a Classification of Need
- **Individual Plan of the District** – A plan showing a breakdown of the wastewater Classification of Need, including indicative growth areas, the sewerage network and ancillaries, and needs for each water cycle function.

The Classification of Need colour coding for the sewage treatment and water resources tables for each district are as follows:

(orange)	Strategic Investment
(dark grey)	Focused Planning
(light grey)	Routine Investment

The plans include the following key elements:

- Evaluated Classification of Need
- Indicative growth areas (*See Section 6.1.5*)
- Sewerage system network and key ancillaries
- Water infrastructure needs, based on the water cycle functions (*See Section 7.1.1*)

For a more information on how to read the District Level Strategic Improvement Requirement plans refer to Appendix G.

8.1 Chiltern

8.1.1 Growth Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 25.

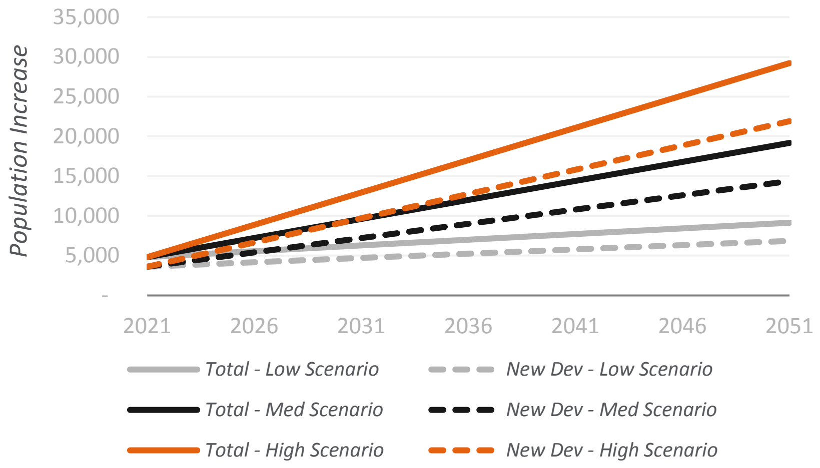


Figure 25 - Projected Population Increase for Chiltern

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 26.

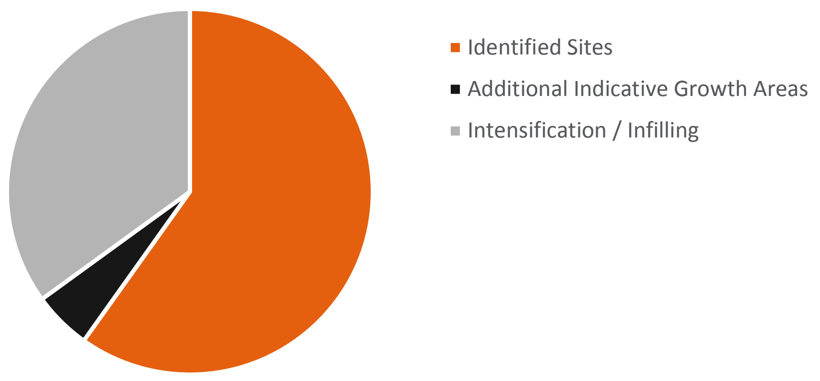


Figure 26 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Chiltern

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The indicative growth areas (identified to facilitate the modelling) for Chiltern in 2021 are limited, with the majority of growth expected to be delivered through new sites, potentially within the green belt. From 2031 the indicative growth areas were focused around Chesham, Amersham, Chorleywood and an area north of Gerrards Cross.

The main outcomes from the evaluation of need for Chiltern as follows:

- Any development proposals along the Amersham Valley (south of Amersham), including in Chalfont St Giles and Gerrards Cross, are likely to require strategic intervention by 2031 to provide sufficient capacity to support long-term growth across much of the catchment
- Maple Lodge STW could require strategic intervention under the high scenario by 2051, the catchment for which covers the whole Amersham Valley and includes the majority of the indicative growth areas identified for Chiltern. Planning to ensure successful delivery of any

proposed development within this area should consider efforts to promote water recycling, appliance and water fitting efficiency, and ensure all rainfall runoff is discharged to the environment (not discharge to the foul water network)

- The evaluation indicates the most significant likely opportunities to deliver unconstrained (by the wastewater system) growth is north of Chesham

8.1.2 Sewage Treatment

Both the major STWs in Chiltern are predicted to require focused planning from 2021 onwards to ensure they can accommodate the quantum of growth projected. Under the high scenario, strategic interventions could be needed at both STWs to ensure they have sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Maple Lodge STW	High			
	Med			
	Low			
Chesham STW	High			
	Med			
	Low			

Figure 27 – Chiltern STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.1.3 Water Resources

The availably of water resources in Chiltern is largely sufficient in 2021 but could require significant improvement by 2051, as with much of the county.

WRZ	2021	2031	2051
1			

Figure 28 – Chiltern WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

8.1.4 Chiltern Classification of Need – Immediate Recommendations (2021)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Focused Planning
(No Scenario variation)

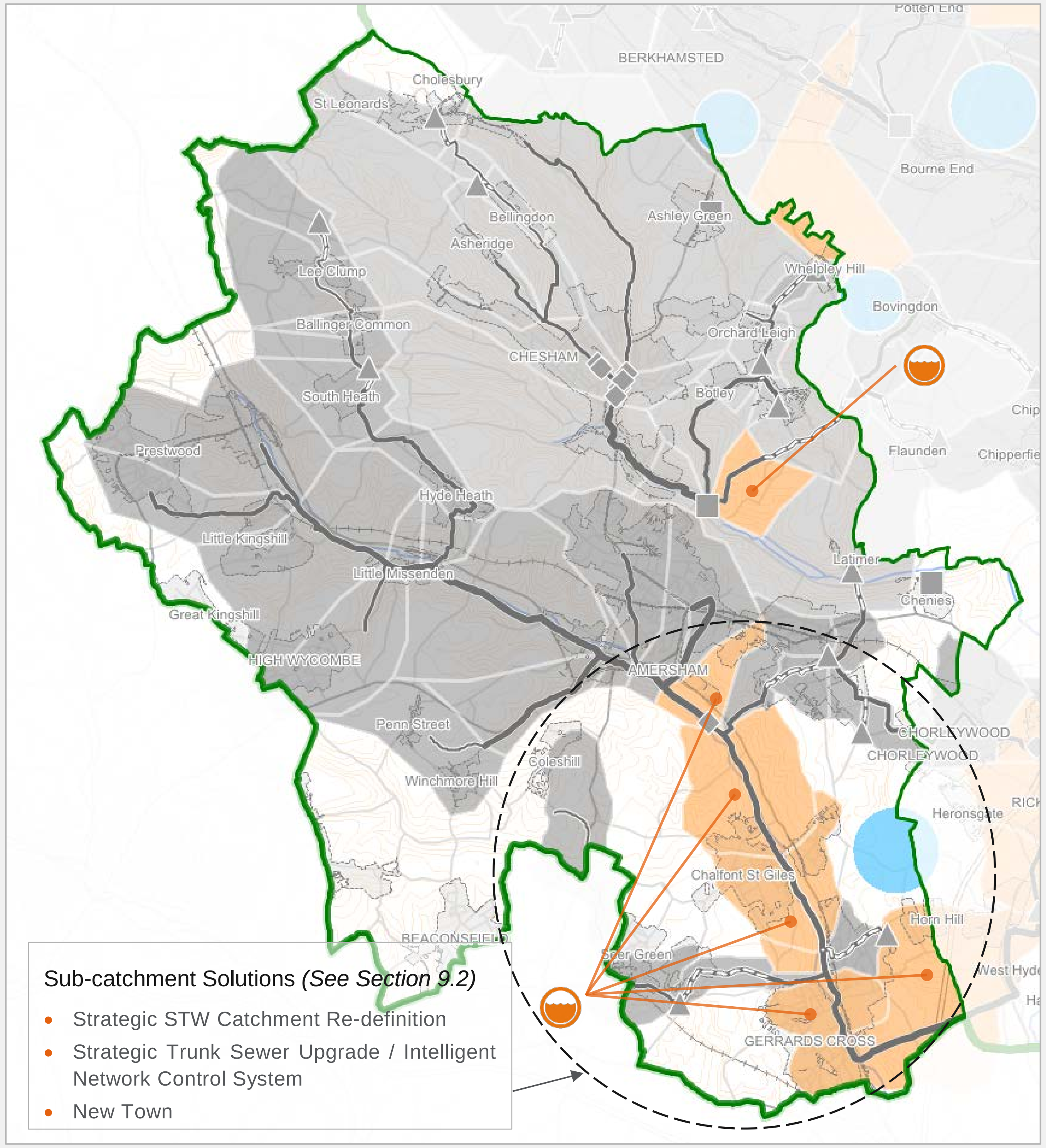
Strategic Intervention
(No Scenario variation)

Indicative Growth Area - Strategic Intervention required
(Potentially Constrained without investment)

Indicative Growth Area
(Relatively unconstrained)

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Sub-catchment Solutions *(See Section 9.2)*

- Strategic STW Catchment Re-definition
- Strategic Trunk Sewer Upgrade / Intelligent Network Control System
- New Town

Water Infrastructure Needs

Trunk sewer upgrade works (upstream of Chesham STW on Botley tributary)

Evaluation of trunk sewer capacity / upgrade works (upstream of Maple Lodge)

Evaluate potential for new strategic trunk sewer (Chalfont St Giles to Maple Lodge STW)

Evaluation of DWF and peak flow capacity (SPSs serving Horn Hill, Maple Cross and South Heath)

CSO evaluation / improvement works (downstream of Amersham)

Evaluation of DWF and peak flow capacity and headroom (Maple Lodge STW)

No clear strategic infrastructure needs identified

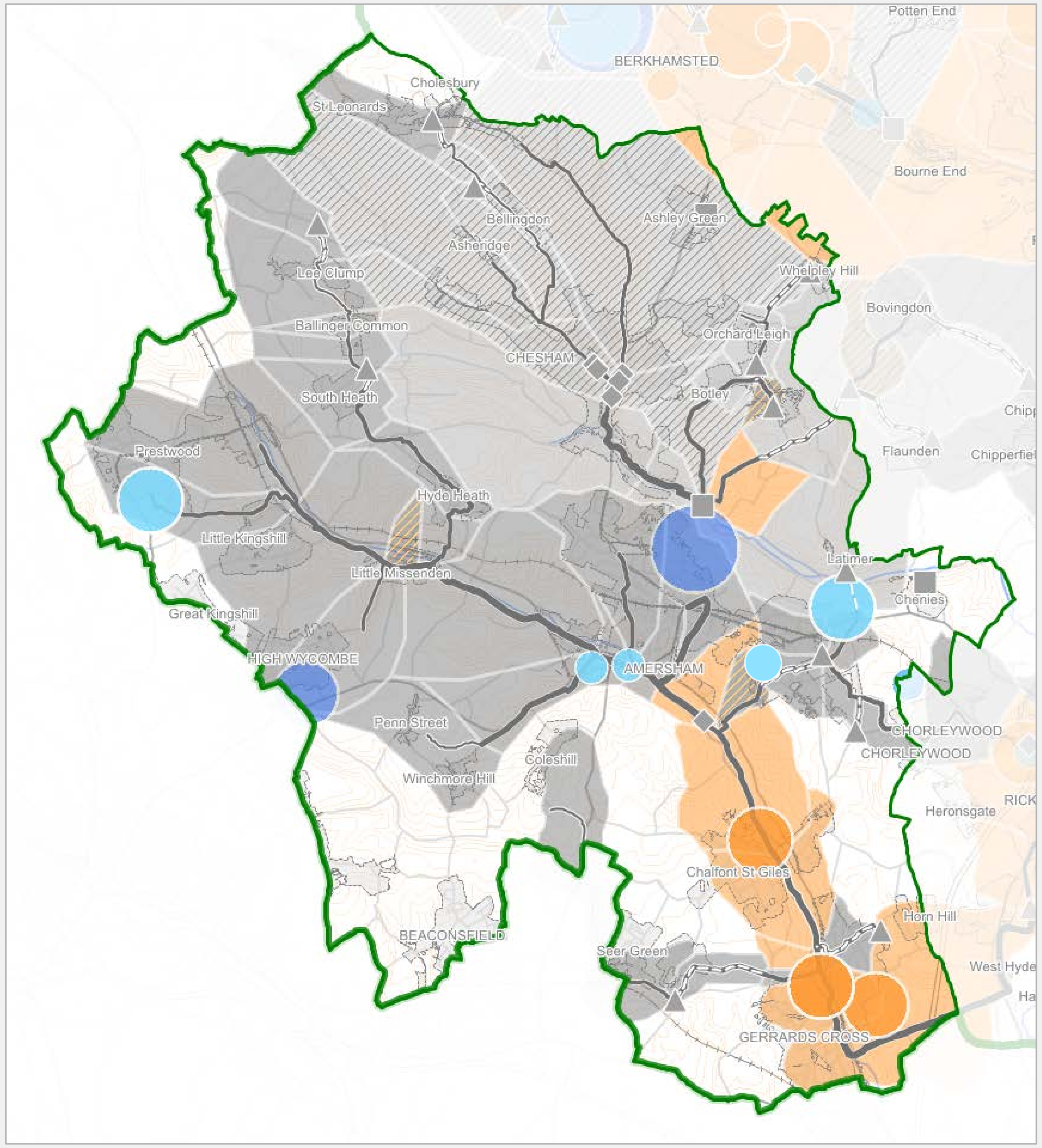
No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

8.1.5 Chiltern Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Routine Investment / Focused Planning *(Low to High Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Focused Planning / Strategic Intervention *(Low to High Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*
- Indicative Growth Area - Low Scenario *(Relatively unconstrained)*
- Indicative Growth Area - Med Scenario *(Relatively unconstrained)*
- Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Targeted rainfall runoff reduction projects (Bovingdon and Botley)

Provide strategic in-catchment storage (Amersham)

Trunk Sewer upgrade works (Chorleywood and Rickmansworth)

Strategic rainfall runoff reduction investment (Chesham) to improve CSO performance

DWF and peak flow capacity upgrade (SPSs serving Horn Hill, Maple Cross, Botley and South Heath)

Upgrade of DWF capacity at Maple Lodge STW

Strategic Foul Flow Reduction (Bovingdon)

Strategic evaluation of supply / demand balance

Strategic rainfall runoff reduction investment (upstream of Chesham Lane STW)

Improvement works to reduce CSO discharges (to the Colne)

Evaluation / improvements in FE discharge quality (Maple Lodge STW)

8.1.6 Chiltern Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Routine Investment / Focused Planning
(Low to High Scenario variation)

Focused Planning
(No Scenario variation)

Focused Planning / Strategic Intervention
(Low to High Scenario variation)

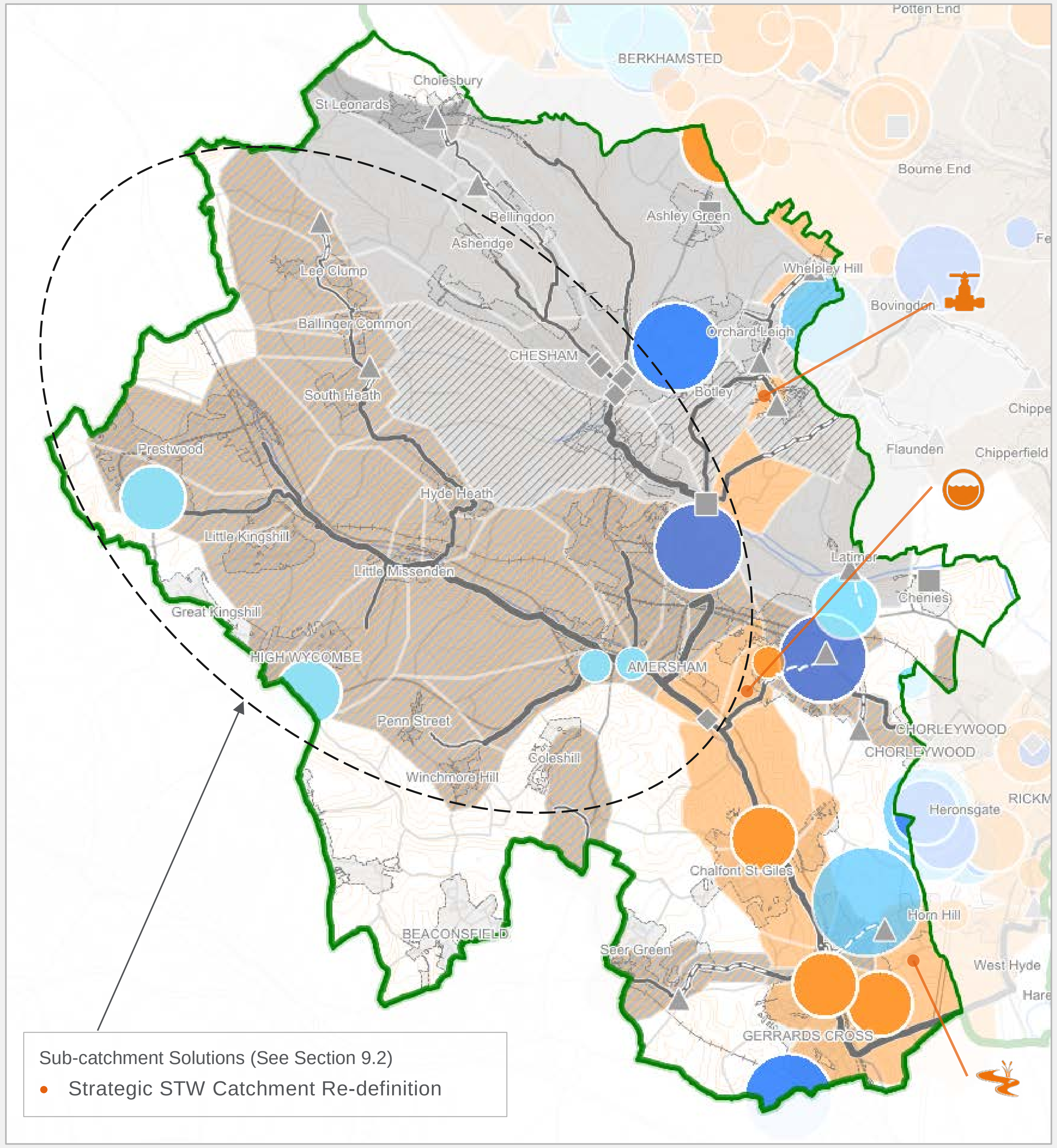
Strategic Intervention
(No Scenario variation)

Growth Area - Strategic Intervention required Med Scenario
(Potentially constrained without investment)

Indicative Growth Area - Low Scenario
(Relatively unconstrained)

Indicative Growth Area - Med Scenario
(Relatively unconstrained)

Indicative Growth Area - High Scenario
(Relatively unconstrained)



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Sewer upgrades / targeted rainfall runoff reduction projects (Tributary southeast of Amersham)

Evaluation / upgrade of DWF and peak flow capacity (SPS serving Bovingdon)

Targeted rainfall runoff reduction projects (Horn Hill)

Strategic rainfall runoff reduction investment (this and all sub-catchments served by Maple Lodge STW)

Strategic Foul Flow Reduction (Amersham, Little Missenden, Great Missenden, Prestwood and Chesham)

Strategic additional resource / reduced demand investment

Strategic rainfall runoff reduction investment (upstream of CSO discharging to the Chess)

Improvement works to reduce CSO and STW storm discharges (Maple Lodge STW and discharges to the Colne)

8.2 Dacorum

8.2.1 Growth Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix EA summary of the projected population used in the modelling can be seen in Figure 29.

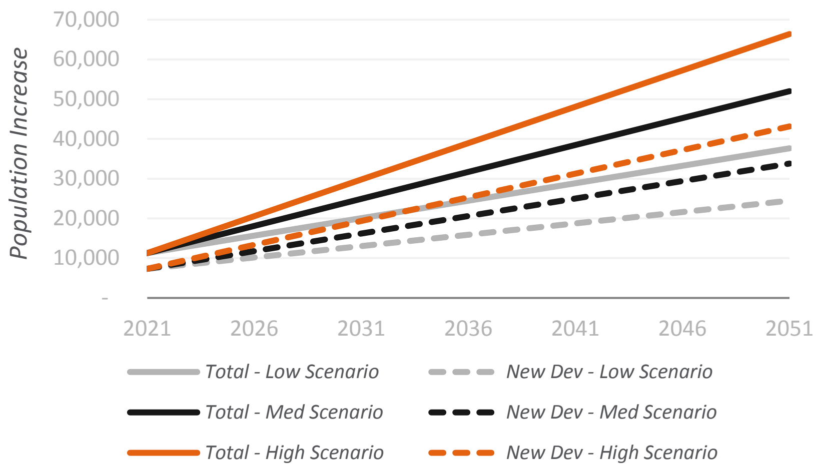


Figure 29 - Projected Population Increase for Dacorum

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 30.

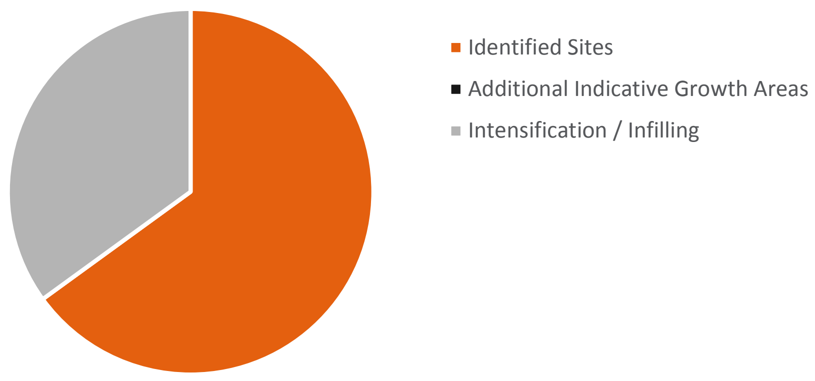


Figure 30 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Dacorum

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The majority of the indicative growth areas (identified to facilitate the modelling) for Dacorum are focused around Berkhamsted, Bovingdon, and Hemel Hempstead (eastern and southern areas). These growth areas form largely urban extensions, the majority adjacent to Berkhamsted and along the A41 transport corridor. By 2051, the potential for growth in Dacorum could extend along the much of the A41 (from Hemel Hempstead southwards) and expand the urban extent of Tring.

8.2.2 Key Outcomes

The main outcomes from the evaluation of need for Dacorum as follows:

- Any development within the Upper Gade catchment by 2031, northwest of Hemel Hempstead, could significantly impact water quality and require sensitive planning
- The indicative development areas around Berkhamsted are likely to require strategic intervention from 2031 onwards to accommodate the scale of projected growth within the Berkhamsted STW catchment
- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the district (mainly to improve STW capacity). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote large-scale water recycling
- Focusing growth proposals on Hemel Hempstead could provide a greater number of unrestricted opportunities, utilising the capacity of the existing system and relieving pressure on Berkhamsted

8.2.3 Sewage Treatment

All the major STWs in Dacorum are predicted to require focused planning from 2021 onwards to ensure they can accommodate the quantum of growth projected. Under the high scenario, strategic interventions could be needed at all STWs to ensure they have sufficient capacity by 2051, potentially by 2031 for Berkhamsted STW.

STWs	Scenario	2021	2031	2051
Maple Lodge STW	High			
	Med			
	Low			
Tring STW	High			
	Med			
	Low			
Berkhamsted STW	High			
	Med			
	Low			

Figure 31 – Dacorum STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.2.4 Water Resources

The availably of water resources in Dacorum is largely sufficient for 2021 but could require significant improvement by 2051, as with much of the county.

WRZ	2021	2031	2051
1			
3			

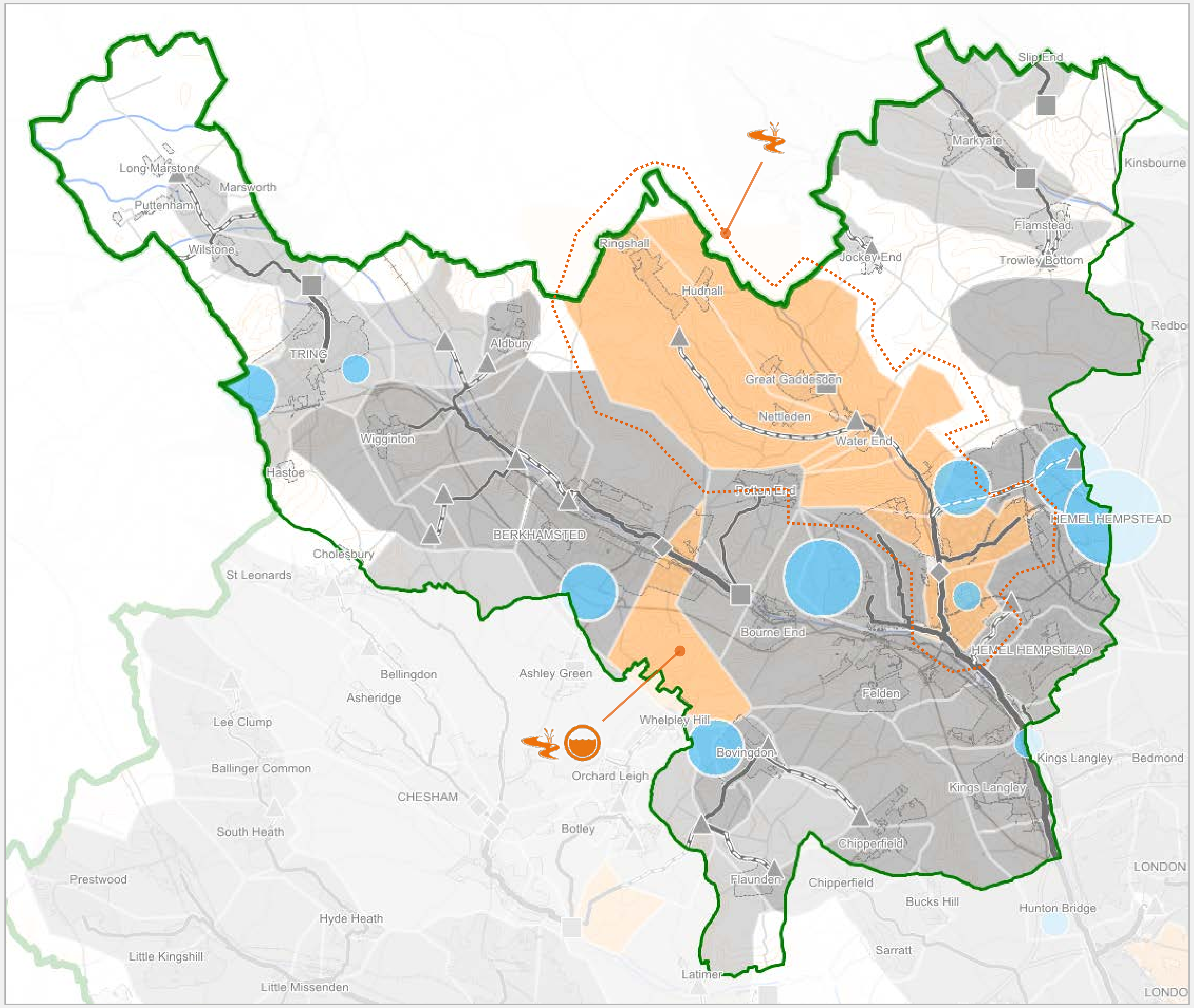
Figure 32 – Dacorum WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

8.2.5 Dacorum Classification of Need – Immediate Recommendations (2021)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*
- Indicative Growth Area *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Trunk sewer upgrade works (upstream of Berkhamsted STW)

Strategic evaluation of rainfall runoff flows (Boxmoor, Kings Langley and Hunton Bridge)

No clear strategic infrastructure needs identified

Evaluation of DWF and peak flow capacity and headroom (Maple Lodge STW)

No clear strategic infrastructure needs identified

Strategic evaluation of supply / demand balance

Evaluation of CSO discharges (to the Bulbourne / upper Gade)

Evaluation / improvements in STW FE discharge quality and storm discharges (Ashley Green STW / Great Gaddesden STW)

8.2.6 Dacorum Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

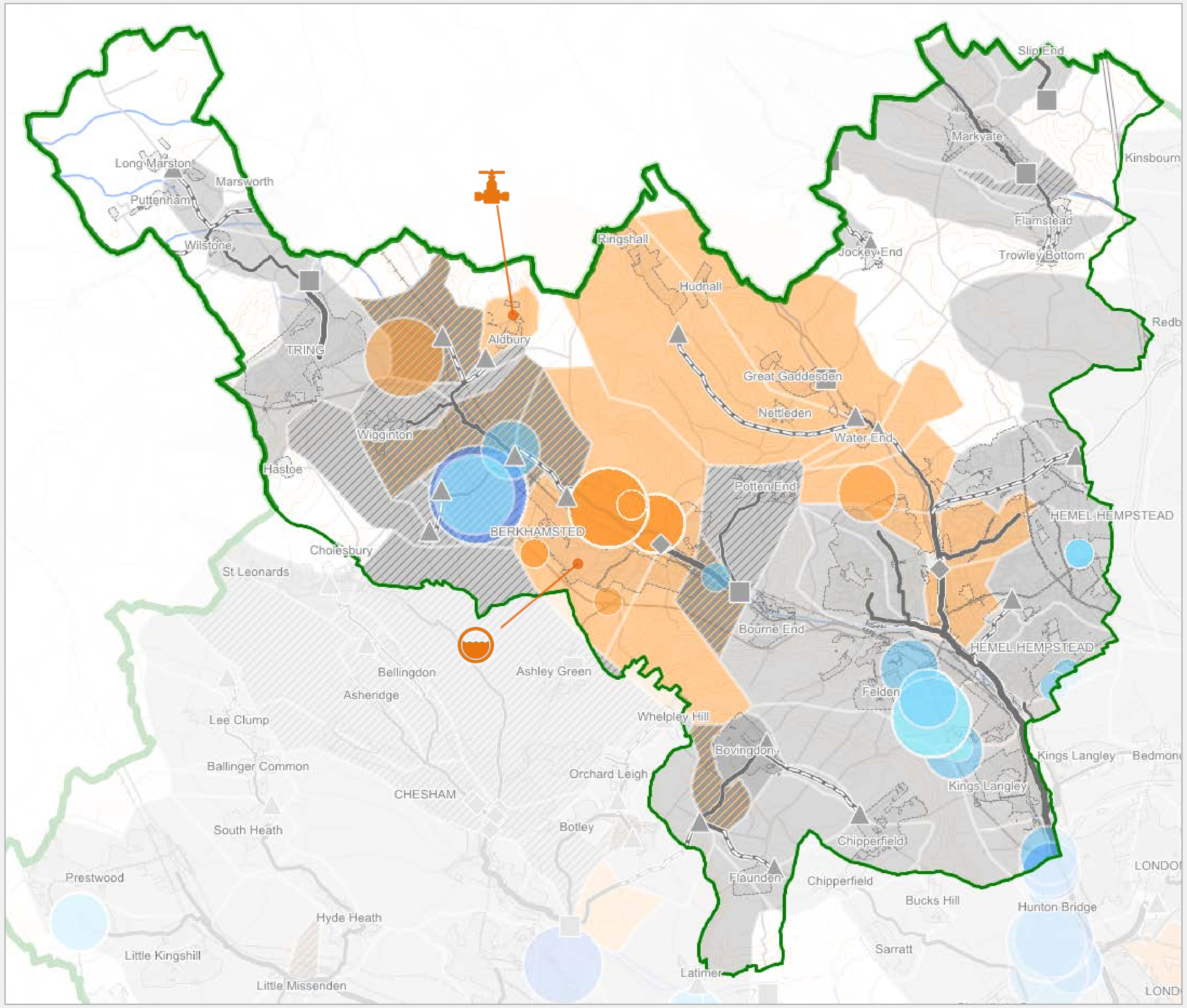
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols

- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required

- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Strategic trunk sewer upgrade works (Berkhamsted)

Strategic rainfall runoff reduction investment (Berkhamsted)

Explore opportunistic rainfall reduction potential (western area of district)

Trunk sewer upgrade works (A146 in Highfield)

DWF and peak flow capacity upgrade (SPSs serving Tring Station and Aldbury)

Targeted rainfall runoff reduction projects (Tring Station) or Peak flow capacity upgrade (SPS serving Tring Station)

Upgrade of DWF capacity at Maple Lodge STW

Strategic Foul Flow Reduction

Strategic evaluation of supply / demand balance

Strategic additional resource / reduced demand investment

Strategic SWS to reduce discharges to the Gade, Bulbourne and upper Colne

Upgrade to Berkhamsted STW, Great Gaddesden STW Ashley Green STW to reduce storm discharges to the Bulbourne and Gade

8.2.7 Dacorum Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Routine Investment / Focused Planning
(Low to High Scenario variation)

Focused Planning
(No Scenario variation)

Focused Planning / Strategic Intervention
(Low to High Scenario variation)

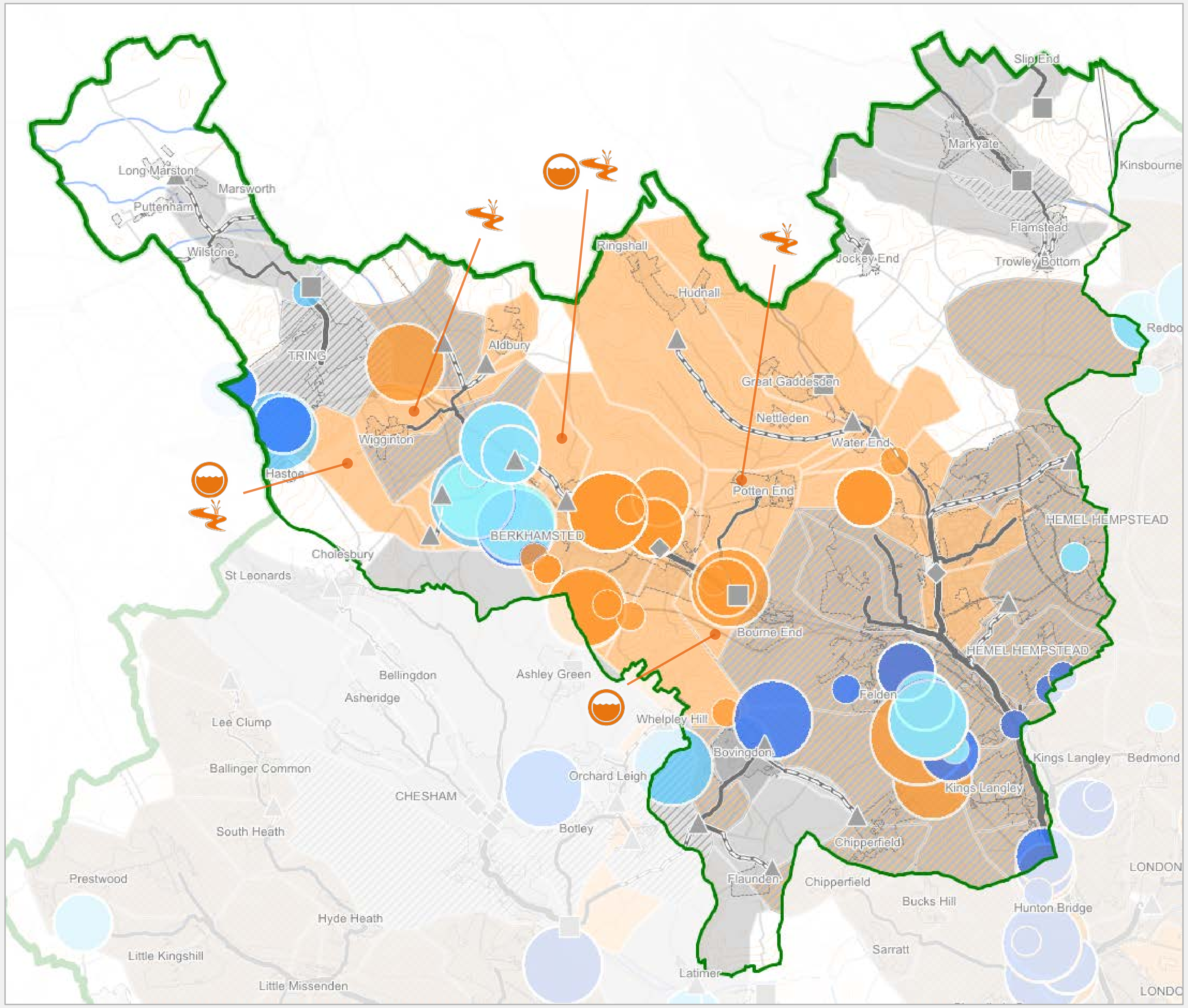
Strategic Intervention
(No Scenario variation)

Growth Area - Strategic Intervention required Med Scenario
(Potentially constrained without investment)

Indicative Growth Area - Low Scenario
(Relatively unconstrained)

Indicative Growth Area - Med Scenario
(Relatively unconstrained)

Indicative Growth Area - High Scenario
(Relatively unconstrained)



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Explore opportunistic rainfall reduction potential

Evaluation of trunk sewer capacity (downstream of the M25 towards Watford)

Targeted rainfall runoff reduction projects (downstream of the M25 and Watford)

No clear strategic infrastructure needs identified

Strategic rainfall runoff reduction investment (this and all sub-catchments served by Maple Lodge STW)

Strategic Foul Flow Reduction (Berkhamsted)

Explore opportunistic rainfall reduction potential

Strategic additional resource / reduced demand investment

Strategic rainfall runoff reduction investment (upstream of Berkhamsted and Ashley Green STW)

8.3 East Hertfordshire

8.3.1 Growth Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 33.

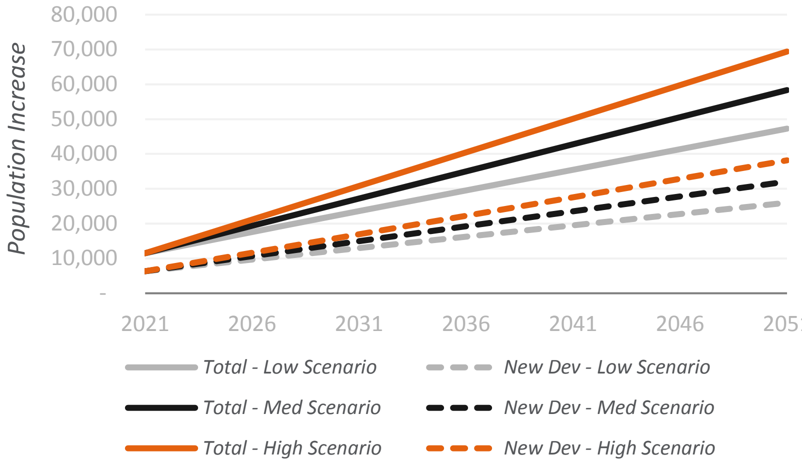


Figure 33 - Projected Population Increase for East Hertfordshire

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 34.

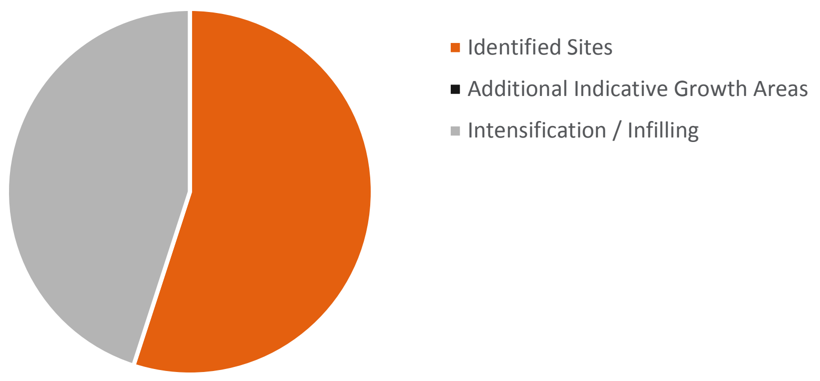


Figure 34 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for East Hertfordshire

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The indicative growth areas (identified to facilitate the modelling) for East Hertfordshire are focused around Hertford and the A414 / A10 transport corridors, including Hertford, Ware, an area east of Welwyn Garden City, Sawbridgeworth and in Bishop's Stortford. A large proportion of the projected quantum of growth up to 2031 is likely to be accommodated within existing settlements, specifically Hertford, Ware and Bishops Stortford, but by 2051 growth is expected to become more widespread.

The main outcomes from the evaluation of need for East Hertfordshire as follows:

- Delivering development within and around Hertford and Ware is likely to be affected somewhat by the impact of growth in the Stevenage and Welwyn Hatfield districts (since they both drain via the trunk sewer network to Rye Meads STW, passing through Herford and Ware). The evaluation has indicated that strategic intervention to improve the capacity of the trunk sewer network could be required as early as 2021 and potentially be essential from 2031 onwards

- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the district (mainly to improve ancillary and STW capacity). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote large-scale water recycling
- Decentralising the indicative growth areas for 2051 away from the Hertford and Ware areas could limit the likely scale of major strategic upgrades to the trunk sewer network and / or provide opportunities to better utilise the capacity of existing sewerage systems in more rural areas of the district
- Effectively delivering the quantum of growth projected for East Hertfordshire, Stevenage and Welwyn Hatfield districts will likely require major strategic interventions to upgrade the trunk sewer network, implemented over a sufficiently long timeframe to support growth in all three districts

8.3.2 Sewage Treatment

The majority of STWs in East Hertfordshire are predicted to require focused planning from 2021 onwards to ensure they can accommodate the projected growth. Under the high scenario, strategic intervention could be required for many of them to ensure them have sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Buntingford STW	High			
	Med			
	Low			
Braughing STW	High			
	Med			
	Low			
Dane End STW	High			
	Med			
	Low			
Rye Meads STW	High			
	Med			
	Low			
Bishop's Stortford STW	High			
	Med			
	Low			
Sandon STW	High			
	Med			
	Low			

Figure 35 – East Hertfordshire STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.3.3 Water Resources

Water resources in East Hertfordshire will require strategic intervention by 2031 to ensure sufficient availability.

WRZ	2021	2031	2051
3			
5			

Figure 36 – East Hertfordshire WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

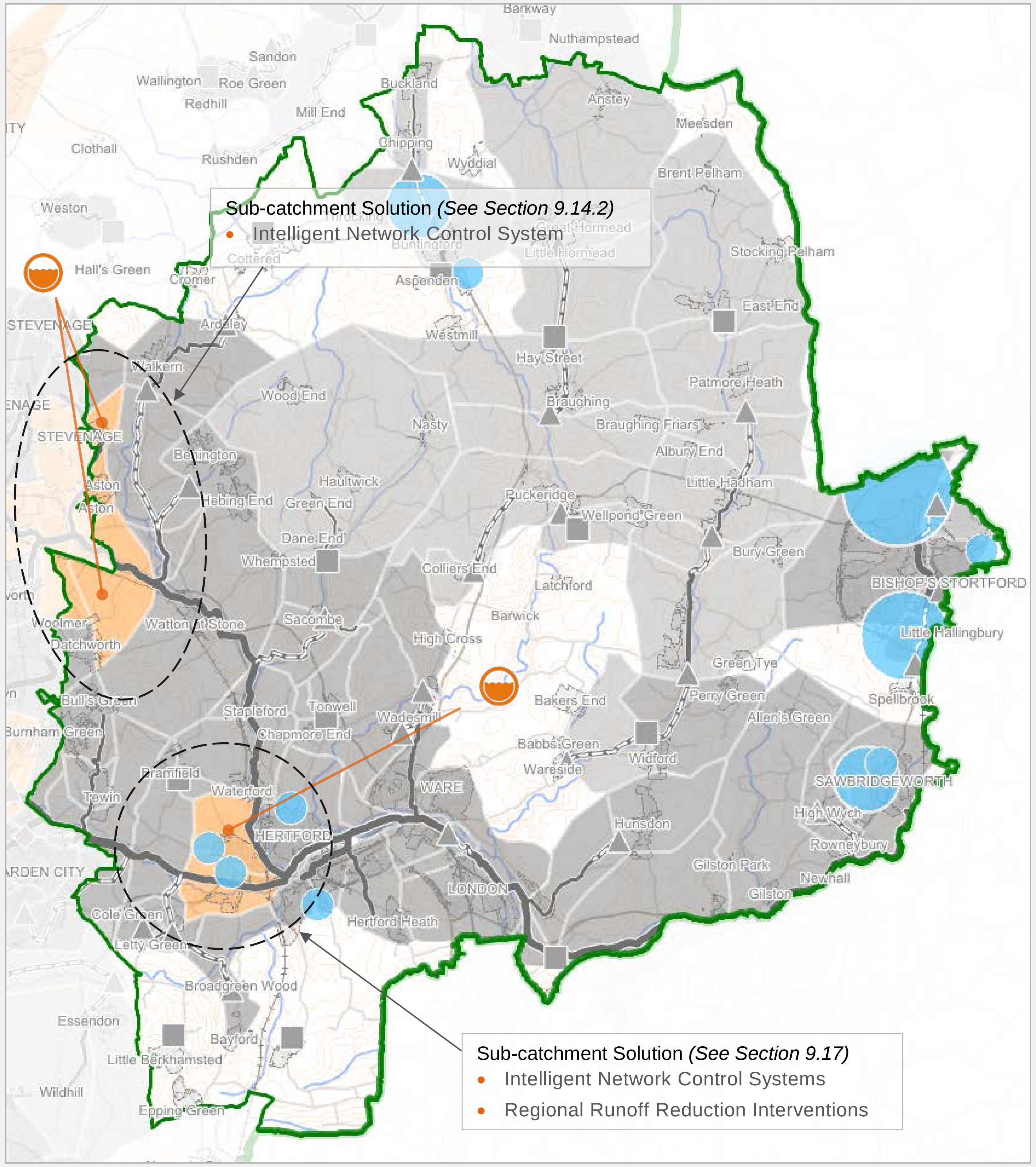
8.3.4 East Hertfordshire Classification of Need – Immediate Recommendations (2021)

District Plan

Legend	
District Boundary	
Study Boundary	
Trunk Network	
SPS	
STW	
CSO	
Routine Investment *(No Scenario variation)*	
Focused Planning *(No Scenario variation)*	
Strategic Intervention *(No Scenario variation)*	
Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*	
Indicative Growth Area *(Relatively unconstrained)*	

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

Trunk sewer upgrade works (Hertford Rd, in Digswell)

Evaluation of trunk sewer capacity / upgrade works (Hertford, from Welwyn Garden City and Stevenage)

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

Strategic evaluation of supply / demand balance

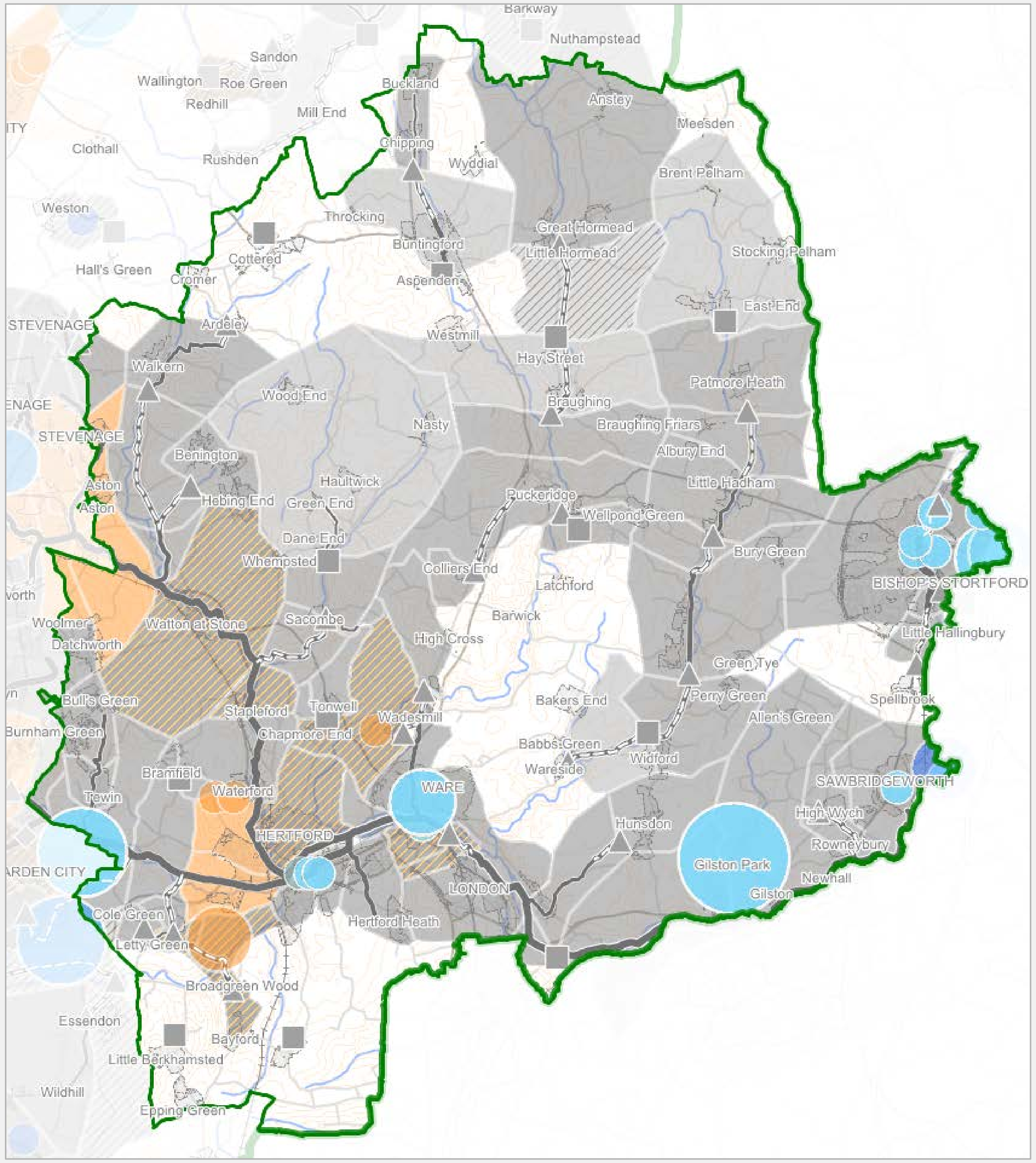
Evaluation / improvements in STW FE discharge quality and storm discharges (Furneux Pelham and Standon STW discharges to the Ash and Rib)

Strategic evaluation of STW FE discharge quality and storm discharges (Bramfield STW)

8.3.5 East Hertfordshire Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Routine Investment / Focused Planning *(Low to High Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Focused Planning / Strategic Intervention *(Low to High Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*
- Indicative Growth Area - Low Scenario *(Relatively unconstrained)*
- Indicative Growth Area - Med Scenario *(Relatively unconstrained)*
- Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required unless they have been provided by the districts for the 2021 scenario
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development.

Water Infrastructure Needs

Evaluation of trunk sewer capacity / upgrade works (downstream of Kelshall and Therfield, and Hadham Cross)

Evaluation of trunk sewer capacity / upgrade works (Hertford to Rye Meads STW)

Evaluation of DWF and peak flow capacity (all SPSs in Ash Valley)

Evaluation / upgrade of DWF and peak flow capacity (all SPSs in Bishop Stortford)

DWF capacity upgrade (SPS serving Hare Street and Great Hormead)

Evaluation / Upgrades to DWF and peak flow capacity and headroom (Rye Meads STW)

Explore Intelligent Network Control Systems (main trunk sewers from Welwyn Garden City and Stevenage)

No clear strategic infrastructure needs identified

Strategic additional resource / reduced demand investment

Strategic evaluation of STW FE discharge quality and storm discharges (all STWs)

8.3.6 East Hertfordshire Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

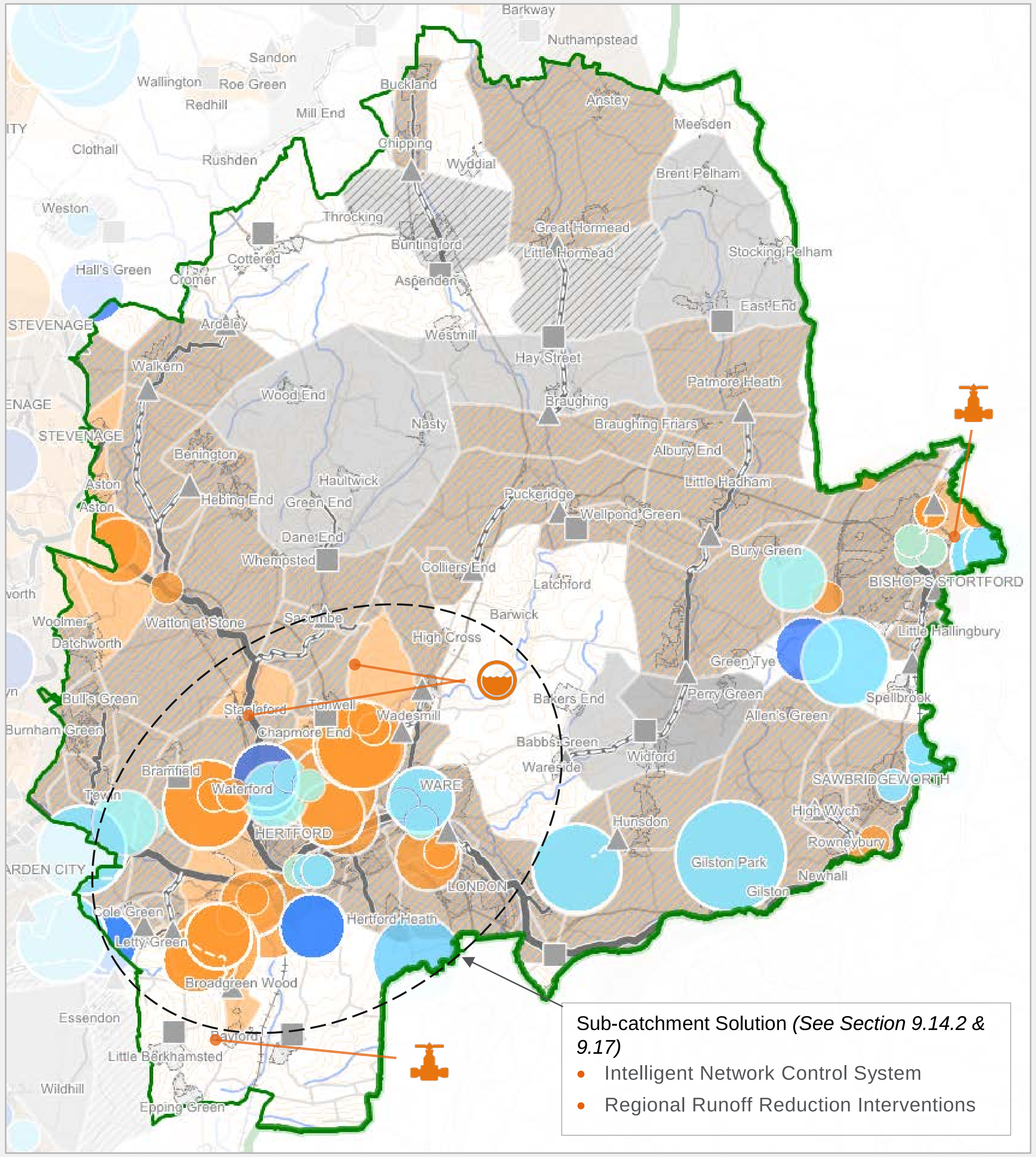
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Evaluation of trunk sewer capacity (Reed and Buntingford)

Evaluate new strategic trunk sewer (to bypass Hertford)

Strategic rainfall runoff reduction investment

DWF capacity upgrade (SPSs serving Thundridge)

Evaluation / upgrade of DWF capacity (SPSs on trunk sewer serving Hertford, Ware and Stevenage)

Strategic rainfall runoff reduction investment

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

Evaluation / improvements in STW FE discharge quality and storm discharges (Braughing and Wideford discharges to the Rib and Ash / Parkway STW and Dane End STW)

8.4 Hertsmere

8.4.1 Growth Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 37.

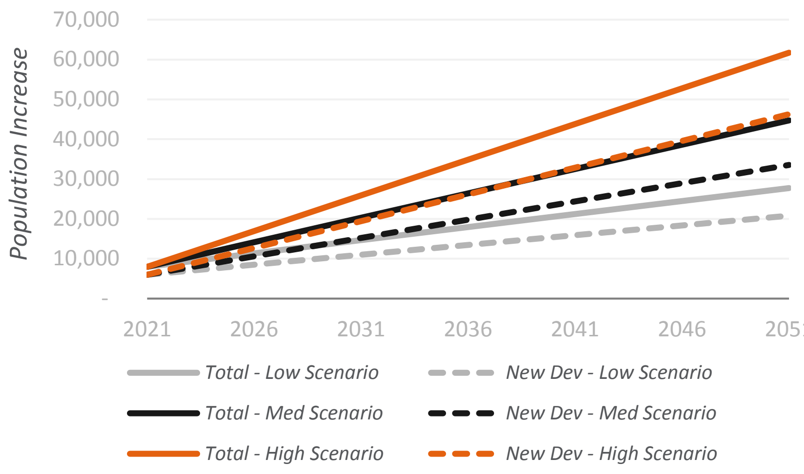


Figure 37 - Projected Population Increase for Hertsmere

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 38.

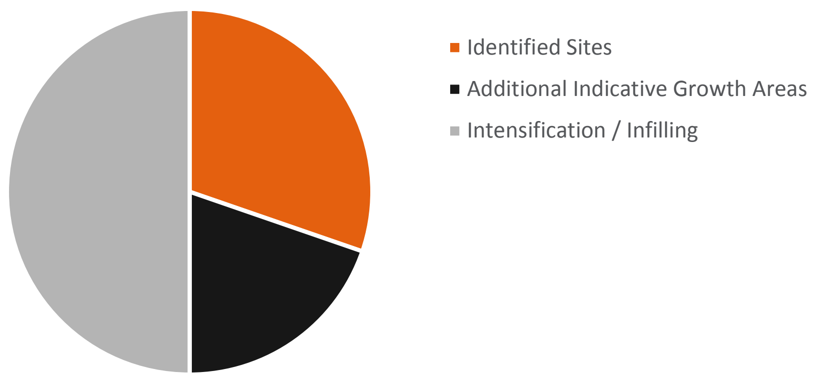


Figure 38 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Hertsmere

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The indicative growth areas (identified to facilitate the modelling) for Hertsmere are relatively evenly spread, located around Potters Bar, Elstree, London Colney, Radlett and Watford.

The main outcomes from the evaluation of need for Hertsmere as follows:

- The evaluation indicates most growth areas remain relatively unconstrained (by the wastewater system), up to and including in 2031, with only localised network capacity likely requiring strategic intervention in Potters Bar
- The potential impact of sewer discharges on watercourse quality in Borehamwood by 2051 could require the promotion of more sustainable construction solutions (for development sites) to ensure rainfall runoff is discharging to the environment (not the foul sewers)

- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the district (mainly to improve sewer and STW capacity). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote large-scale water recycling

8.4.2 Sewage Treatment

Maple Lodge STW is predicted to require at least focused planning from 2021 onwards to ensure it can accommodate expected growth. Under the high scenario, strategic interventions could be needed to ensure it has sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Maple Lodge STW	High			
	Med			
	Low			

Figure 39 – Hertsmere STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.4.3 Water Resources

The availably of water resources in Hertsmere is largely sufficient in 2021 but could require significant improvement by 2051.

WRZ	2021	2031	2051
2			
3			

Figure 40 – Hertsmere WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

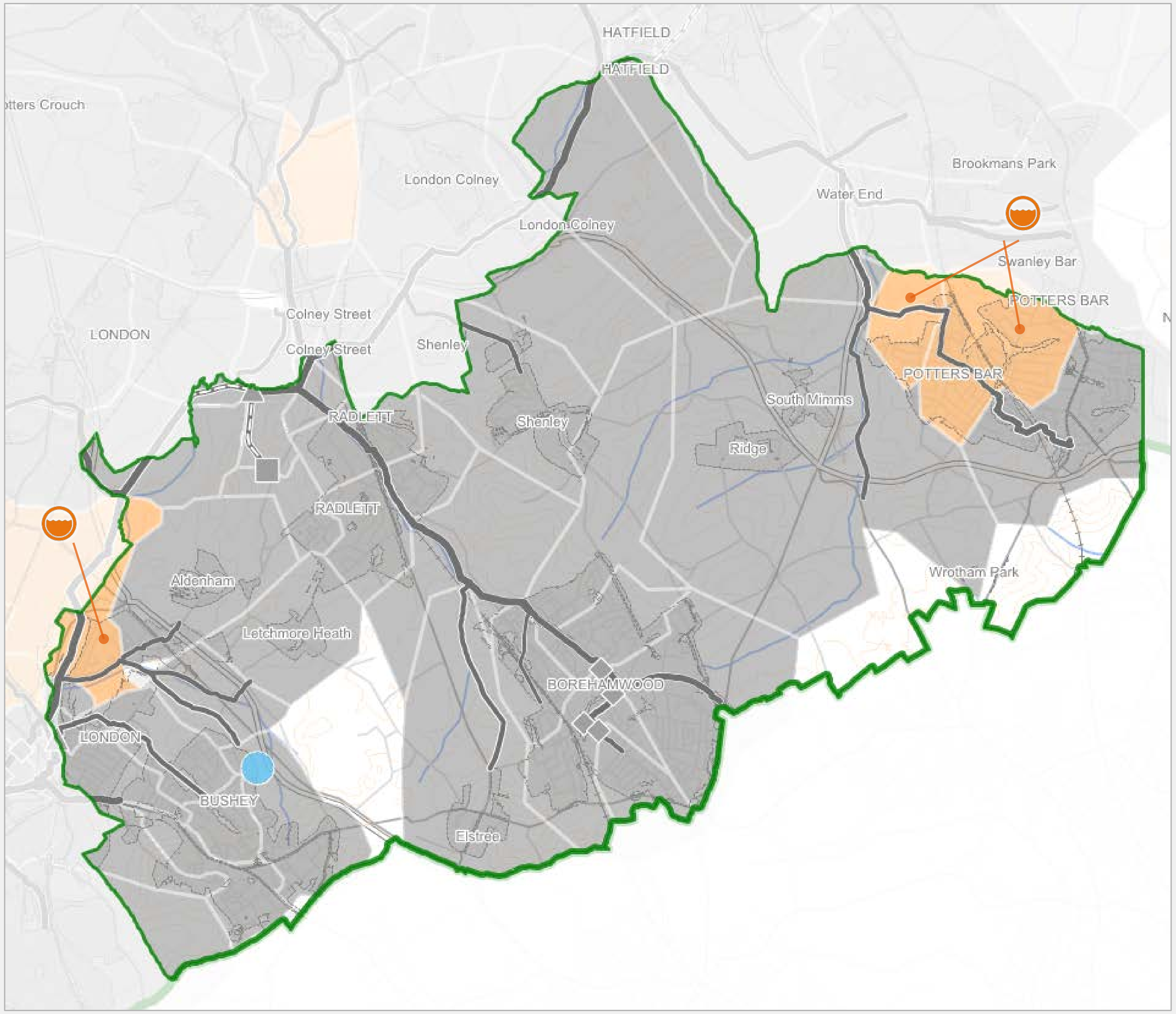
8.4.4 Hertsmere Classification of Need – Immediate Recommendations (2021)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*
- Indicative Growth Area *(Relatively unconstrained)*

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



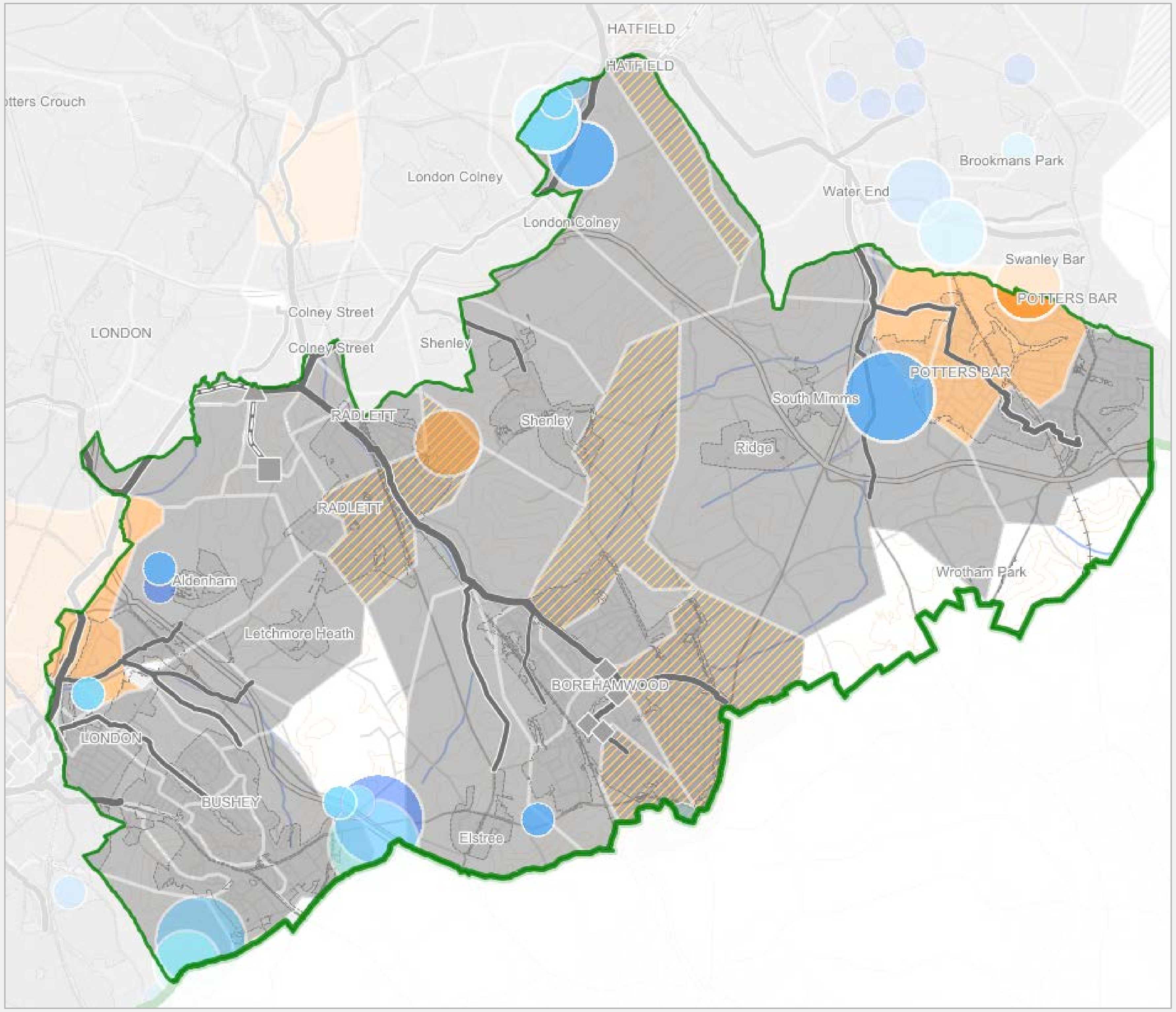
Water Infrastructure Needs

Wastewater network	Evaluation of trunk sewer capacity (St Albans between A414 and M25)
Water network	No clear strategic infrastructure needs identified
Wastewater treatment	Evaluation of DWF and peak flow capacity and headroom (Maple Lodge STW)
Drainage / flooding	No clear strategic infrastructure needs identified
Water supply	Strategic evaluation of supply / demand balance
Environment	No clear strategic infrastructure needs identified

8.4.5 Hertsmere Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Routine Investment / Focused Planning *(Low to High Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Focused Planning / Strategic Intervention *(Low to High Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*
- Indicative Growth Area - Low Scenario *(Relatively unconstrained)*
- Indicative Growth Area - Med Scenario *(Relatively unconstrained)*
- Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

- No clear strategic infrastructure needs identified
- Strategic rainfall runoff reduction investment

  DWF and peak flow capacity upgrade (terminal SPS on main trunk sewer to Blackbirds STW)

  CSO evaluation / improvement works (CSOs in Borehamwood)
- Upgrade of DWF capacity at Maple Lodge STW
- No clear strategic infrastructure needs identified
- Strategic additional resource / reduced demand investment
- Targeted rainfall runoff reduction projects (catchment upstream of CSOs discharging to the Tykeswater)

8.4.6 Hertsmere Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

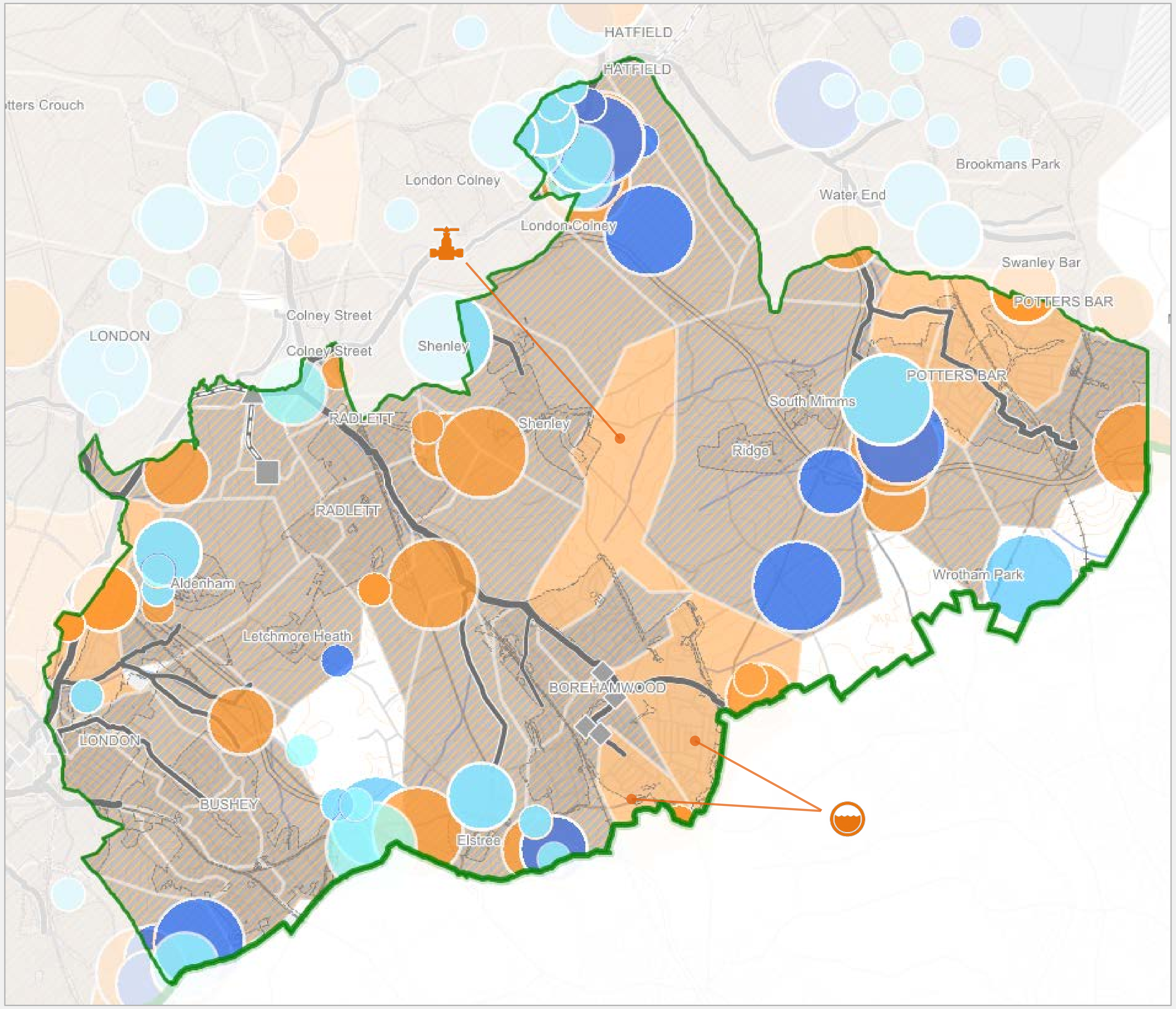
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Water Infrastructure Needs

Strategic rainfall runoff reduction investment (whole district)

Large-scale SWS across whole district

Strategic rainfall runoff reduction investment (this and all catchments served by Maple Lodge STW)

No clear strategic infrastructure needs identified

Strategic additional resource / reduced demand investment

No clear strategic infrastructure needs identified

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

8.5 North Hertfordshire

8.5.1 Growth Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 41.

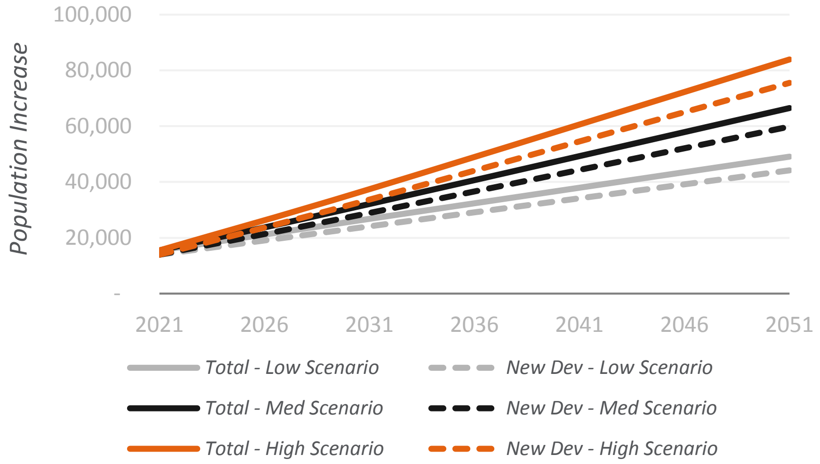


Figure 41 - Projected Population Increase for North Hertfordshire

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 42.

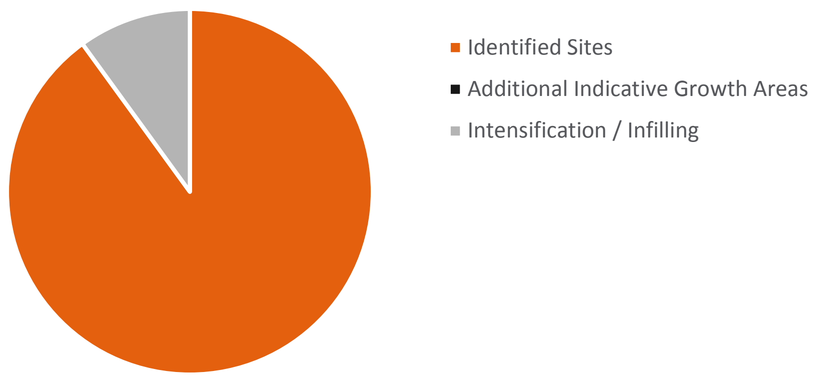


Figure 42 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for North Hertfordshire

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The indicative growth areas (identified to facilitate the modelling) for North Hertfordshire are focused around Hitchin and Letchworth Garden City. These growth areas are derived a combination of urban extensions and transport corridors, being the main settlements in the district and located in close proximity to the A1.

By 2031, the indicative areas of growth surround Hitchin to the north, west and east, which by 2051 extends south and links up with Stevenage. Such a growth strategy is very unlikely to be promoted as it would create an amorphous conurbation area, removing discrete settlement boundaries. The indicative growth areas were derived through a specific methodology (detailed in Section 6.1.5) which was unable to account for this aspect of development planning.

As a result, confidence in the distribution of indicative growth is limited in this area and should be a subject for further investigation.

The main outcomes from the evaluation of need for North Hertfordshire as follows:

- Any development proposals around the northeast of Letchworth Garden City are likely require significant new infrastructure and / or upgrades to the existing sewerage system near Ashbrook STW
- Due to the expected need for strategic intervention at Ashbrook STW the significant quantum of growth projected for its catchment will need to be planned and delivered with focus on reducing foul flows

8.5.2 Sewage Treatment

The majority of STWs in North Hertfordshire are predicted to require focused planning from 2021 onwards to ensure they can accommodate the quantum of growth projected. Under the high scenario, strategic interventions could be required at Ashbrook, Whitwell and Weston STWs to ensure it has sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Letchworth Garden STW	High			
	Med			
	Low			
Ashbrook STW	High			
	Med			
	Low			
Whitwell STW	High			
	Med			
	Low			
Kimpton STW	High			
	Med			
	Low			
Weston STW	High			
	Med			
	Low			
Barkway STW	High			
	Med			
	Low			

Figure 43 – North Hertfordshire STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.5.3 Water Resources

The water resources in North Hertfordshire is likely to require strategic intervention by 2031 to ensure sufficient availability.

WRZ	2021	2031	2051
5			

Figure 44 – North Hertfordshire WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

8.5.4 North Hertfordshire Classification of Need – Immediate Recommendations (2021)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Focused Planning
(No Scenario variation)

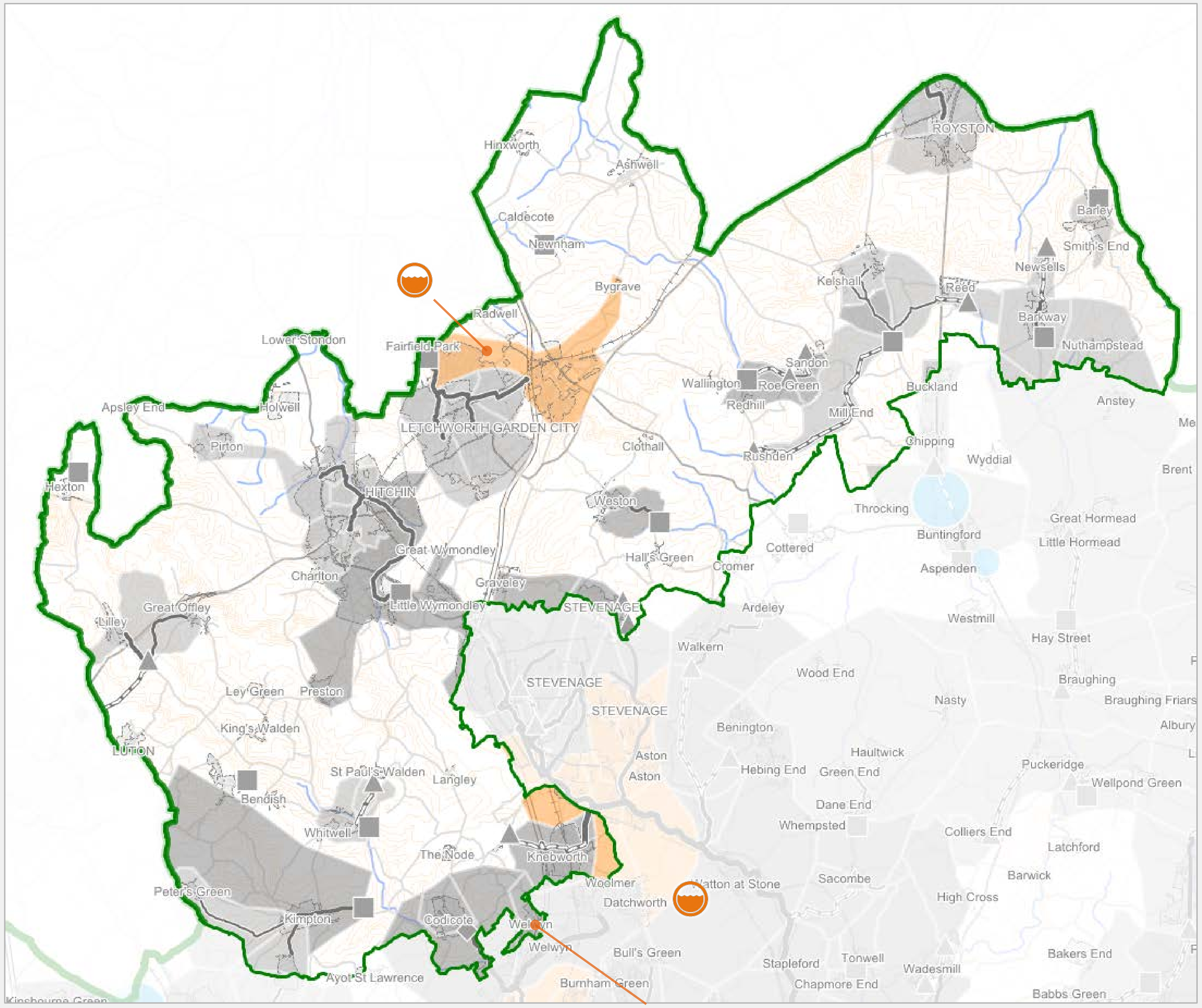
Strategic Intervention
(No Scenario variation)

Indicative Growth Area - Strategic Intervention required
(Potentially Constrained without investment)

Indicative Growth Area
(Relatively unconstrained)

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

Evaluation of trunk sewer capacity (Baldock and northern area of Letchworth Garden City)

Strategic evaluation of rainfall runoff flows (Letchworth Garden City)

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

Strategic evaluation of supply / demand balance

No clear strategic infrastructure needs identified

8.5.5 North Hertfordshire Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Routine Investment / Focused Planning
(Low to High Scenario variation)

Focused Planning
(No Scenario variation)

Focused Planning / Strategic Intervention
(Low to High Scenario variation)

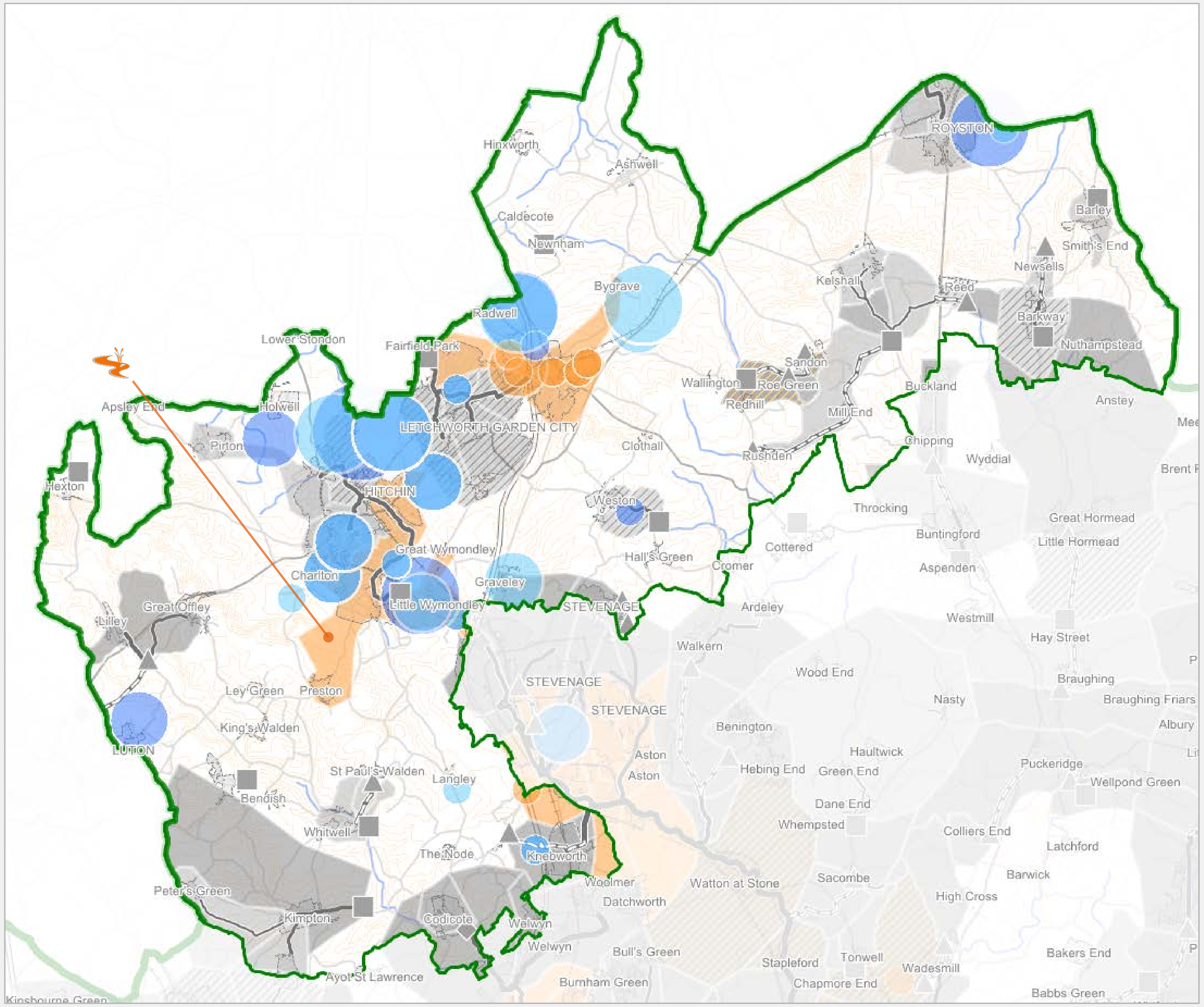
Strategic Intervention
(No Scenario variation)

Growth Area - Strategic Intervention required Med Scenario
(Potentially constrained without investment)

Indicative Growth Area - Low Scenario
(Relatively unconstrained)

Indicative Growth Area - Med Scenario
(Relatively unconstrained)

Indicative Growth Area - High Scenario
(Relatively unconstrained)



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols

- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required

- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Trunk sewer upgrade works (northern areas of Letchworth Garden City upstream of Letchworth STW)

Targeted rainfall runoff reduction projects (Little Wymondley, St Ippolyts and south eastern area of Hitchin)

No clear strategic infrastructure needs identified

Strategic rainfall runoff reduction investment (northern area of Letchworth Garden City)

No clear strategic infrastructure needs identified

Strategic additional resource / reduced demand investment

Targeted rainfall runoff reduction projects to reduce foul discharges to watercourses (Eastern and southern areas of Hitchin)

8.5.6 North Hertfordshire Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Routine Investment / Focused Planning
(Low to High Scenario variation)

Focused Planning
(No Scenario variation)

Focused Planning / Strategic Intervention
(Low to High Scenario variation)

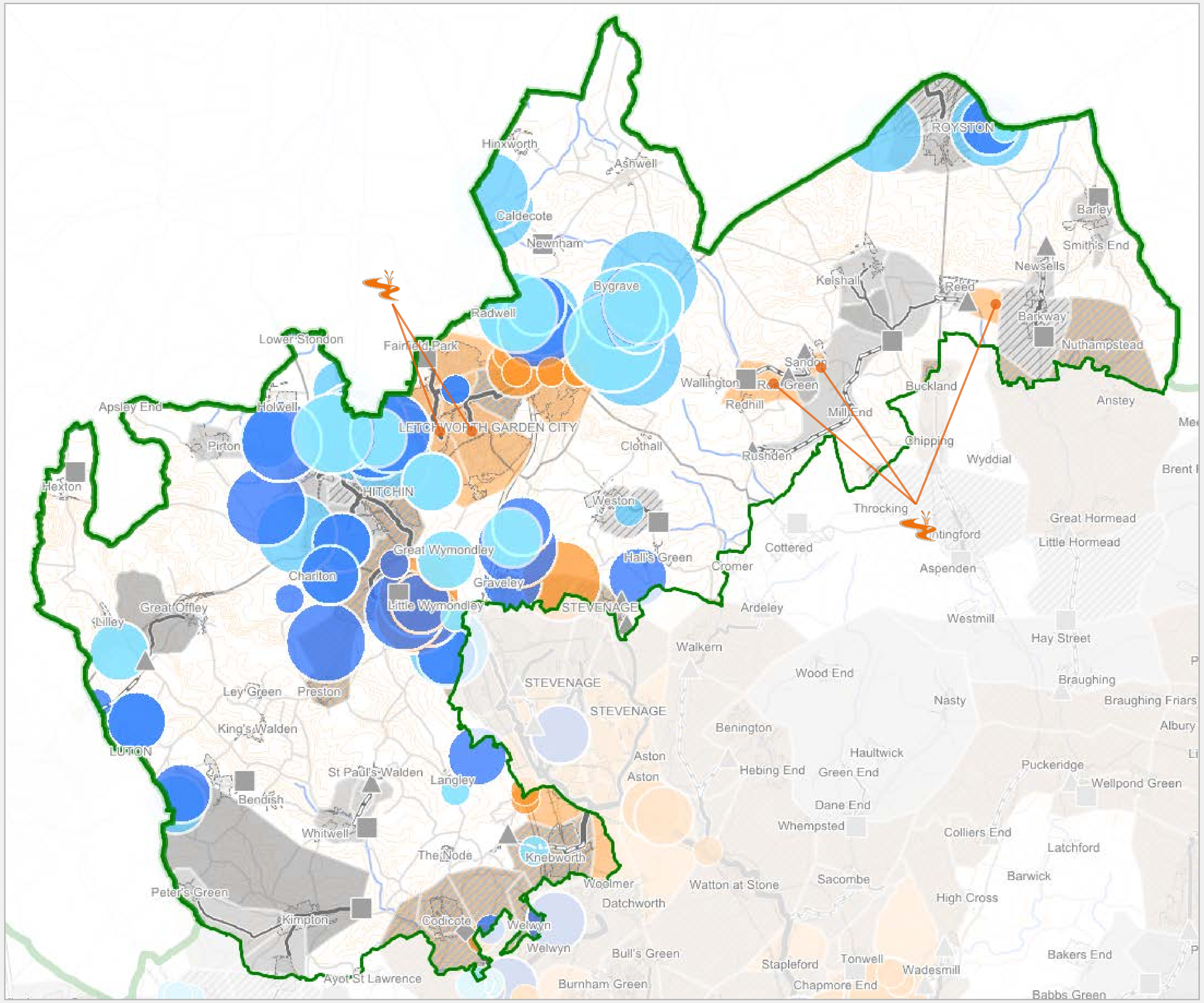
Strategic Intervention
(No Scenario variation)

Growth Area - Strategic Intervention required Med Scenario
(Potentially constrained without investment)

Indicative Growth Area - Low Scenario
(Relatively unconstrained)

Indicative Growth Area - Med Scenario
(Relatively unconstrained)

Indicative Growth Area - High Scenario
(Relatively unconstrained)



Water Infrastructure Needs

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

Targeted rainfall runoff reduction projects to reduce foul discharges to watercourses (Letchworth Garden City and eastern rural settlements)

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

8.6 St Albans

8.6.1 Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 45.

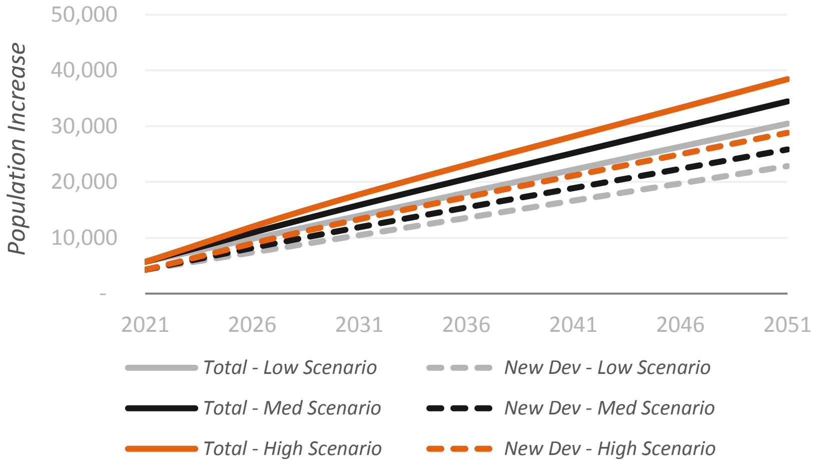


Figure 45 - Projected Population Increase for St Albans

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 46.

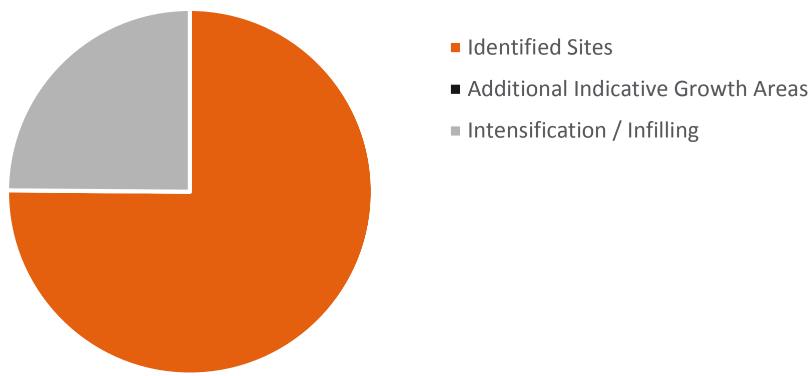


Figure 46 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for St Albans

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The majority of the indicative growth areas (identified to facilitate the modelling) for the 2021 and 2031 scenarios are grouped into three areas, Harpenden, East Hemel Hempstead and east of Albans. By 2051, other indicative growth areas become focused to the southeast of St Albans (adjacent to Hatfield), south of St Albans, adjacent to Watford and around Redbourn.

The main outcomes from the evaluation of need for St Albans as follows:

- Any development proposals around the southern and eastern edges of St Albans are likely to require strategic intervention in 2051, potentially linked to large-scale trunk sewer upgrades
- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the southern part of the district (mainly to improve the capacity

of Maple lodge STW and Blackbirds STW). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote large-scale water recycling

8.6.2 Sewage Treatment

Maple Lodge STW is predicted to require at least focused planning from 2021 onwards to ensure it can accommodate expected growth. Under the high scenario, strategic interventions could be needed to ensure it has sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Maple Lodge STW	High			
	Med			
	Low			

Figure 47 – St Albans STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.6.3 Water Resources

The availably of water resources in St Albans is largely sufficient in 2021 but could require significant improvement by 2051, as with much of the county.

WRZ	2021	2031	2051
1			
2			

Figure 48 – St Albans WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

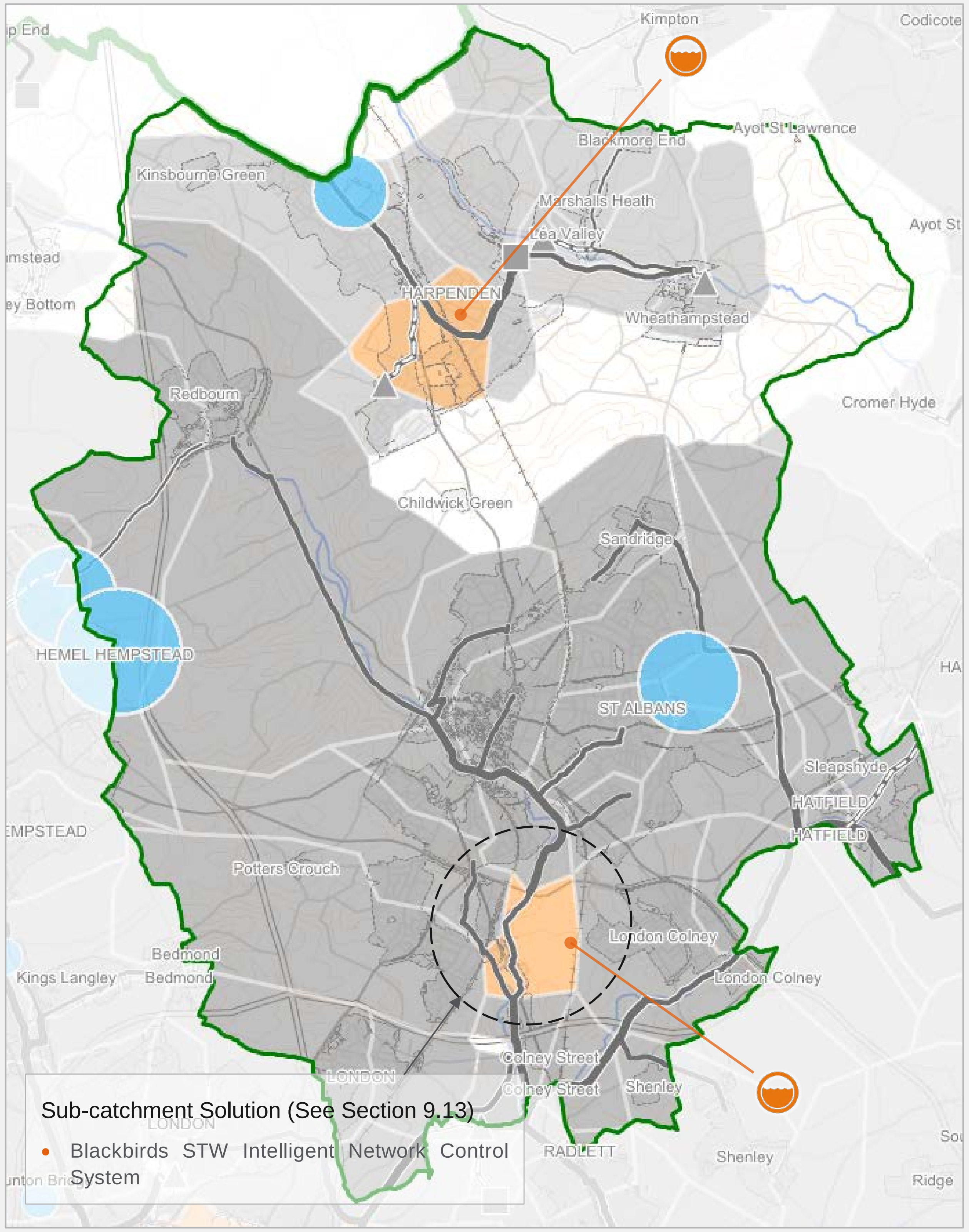
8.6.4 St Albans Classification of Need – Immediate Recommendations (2021)

District Plan

Legend	
District Boundary	
Study Boundary	
Trunk Network	
SPS	
STW	
CSO	
Routine Investment *(No Scenario variation)*	
Focused Planning *(No Scenario variation)*	
Strategic Intervention *(No Scenario variation)*	
Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*	
Indicative Growth Area *(Relatively unconstrained)*	

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

Evaluation of trunk sewer capacity (Hatching Green)

Evaluation of trunk sewer capacity (St Albans between A414 and M25)

Explore opportunistic rainfall reduction potential (St Albans)

No clear strategic infrastructure needs identified

Evaluation of DWF and peak flow capacity and headroom (Maple Lodge STW)

No clear strategic infrastructure needs identified

Strategic evaluation of supply / demand balance

No clear strategic infrastructure needs identified

8.6.5 St Albans Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

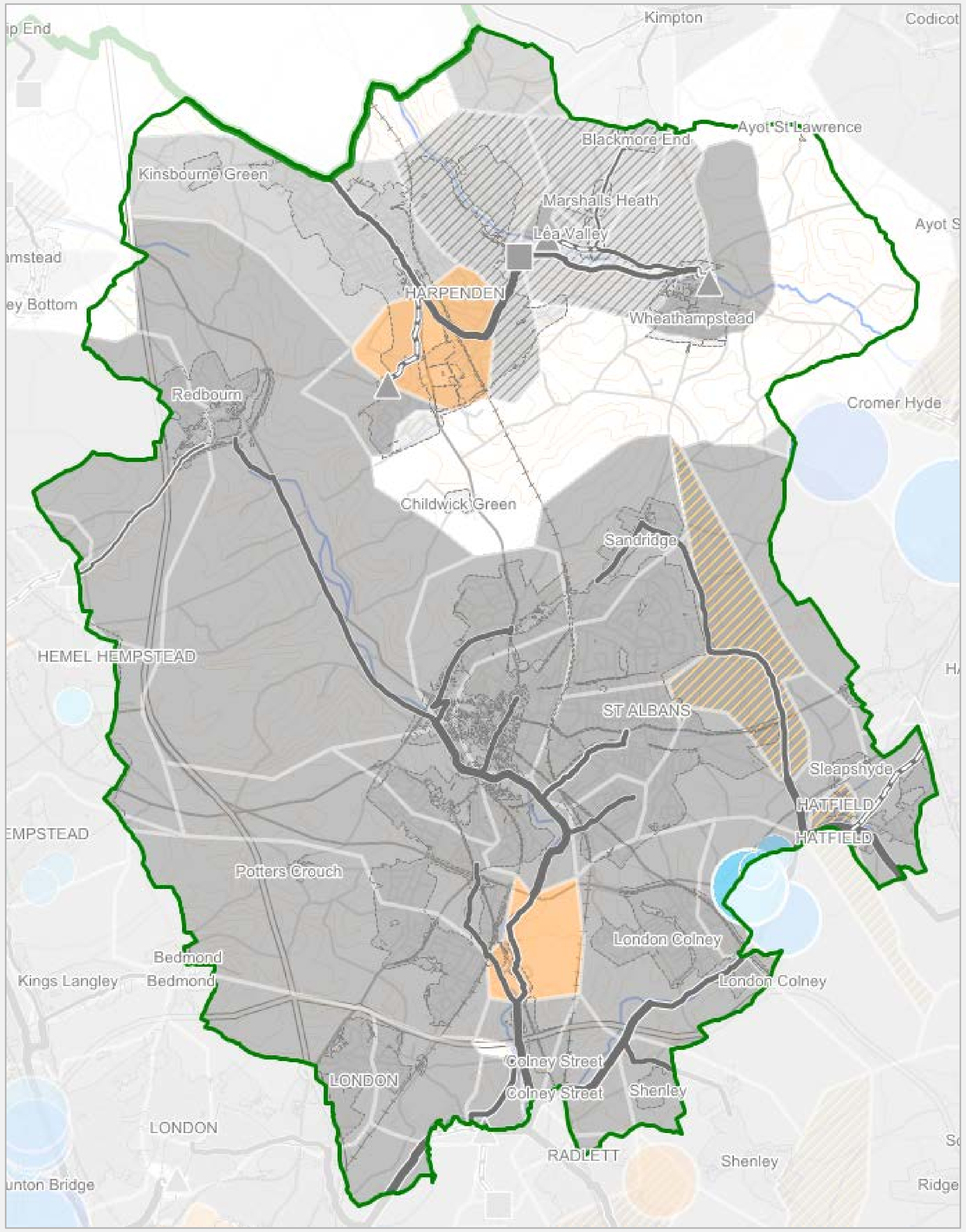
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Targeted rainfall runoff reduction projects (Kinsbourne Green, west Harpenden, Hatching Green and Jersey Farm area)

Evaluation of DWF and peak flow capacity (SPS serving Hatching Green and Wheathampstead)

Strategic rainfall runoff reduction investment

DWF and peak flow capacity upgrade (terminal SPS on main trunk sewer to Blackbirds STW)

CSO evaluation / improvement works (CSOs in Borehamwood)

Upgrade of DWF capacity at Maple Lodge STW

Long-term foul flow reduction strategic for Hatching Green

Strategic evaluation of supply / demand balance

Strategic rainfall runoff reduction investment (catchment served by Harpenden STW / upstream of CSOs discharging to the Tykeswater)

8.6.6 St Albans Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

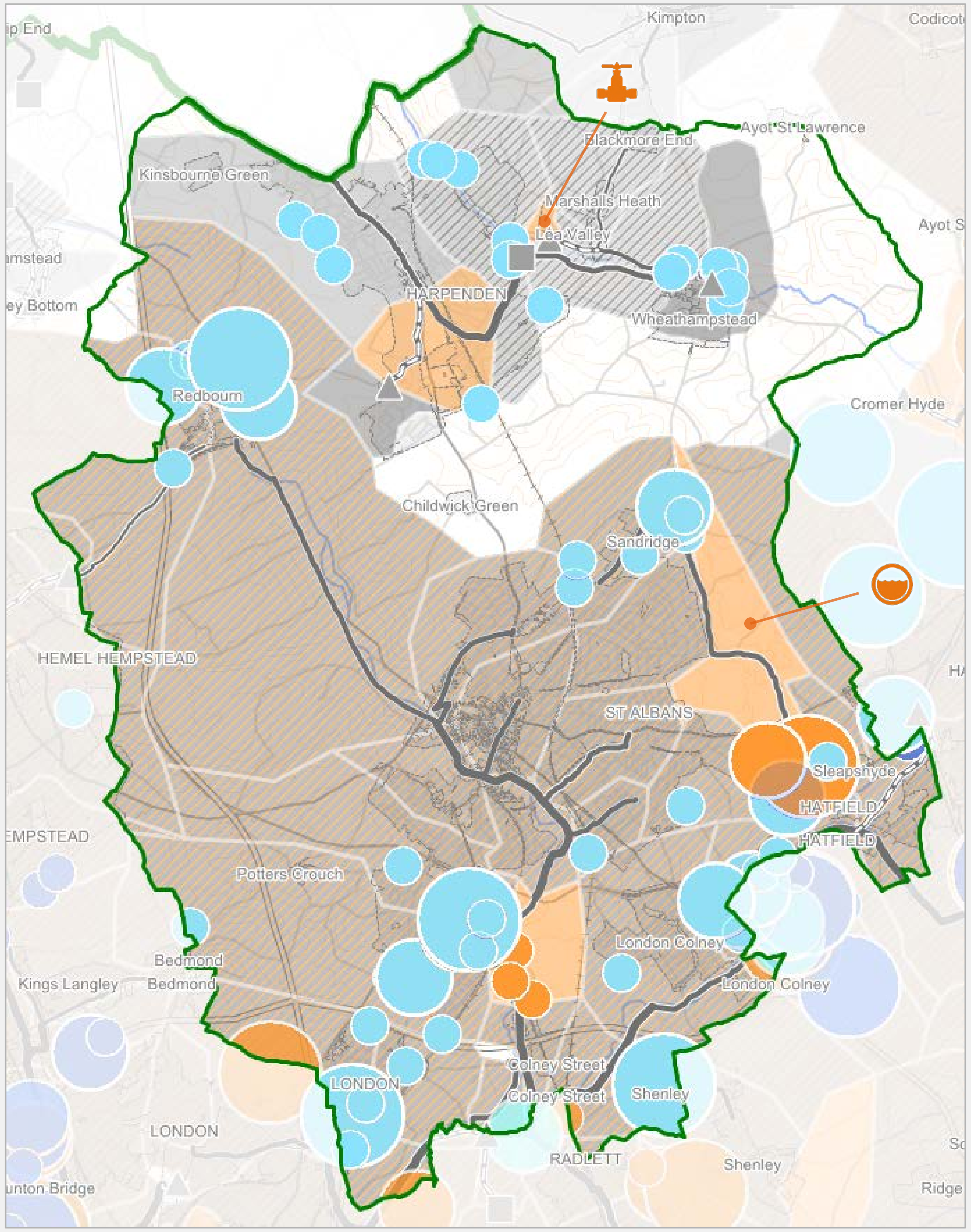
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Evaluation of trunk sewer capacity / upgrade works (Hatching Green to Harpenden STW)

Targeted rainfall runoff reduction projects (Batford)

No clear strategic infrastructure needs identified

Opportunistic rainfall runoff reduction investment

Strategic additional resource / reduced demand investment

No clear strategic infrastructure needs identified

8.7 Stevenage

8.7.1 Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 49.

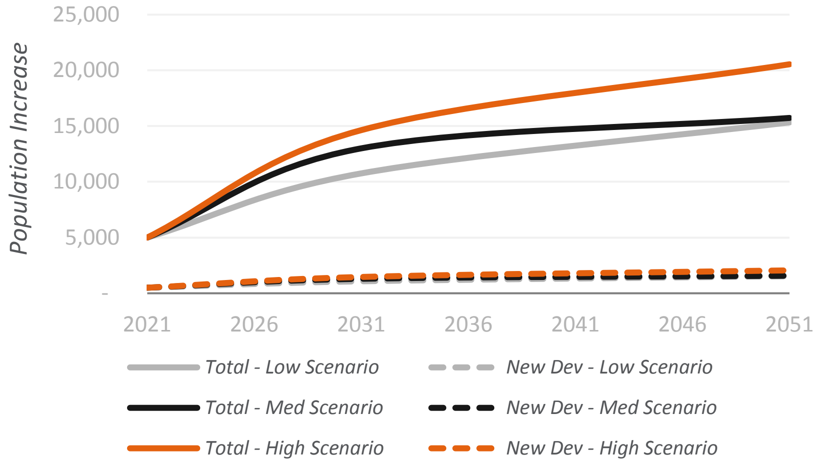


Figure 49 - Projected Population Increase for Stevenage

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 50.

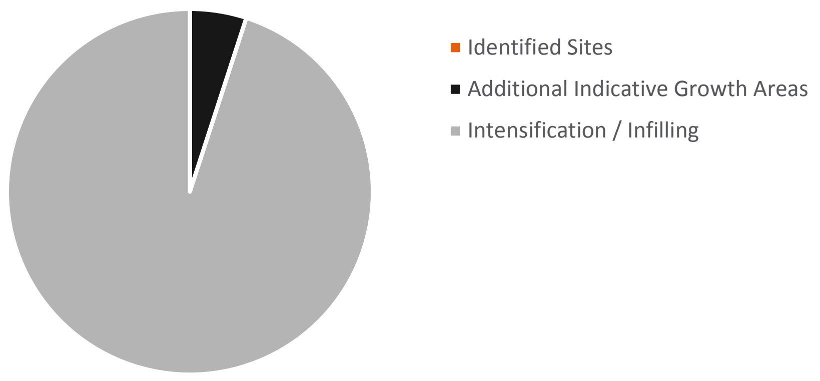


Figure 50 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Stevenage

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

All projected growth in Stevenage will be served by the existing sewer network, with the settlement forming its upper end and farthest catchment discharging to Rye Meads STW.

The main outcomes from the evaluation of need for Stevenage as follows:

- The expected quantum of growth will likely require strategic interventions within the southern half of the settlement by 2031. To reduce the potential scale of any strategic interventions any re-development proposals should be used as opportunities to install rainwater harvesting systems and retro-fit SuDS systems to limit the amount of rainfall runoff entering the foul sewers
- The evaluation indicates potential issues for development for 2021, largely due to the estimates of sewers capacity and flows entering the sewers. The extensive surface water system in Stevenage implies that

the Classification of Need is likely to be over-conservative for 2021 (the evaluation has assumed rainfall runoff in both foul and combined sewers). However, due to the extent of potential strategic interventions in the future and lack of alternative growth areas, further investigations into the capacity of the existing system based on the planned location of development / re-development in Stevenage is recommended by 2021, to inform long-term planning for 2031 and 2051

- The evaluation indicates a large degree of uncertainty between 2031 and 2051, with the high scenario demonstrating strategic intervention could be required across the southern part of the county (mainly to improve the capacity of Rye Meads STW). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote large-scale water recycling

8.7.2 Sewage Treatment

Rye Meads STW is predicted to require at least focused planning from 2021 onwards to ensure it can accommodate expected growth. Under the high scenario, strategic interventions could be needed to ensure it has sufficient capacity in 2051. A small area of Stevenage is served by Whitwell STW which is not predicted to require major investment.

STWs	Scenario	2021	2031	2051
Rye Meads STW	High			
	Med			
	Low			

Figure 51 – Stevenage STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.7.3 Water Resources

The water resources in Stevenage is likely to require strategic intervention by 2031 to ensure sufficient availability.

WRZ	2021	2031	2051
3			

Figure 52 – Stevenage WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

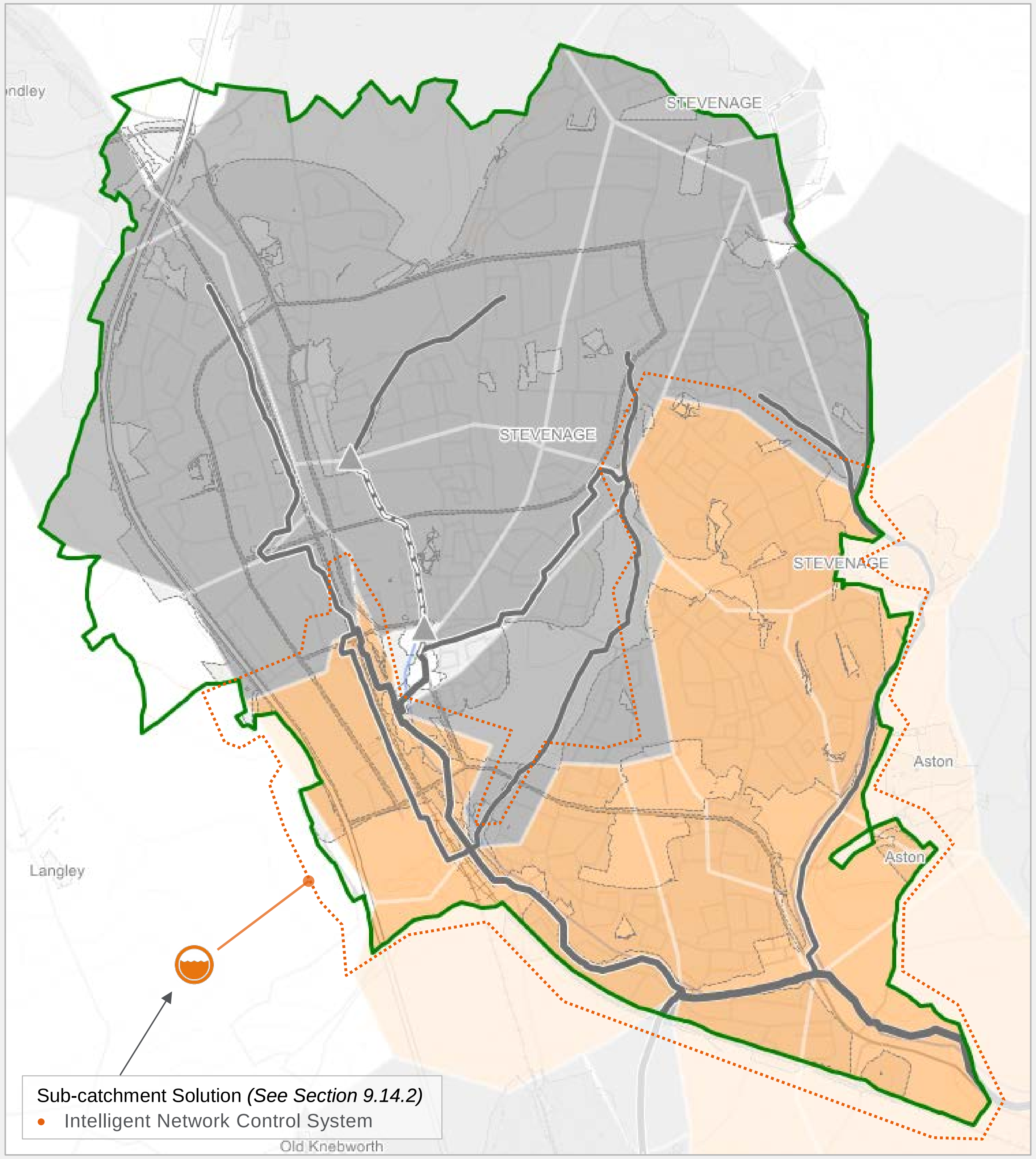
8.7.4 Stevenage Classification of Need – Immediate Recommendations (2021)

District Plan

District Boundary	
Study Boundary	
Trunk Network	
SPS	
STW	
CSO	
Routine Investment *(No Scenario variation)*	
Focused Planning *(No Scenario variation)*	
Strategic Intervention *(No Scenario variation)*	
Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*	
Indicative Growth Area *(Relatively unconstrained)*	

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

- Evaluation of trunk sewer capacity / upgrade works (southern trunk sewer)
  Strategic evaluation of rainfall runoff flows
- No clear strategic infrastructure needs identified
- No clear strategic infrastructure needs identified
- No clear strategic infrastructure needs identified
- Strategic evaluation of supply / demand balance
- No clear strategic infrastructure needs identified

8.7.5 Stevenage Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Routine Investment / Focused Planning
(Low to High Scenario variation)

Focused Planning
(No Scenario variation)

Focused Planning / Strategic Intervention
(Low to High Scenario variation)

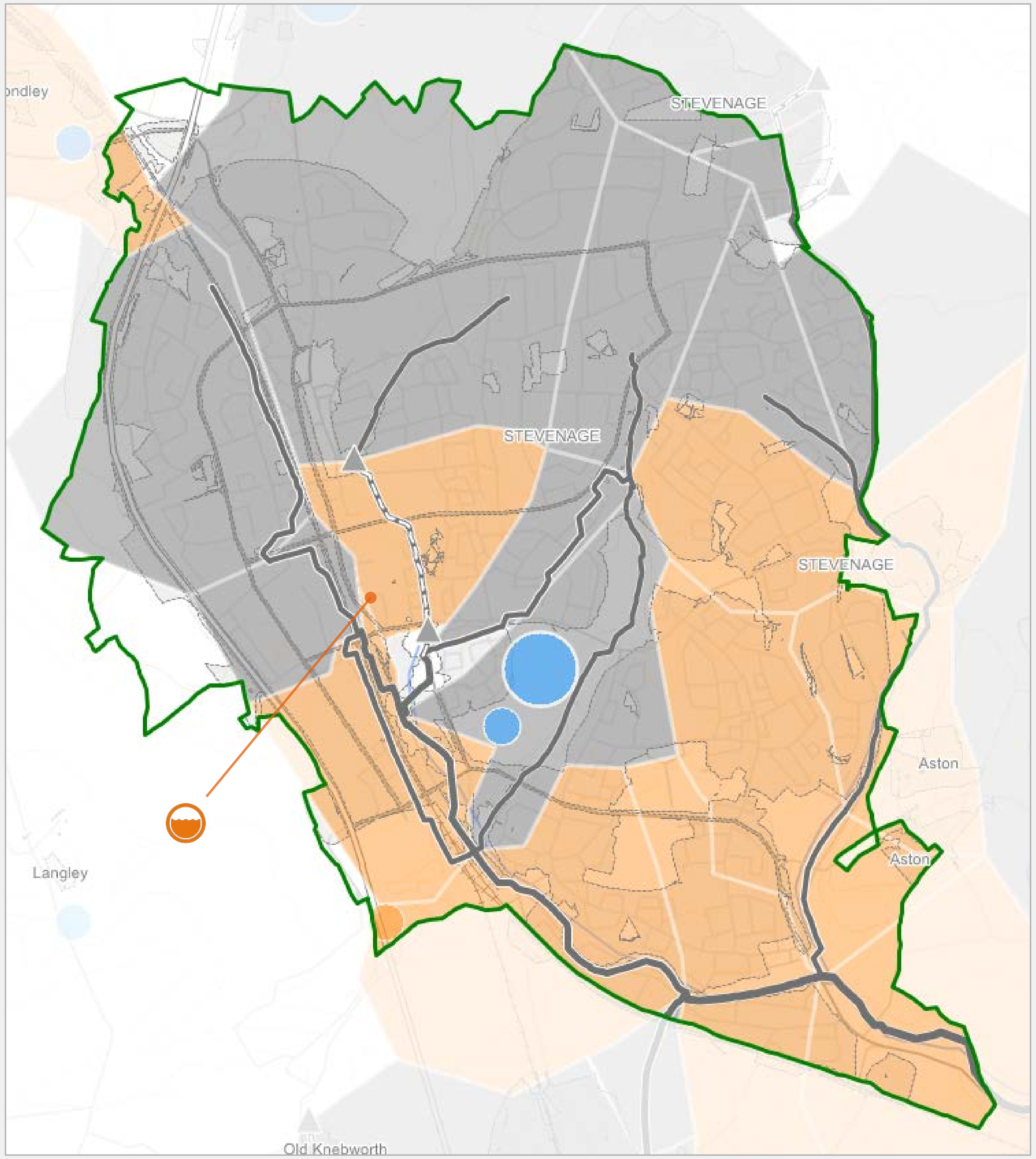
Strategic Intervention
(No Scenario variation)

Growth Area - Strategic Intervention required Med Scenario
(Potentially constrained without investment)

Indicative Growth Area - Low Scenario
(Relatively unconstrained)

Indicative Growth Area - Med Scenario
(Relatively unconstrained)

Indicative Growth Area - High Scenario
(Relatively unconstrained)



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Targeted rainfall runoff reduction projects (Stevenage)

Trunk sewer upgrade works (downstream of Stevenage)

Provide strategic in-catchment storage (Stevenage)

Strategic rainfall runoff reduction investment

Peak flow capacity upgrade (all SPSs in district)

Evaluation / Upgrades to DWF and peak flow capacity and headroom (Rye Meads STW)

Explore Intelligent Network Control Systems (main trunk sewers from Welwyn Garden City and Stevenage)

No clear strategic infrastructure needs identified

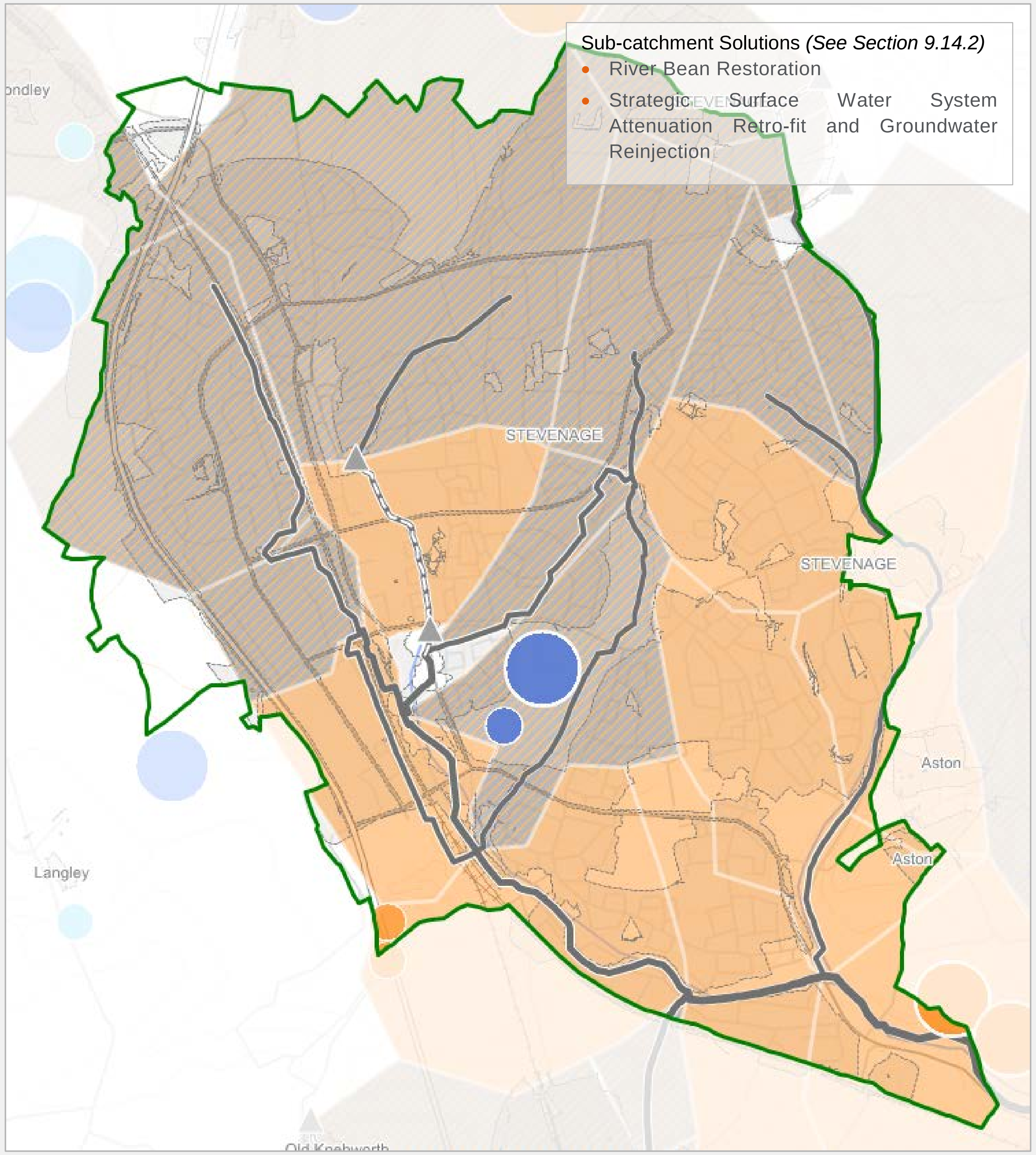
Strategic additional resource / reduced demand investment

No clear strategic infrastructure needs identified

8.7.6 Stevenage Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Routine Investment / Focused Planning *(Low to High Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Focused Planning / Strategic Intervention *(Low to High Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*
- Indicative Growth Area - Low Scenario *(Relatively unconstrained)*
- Indicative Growth Area - Med Scenario *(Relatively unconstrained)*
- Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

- No clear strategic infrastructure needs identified
- Evaluation / upgrade of DWF capacity (all SPSs in district)
- Strategic rainfall runoff reduction investment
- Strategic Foul Flow Reduction (Shephall and Poplar)
- No clear strategic infrastructure needs identified
- Strategic rainfall runoff reduction investment (catchment served by Rye Meads STW)

8.8 Three Rivers

8.8.1 Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 53.

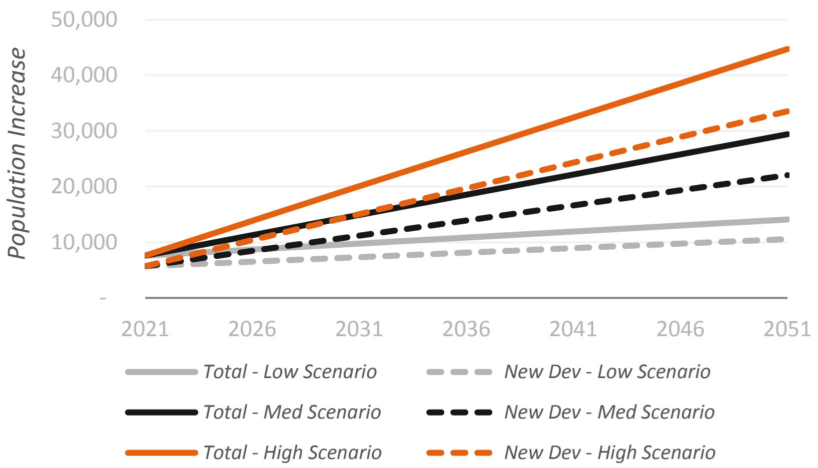


Figure 53 - Projected Population Increase for Three Rivers

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 54.

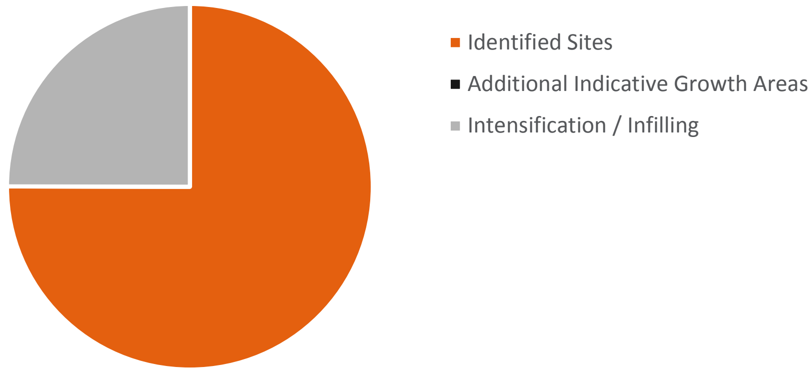


Figure 54 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Three Rivers

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

The indicative growth areas (identified to facilitate the modelling) for 2031 are grouped into two main areas, around the M25 south of Kings Langley and to the southwest of Watford. By 2051, other indicative growth areas become focused on areas south of Chorleywood and east of Rickmansworth.

The main outcomes from the evaluation of need for Three Rivers as follows:

- In 2031, the majority of indicative growth areas are relatively unconstrained (by the wastewater system), with areas to the northwest of Watford remaining partly constrained by 2051
- Most indicative growth areas southwest of Watford and in Rickmansworth are likely to need strategic intervention to ensure the main trunk sewer network discharging to Maple Lodge STW has adequate capacity

- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the southern part of the county (mainly to improve the capacity of Maple Lodge STW). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote large-scale water recycling.

8.8.2 Sewage Treatment

Rye Meads STW is predicted to require at least focused planning from 2021 onwards to ensure it can accommodate expected growth. Under the high scenario, strategic interventions could be needed to ensure it has sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Maple Lodge STW	High			
	Med			
	Low			

Figure 55 – Three Rivers STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.8.3 Water Resources

The availably of water resources in Three Rivers is largely sufficient in 2021 but could require significant improvement by 2051/

WRZ	2021	2031	2051
1			
2			

Figure 56 – Three Rivers WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

8.8.4 Three Rivers Classification of Need – Immediate Recommendations (2021)

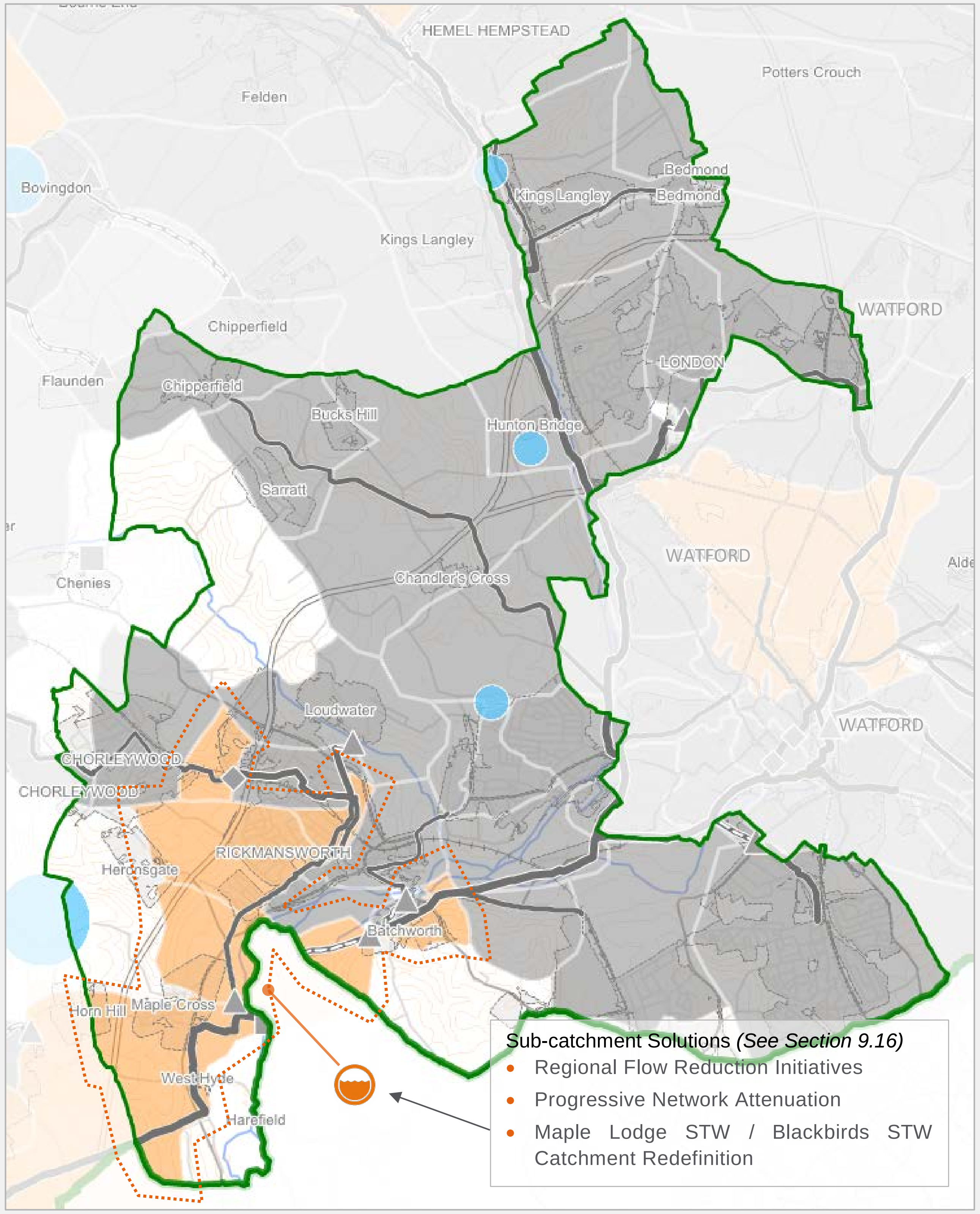
District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*
- Indicative Growth Area *(Relatively unconstrained)*

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols

- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

Evaluation of trunk sewer capacity / upgrade works (southern trunk sewer)

Strategic evaluation of rainfall runoff flows

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

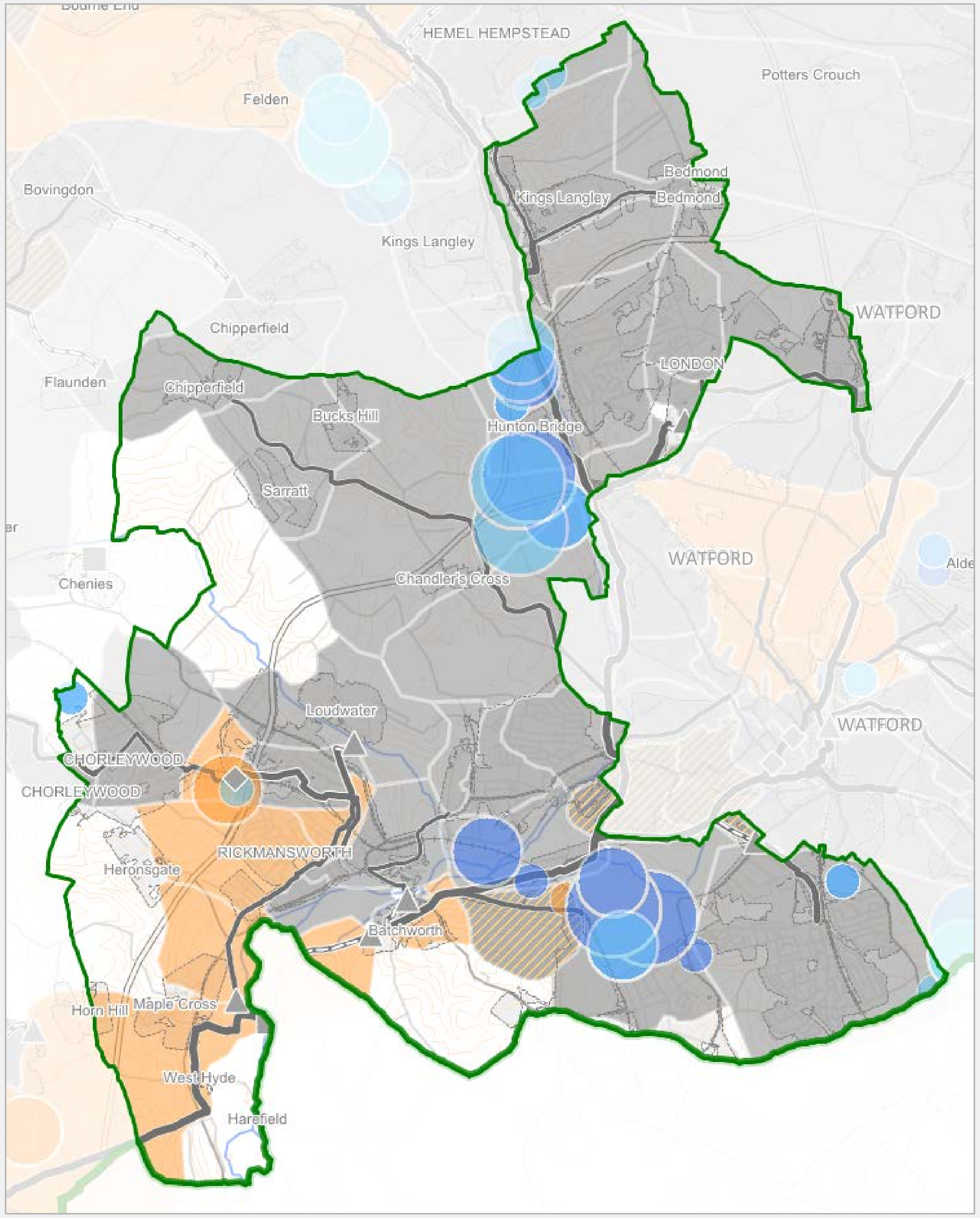
Strategic evaluation of supply / demand balance

No clear strategic infrastructure needs identified

8.8.5 Three Rivers Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Routine Investment / Focused Planning *(Low to High Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Focused Planning / Strategic Intervention *(Low to High Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*
- Indicative Growth Area - Low Scenario *(Relatively unconstrained)*
- Indicative Growth Area - Med Scenario *(Relatively unconstrained)*
- Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Targeted rainfall runoff reduction projects (Stevenage)

Trunk sewer upgrade works (downstream of Stevenage)

Provide strategic in-catchment storage (Stevenage)

Strategic rainfall runoff reduction investment

Peak flow capacity upgrade (all SPSs in district)

Evaluation / Upgrades to DWF and peak flow capacity and headroom (Rye Meads STW)

Explore Intelligent Network Control Systems (main trunk sewers from Welwyn Garden City and Stevenage)

No clear strategic infrastructure needs identified

Strategic additional resource / reduced demand investment

No clear strategic infrastructure needs identified

8.8.6 Three Rivers Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

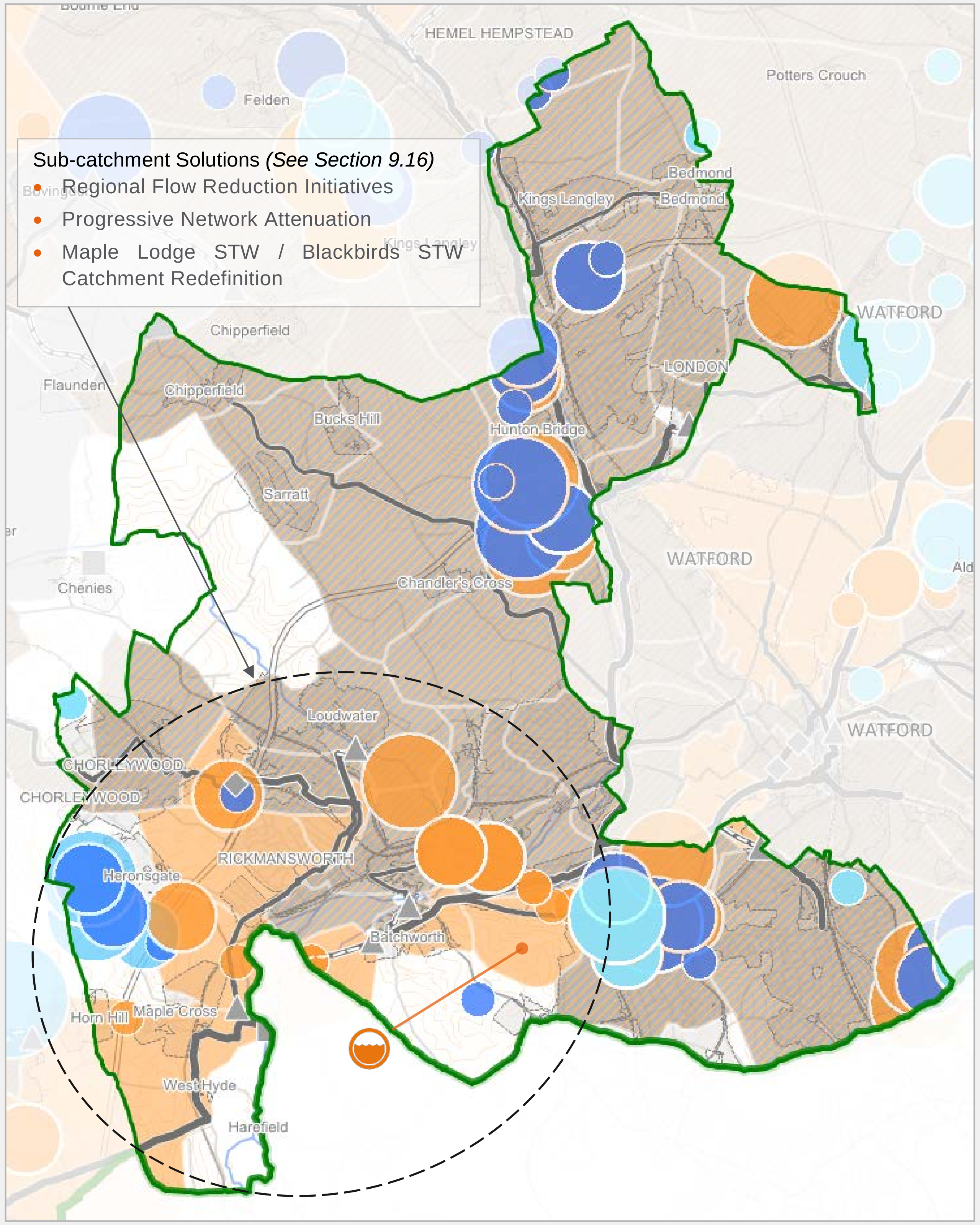
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Sewer upgrades / targeted rainfall runoff reduction projects (Tributary southeast of Amersham)

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

8.9 Watford

8.9.1 Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 57.

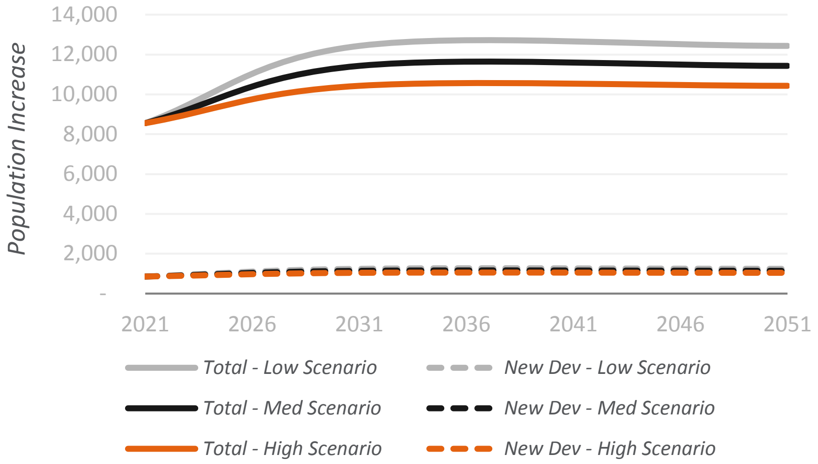


Figure 57 - Projected Population Increase for Watford

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 58.

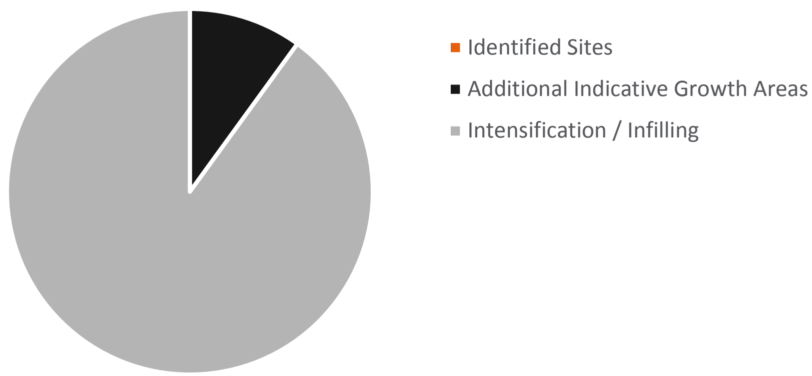


Figure 58 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Watford

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

All projected growth in Watford will be served by the existing sewer network. The majority of this district is located on the downstream section of two of the main trunk sewers discharging to Maple Lodge STW, both carrying foul flows from the majority of the Three Rivers, St Albans and Hertsmere districts. As a result, upgrades to the trunk network are likely to require strategic and long-term planning across all four districts.

The main outcomes from the evaluation of need for Watford as follows:

- The projected growth increase in the central area of Watford is likely to require strategic intervention from 2021 onwards to increase the capacity of the main sewer. To reduce the potential scale of any strategic interventions any re-development proposals should be used as opportunities to install rainwater harvesting systems and retro-fit

SuDS systems to limit the amount of rainfall runoff entering the foul sewers

- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the whole district (mainly to improve the capacity of Maple Lodge STW and the trunk sewer capacity downstream). This scale of intervention could require adaptation of local planning policies and / or housing development design methods to limit foul flows and promote large-scale water recycling.

8.9.2 Sewage Treatment

Maple Lodge STW is predicted to require at least focused planning from 2021 onwards to ensure it can accommodate expected growth. Under the high scenario, strategic interventions could be needed to ensure it has sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Maple Lodge STW	High			
	Med			
	Low			

Figure 59 – Watford STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.9.3 Water Resources

The availably of water resources in Watford is largely sufficient in 2021 but could require significant improvement by 2051, as with much of the county.

WRZ	2021	2031	2051
2			

Figure 60 – Watford WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

8.9.4 Watford Classification of Need – Immediate Recommendations (2021)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Focused Planning
(No Scenario variation)

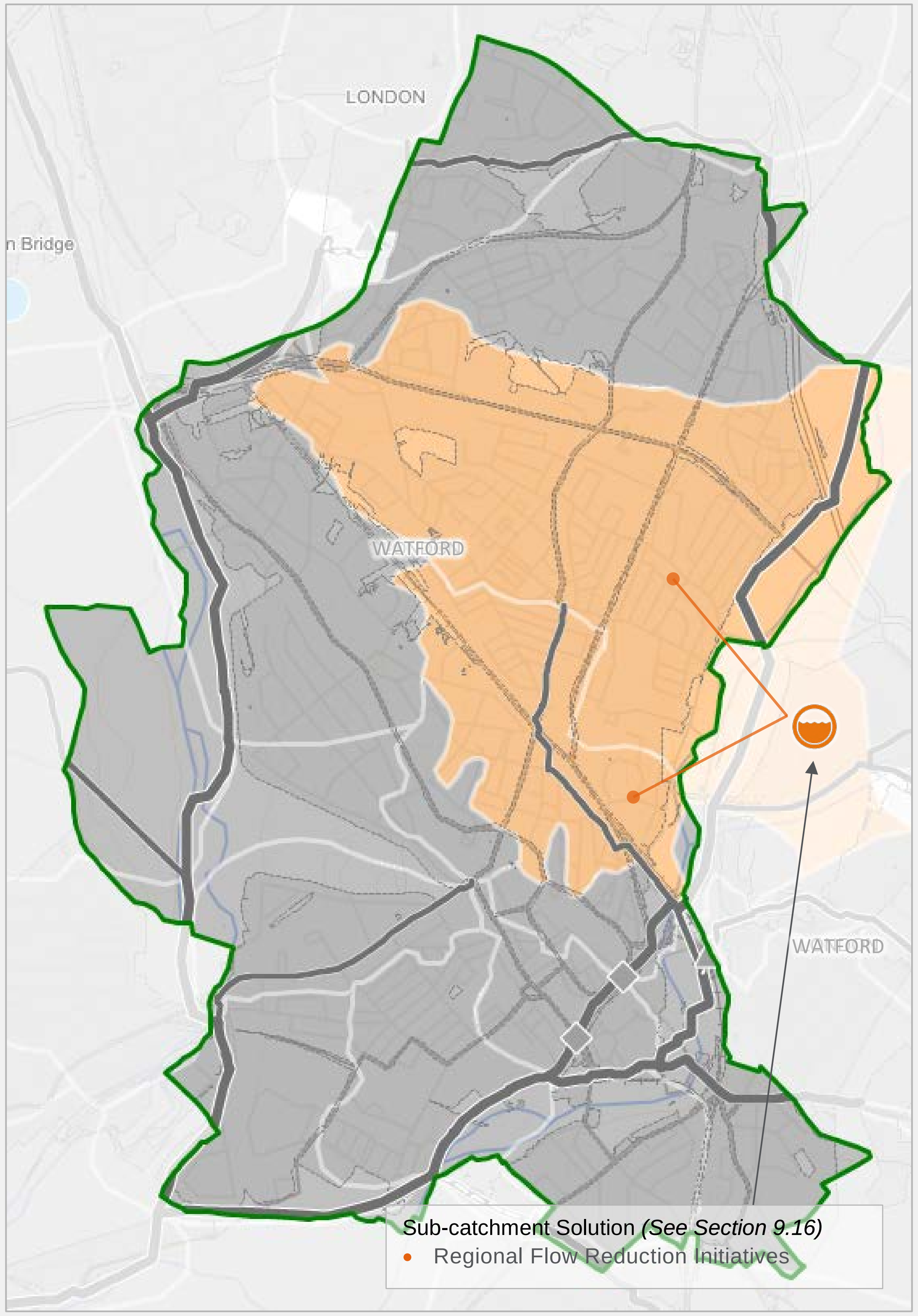
Strategic Intervention
(No Scenario variation)

Indicative Growth Area - Strategic Intervention required
(Potentially Constrained without investment)

Indicative Growth Area
(Relatively unconstrained)

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

Evaluation of trunk sewer capacity (Northern Watford and downstream of Watford to Maple Lodge STW)

No clear strategic infrastructure needs identified

Evaluation of DWF and peak flow capacity and headroom (Maple Lodge STW)

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

No clear strategic infrastructure needs identified

8.9.5 Watford Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

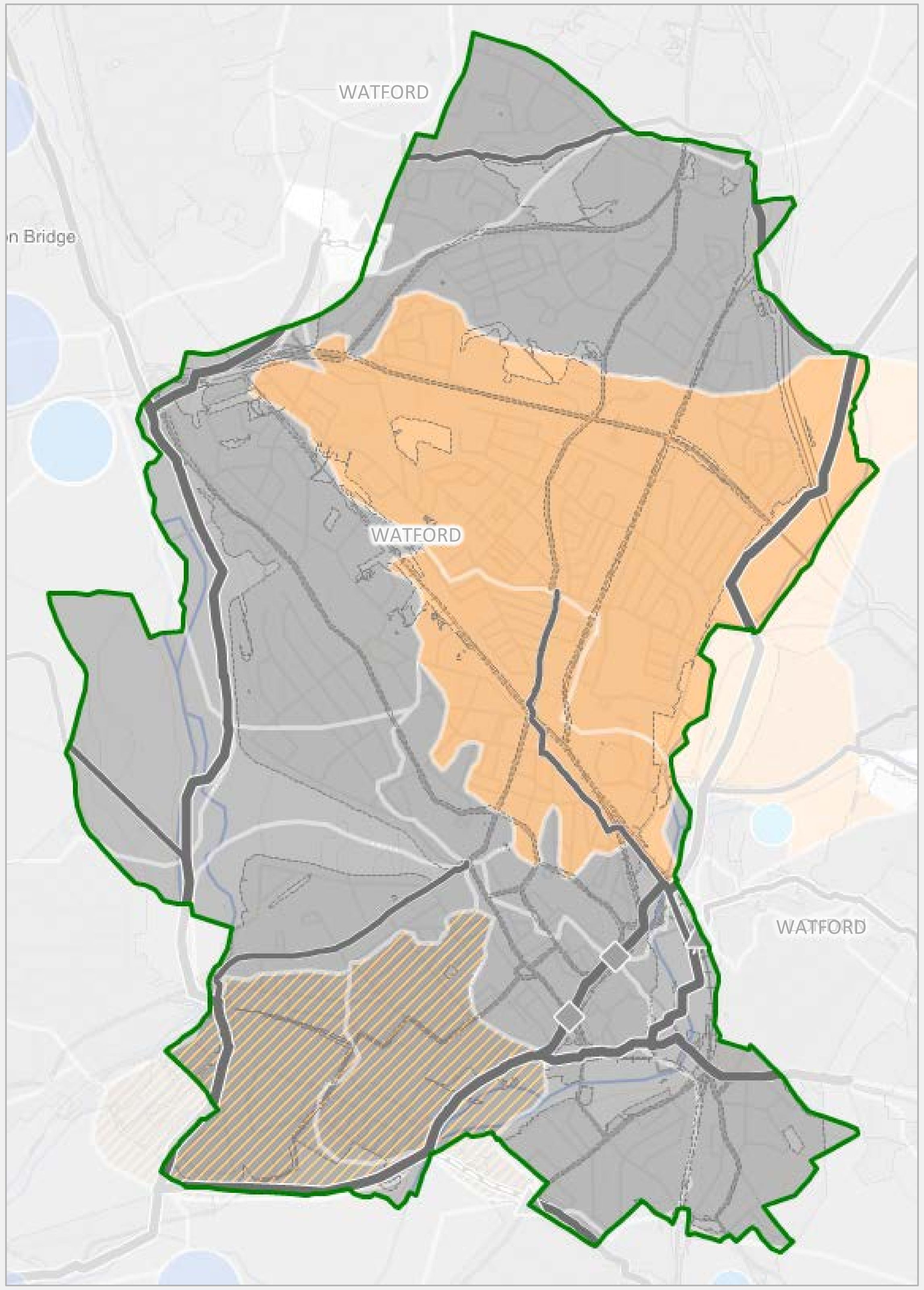
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Targeted rainfall runoff reduction investment (North Watford, west of the railway line)

Evaluation of trunk sewer capacity (Watford to Maple Lodge STW)

No clear strategic infrastructure needs identified

Upgrade of DWF capacity at Maple Lodge STW

No clear strategic infrastructure needs identified

Strategic evaluation of supply / demand balance

Targeted rainfall runoff reduction projects (catchments upstream of CSOs in Watford)

Strategic evaluation of STW FE discharge quality and storm discharges (Maple Lodge STW)

8.9.6 Watford Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment *(No Scenario variation)*

Routine Investment / Focused Planning *(Low to High Scenario variation)*

Focused Planning *(No Scenario variation)*

Focused Planning / Strategic Intervention *(Low to High Scenario variation)*

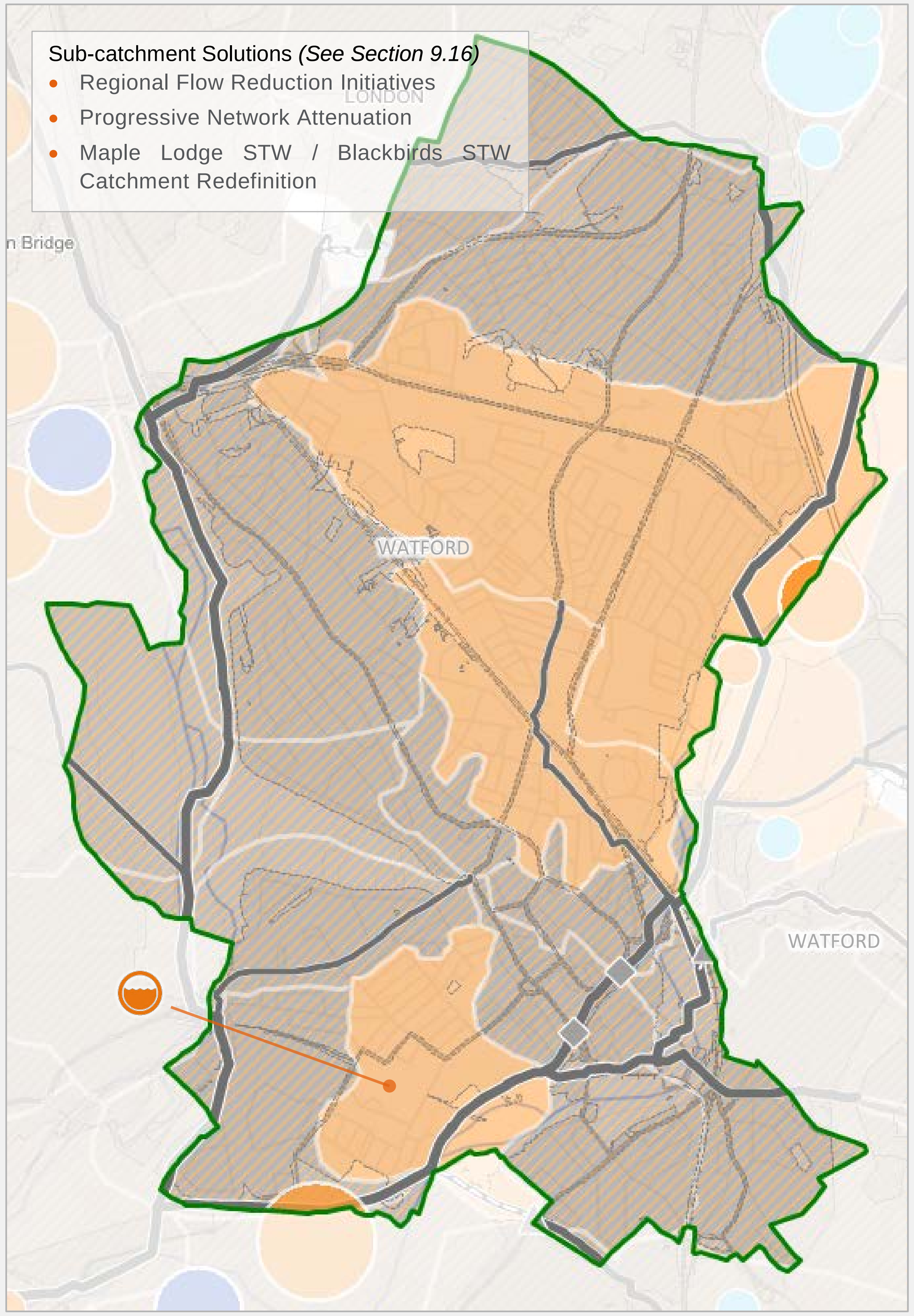
Strategic Intervention *(No Scenario variation)*

Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*

Indicative Growth Area - Low Scenario *(Relatively unconstrained)*

Indicative Growth Area - Med Scenario *(Relatively unconstrained)*

Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

- Trunk sewer upgrade works (northern Watford)
- No clear strategic infrastructure needs identified
- Strategic rainfall runoff reduction investment (this and all sub-catchments served by Maple Lodge STW)
- No clear strategic infrastructure needs identified
- Strategic additional resource / reduced demand investment
- No clear strategic infrastructure needs identified

8.10 Welwyn Hatfield

8.10.1 Assumptions & Projections

Detailed information on the derivation of population projections and growth strategies can be found in Section 6.1 and Appendix E. A summary of the projected population used in the modelling can be seen in Figure 61.

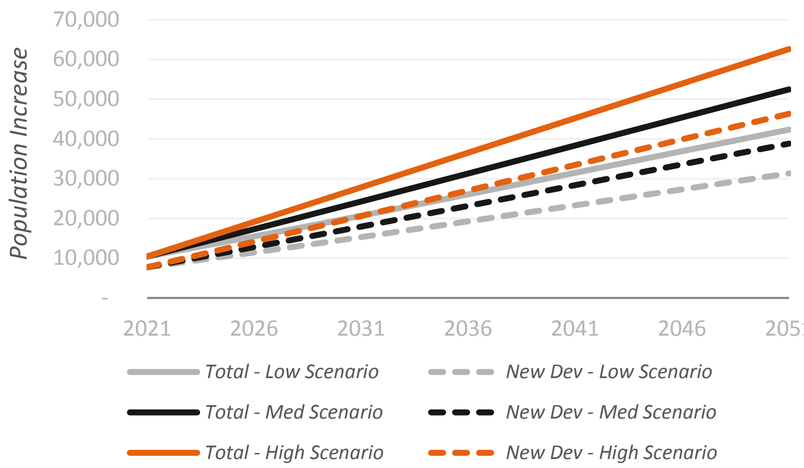


Figure 61 - Projected Population Increase for Welwyn Hatfield

Note: The 'New Dev' lines indicate the proportion of the total population projection that is expected to be delivered within new development sites, rather than within existing settlements (i.e. intensification / infilling)

Current planned and promoted development sites were provided by the districts and used to inform the creation of the indicative growth areas for the 2021 scenario, as detailed in Section 6.1.5. The split of population between identified sites, additional indicative growth areas (derived to apply remaining population not assigned to identified sites or intensification / infilling within existing settlements) and intensification / infilling of existing settlements can be seen in Figure 62.

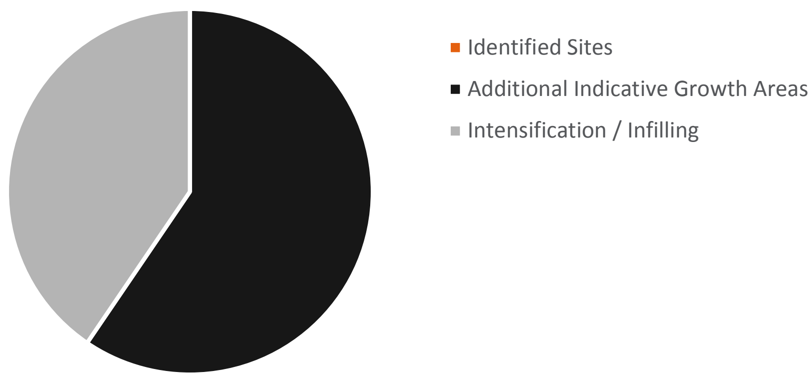


Figure 62 – Split Between Identified Development Sites and Other Types of Development Included to Apply the Projected 2021 Population to the Modelling for Welwyn Hatfield

Note: 'Identified sites' refers to the proportion of growth delivered by 2021 within defined geographical areas provided by the districts during consultation

Growth in Welwyn Hatfield is projected to be limited largely to existing settlements in 2021, after which indicative growth areas (identified to facilitate the modelling) have been identified northeast, southeast and east of Welwyn Garden City in 2031. Further indicative growth has been identified within an area north of Potters Bar for 2031. By 2051, indicative growth areas extend up the A1(M1) from Hatfield to the northern side of Welwyn Garden City, and extend across the southern end of the district.

The main outcomes from the evaluation of need for Welwyn Hatfield as follows:

- Growth along the A1 transport corridor is likely to require a range of strategic upgrades to sewerage ancillaries and networks
- Shifting proposed development areas from the A1 transport corridor westwards could reduce the likely scale of strategic interventions within

the existing network by providing opportunities to develop new dedicated sewerage systems

- Any development proposals to the northwest of Hatfield and north of Potters Bar have been evaluated as relatively unconstrained (by the wastewater system). These areas could become focal points for more large-scale developments for up to and including in 2051
- The evaluation indicates a large degree of uncertainty in 2051, with the high scenario demonstrating strategic intervention could be required across the southeast and north of the county (mainly to improve the capacity of Maple Lodge and Rye Meads STWs). This scale of intervention could require adaptation of local planning policies and / or construction methods to limit foul flows and promote water recycling

8.10.2 Sewage Treatment

All the major STWs are predicted to require at least focused planning from 2021 onwards to they can accommodate expected growth. Under the high scenario, strategic interventions could be necessary to ensure they have sufficient capacity in 2051.

STWs	Scenario	2021	2031	2051
Mill Green STW	High			
	Med			
	Low			
Rye Meads STW	High			
	Med			
	Low			
Maple Lodge STW	High			
	Med			
	Low			

Figure 63 – Welwyn Hatfield STW Classification of Need

Note: table only shows STWs which are predicted to require at least focused planning by 2051

8.10.3 Water Resources

The water resources in Welwyn Hatfield is likely to require strategic intervention by 2031 to ensure sufficient availability.

WRZ	2021	2031	2051
3			

Figure 64 – Welwyn Hatfield WRZ Classification of Need

Note: More information on the location, name and extent of the WRZs can be found in Section 6.3.

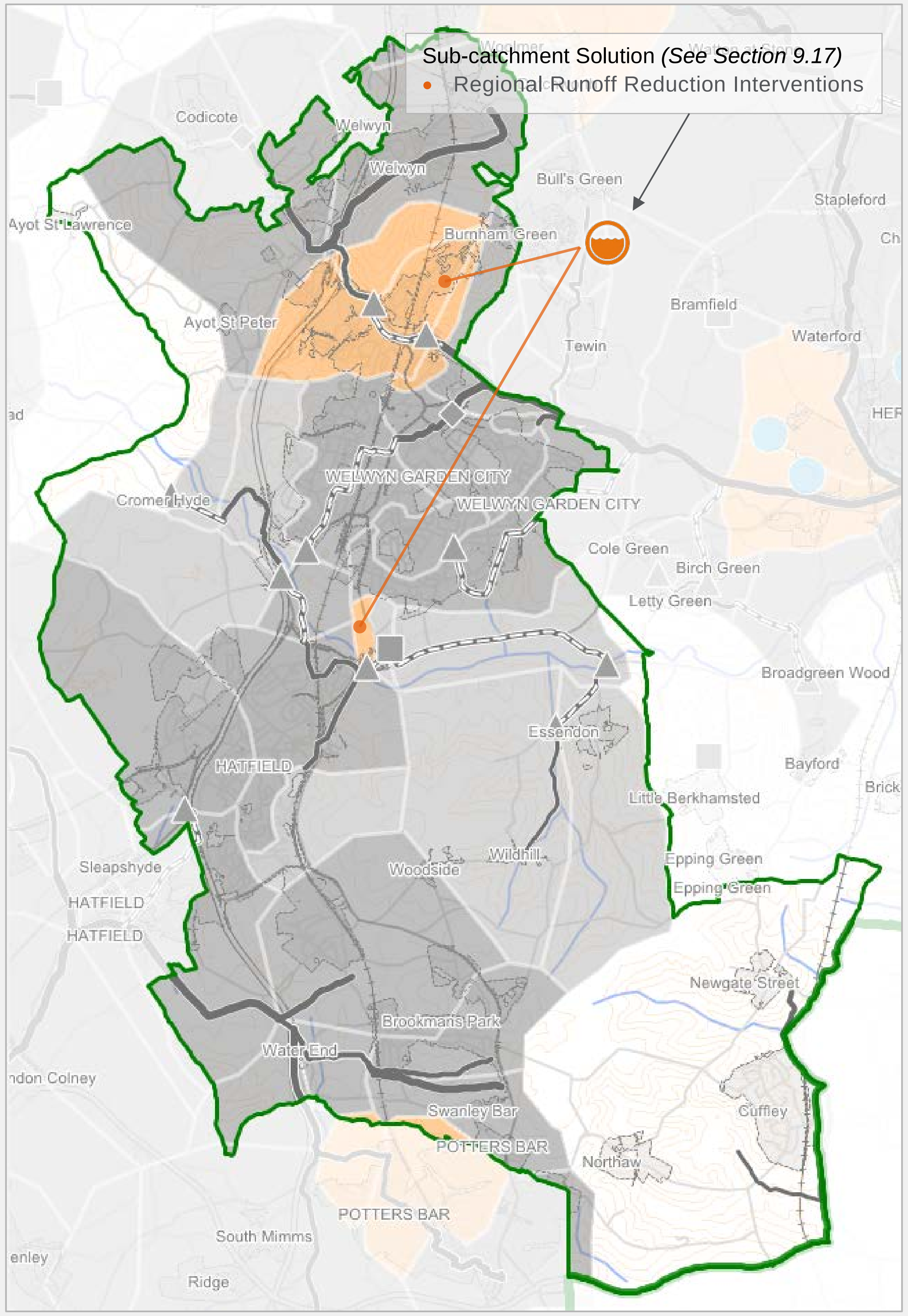
8.10.4 Welwyn Hatfield Classification of Need – Immediate Recommendations (2021)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Indicative Growth Area - Strategic Intervention required *(Potentially Constrained without investment)*
- Indicative Growth Area *(Relatively unconstrained)*

Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario



Water Infrastructure Needs

- Evaluation of trunk sewer capacity / upgrade works (immediately upstream of Mill Green STW from Hatfield)
- CSO Improvement works (Central Welwyn Garden City)
- Evaluation / Upgrades to DWF and peak flow capacity and headroom (Rye Meads STW)

  Explore Intelligent Network Control Systems (main trunk sewers from Welwyn Garden City and Stevenage)
- No clear strategic infrastructure needs identified
- Strategic evaluation of supply / demand balance
- Strategic evaluation of STW FE discharge quality and storm discharges (Bramfield STW)

  Evaluation of CSO discharges (CSOs discharging into the upper Mimram)

8.10.5 Welwyn Hatfield Classification of Need – Recommended Medium-Term Investment (2031)

District Plan

District Boundary

Study Boundary

Trunk Network

SPS

STW

CSO

Routine Investment
(No Scenario variation)

Routine Investment / Focused Planning
(Low to High Scenario variation)

Focused Planning
(No Scenario variation)

Focused Planning / Strategic Intervention
(Low to High Scenario variation)

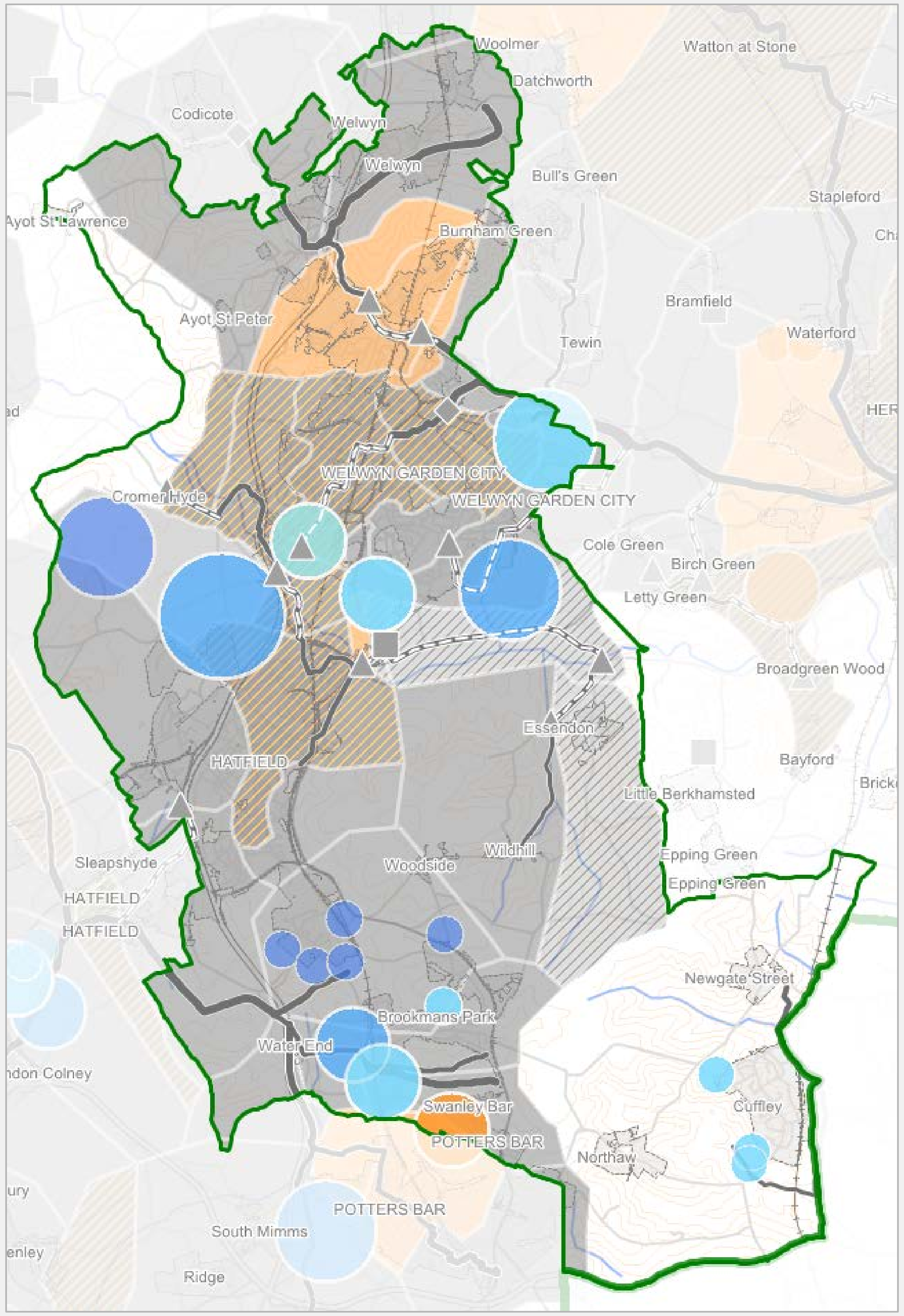
Strategic Intervention
(No Scenario variation)

Growth Area - Strategic Intervention required Med Scenario
(Potentially constrained without investment)

Indicative Growth Area - Low Scenario
(Relatively unconstrained)

Indicative Growth Area - Med Scenario
(Relatively unconstrained)

Indicative Growth Area - High Scenario
(Relatively unconstrained)



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

Trunk sewer upgrade works (Northern Hatfield to Mill Green STW / along A414)

Strategic rainfall runoff reduction investment (Hatfield)

Trunk sewer upgrade works (Northern Hatfield to Mill Green STW / along A414)

Strategic rainfall runoff reduction investment (Hatfield)

No clear strategic infrastructure needs identified

Strategic Foul Flow Reduction (Hatfield)

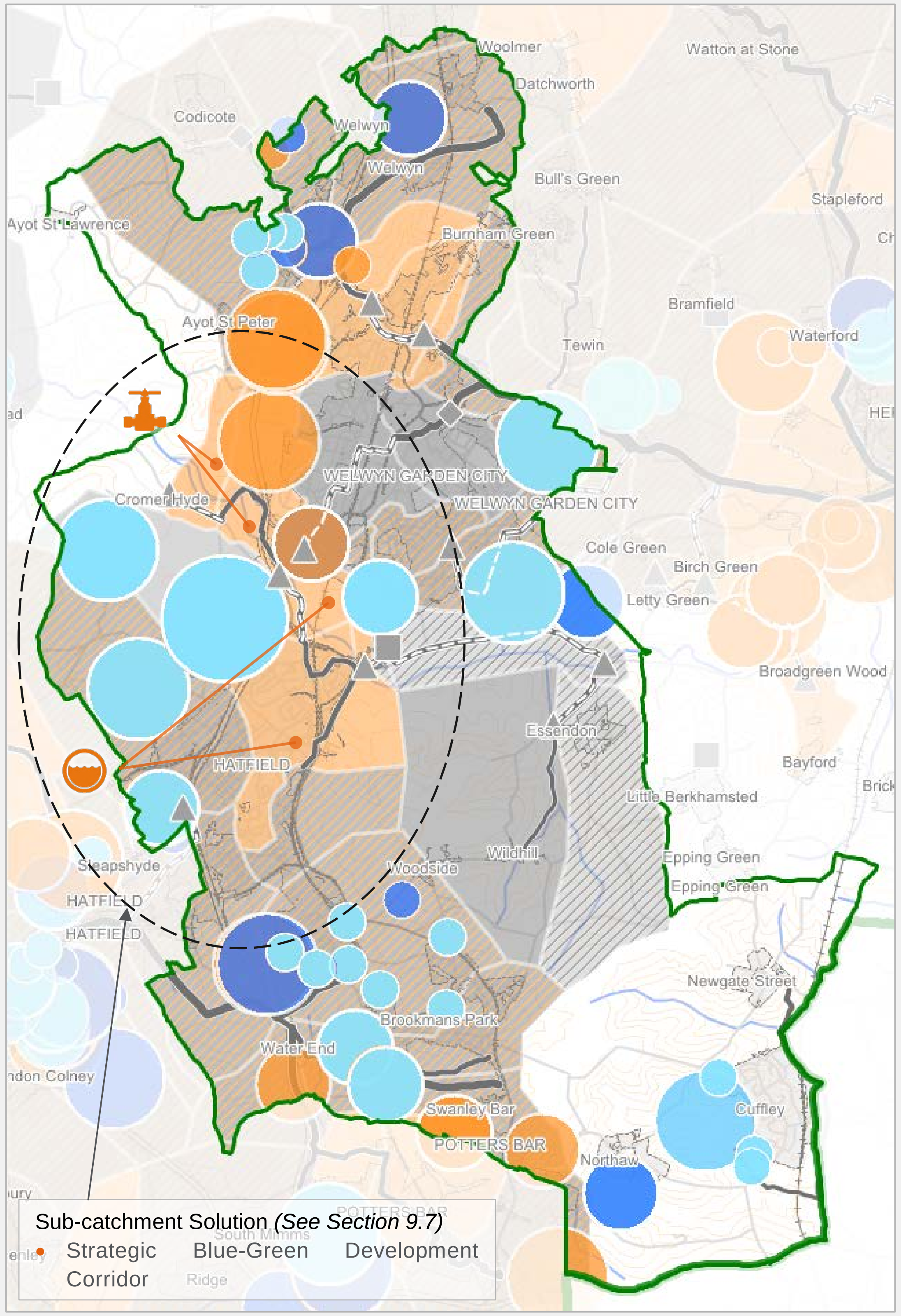
Strategic additional resource / reduced demand investment

Strategic rainfall runoff reduction investment (catchment served by Mill Green STW)

8.10.6 Welwyn Hatfield Classification of Need – Suggested Long-Term Considerations (2051)

District Plan

- District Boundary
- Study Boundary
- Trunk Network
- SPS
- STW
- CSO
- Routine Investment *(No Scenario variation)*
- Routine Investment / Focused Planning *(Low to High Scenario variation)*
- Focused Planning *(No Scenario variation)*
- Focused Planning / Strategic Intervention *(Low to High Scenario variation)*
- Strategic Intervention *(No Scenario variation)*
- Growth Area - Strategic Intervention required Med Scenario *(Potentially constrained without investment)*
- Indicative Growth Area - Low Scenario *(Relatively unconstrained)*
- Indicative Growth Area - Med Scenario *(Relatively unconstrained)*
- Indicative Growth Area - High Scenario *(Relatively unconstrained)*



Notes:

- The main water infrastructure function(s) resulting in the need for a Strategic Interventions have been identified using their relevant symbols
- The water infrastructure function symbols only shown for the relevant time horizon when a Strategic Intervention is first required
- The indicative growth areas represent a broad indication of the likely locations of development and do not represent specific sites for development, unless they have been provided by the districts for the 2021 scenario

Water Infrastructure Needs

- Trunk sewer upgrade works (Northern Hatfield to Mill Green STW / along A414)
- SPS upgrade schemes (Ayot St Peter and Cromer Hyde)
- No clear strategic infrastructure needs identified
- No clear strategic infrastructure needs identified
- No clear strategic infrastructure needs identified
- No clear strategic infrastructure needs identified

9 SUB-CATCHMENT SOLUTIONS

9.1 Overview

Major recommendations and water infrastructure requirements outlined in Section 8 have been used to identify a range of key strategic infrastructure solutions, applicable to specific 'sub-catchments'. These solutions are focused on major engineering and / or physical interventions. Many of these options will be tied in with broader water management and policy planning options, discussed later in Section 10.

The potential water cycle function benefits (*See Section 7.1.1*) for each solution has been stated, aiming to assist the selection process to ensure that all elements of the water cycle can be addressed through proactive interventions.

9.1.1 Solutions

Within the individual sub-catchment sections (See *Section 9.2 to Section 9.17*) the location and extent of potential options have been defined, including an outline of what they would entail to plan, design and implement, including a broad implementation strategy.

9.1.2 Evaluation Criteria

The necessary infrastructure engineering works across the whole water cycle up until 2051 will be extensive, driven by a wide variety

of economic and environmental mechanisms and varying levels of growth. Most of these interventions are likely to be required to address very specific issues with defined delivery scopes, within tight design constraints, construction programmes and performance criteria (e.g. construction a new storage tank at a SPS to reduce spills to a watercourse).

The focus of this study is primarily on identifying potential opportunities to implement multi-stakeholder multi-benefit schemes, drawing upon an integrated planning process to create a more sustainable and resilient water cycle to support development growth.

9.1.3 Sub-catchments

The identified sub-catchments (*See Section 4.6*), along with their name, a unique ID and the extent of sub-catchment (i.e. which districts are covered / partially covered) can be seen in Table 4. A plan showing their location and extent can be seen in Figure 65.

Some areas of Hertfordshire are not covered by defined sub-catchments due to the dominance of minor rural settlements served by minor sewerage infrastructure. The high-level assessment of capacity and performance is not suitable for the evaluation of these areas without introducing unacceptable levels of uncertainty, so they have been omitted at this stage.

ID	Sub-catchment Name	Extent of Sub-catchment
1	Amersham and Misbourne Valley	Chiltern / Three Rivers
2	Ash Valley Rural Settlements	East Hertfordshire
3	Berkhamsted	Dacorum / Chiltern
4	Bishop's Stortford	East Hertfordshire
5	Chesham and Upper Chess Valley	Dacorum / Chiltern
6	East Hatfield	Welwyn Hatfield
7	Harpenden	St Albans
8	Hemel Hempstead and Bulbourne Valley	Dacorum / Three Rivers / Watford
9	Hitchin and Letchworth Garden City	North Hertfordshire

ID	Sub-catchment Name	Extent of Sub-catchment
10	North East Hertfordshire Rural Settlements	East Hertfordshire / North Hertfordshire
11	St Albans and Upper Colne Valley	St Albans / Hertsmere / Welwyn Hatfield
12	Stevenage and Rural Area	Stevenage / East Hertfordshire / North Hertfordshire
13	Tring	Dacorum
14	Watford Urban Area	Watford / Hertsmere / Three Rivers / St Albans
15	Welwyn Garden City and Hertford Growth Area	East Hertfordshire / Welwyn Hatfield / North Hertfordshire

Table 4 - Schedule of Sub-catchments

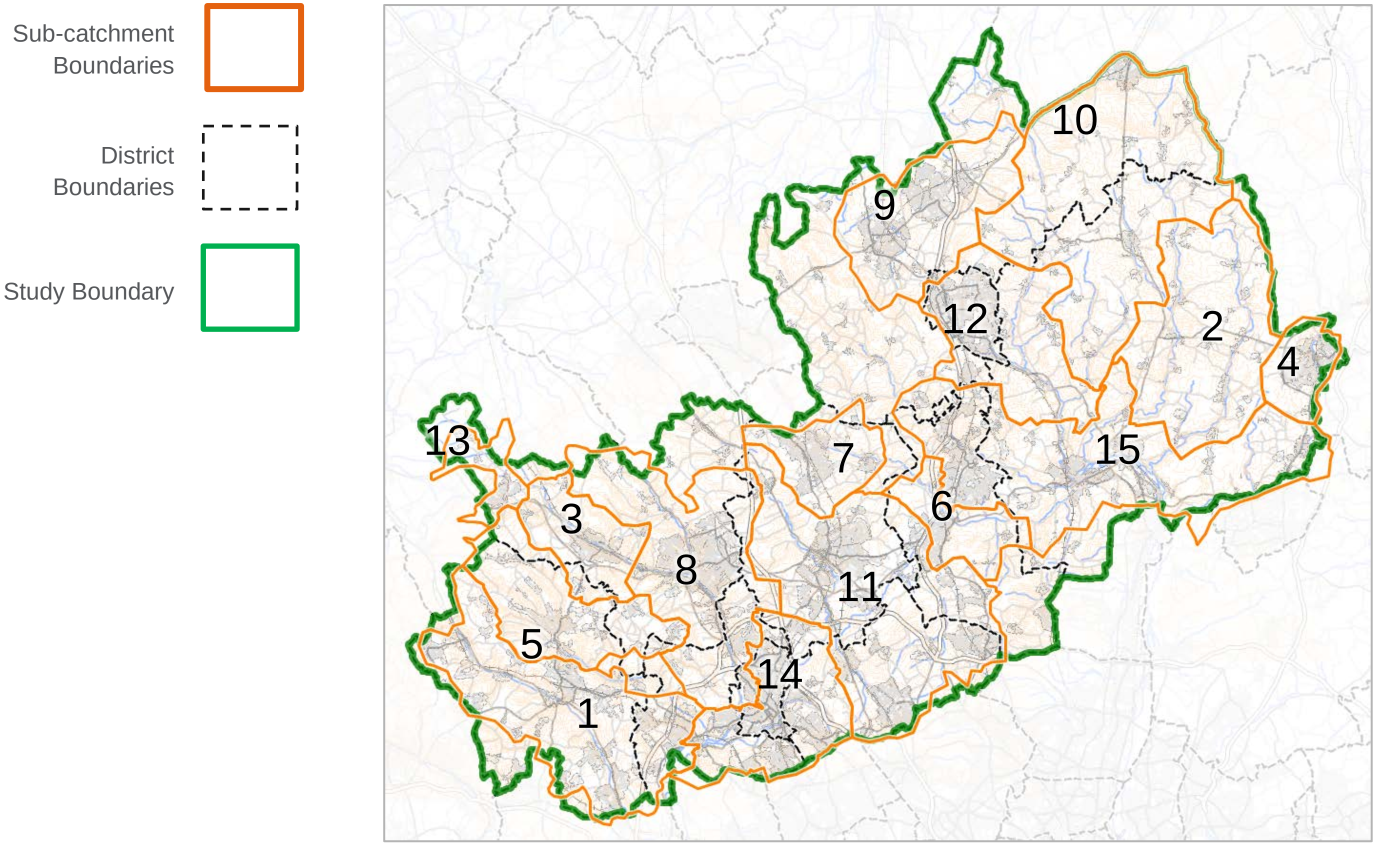


Figure 65 - Plan of Sub-catchments

9.2 Amersham & Misbourne Valley (1)

9.2.1 Sub-catchment Overview

This sub-catchment has been defined based on the natural Amersham Valley basin and covers approximately half of Chiltern and the western reaches of the Three Rivers district, including the following settlements:

- Amersham
- Gerrards Cross
- Chorleywood
- Rickmansworth
- Prestwood
- Little Kingshill
- High Wycombe

All foul flows are served by a single strategic trunk sewer which discharges into Maple Lodge STW.

The strategic water infrastructure needs are primarily likely to be increased network capacity, which will require specific planning and may require early implementation in 2021 to facilitate the extensive projected growth around Amersham, Chorleywood and Gerrards Cross.

More detailed information can be found in Section 8.1 and Section 8.8.

9.2.2 Sub-catchment Solutions

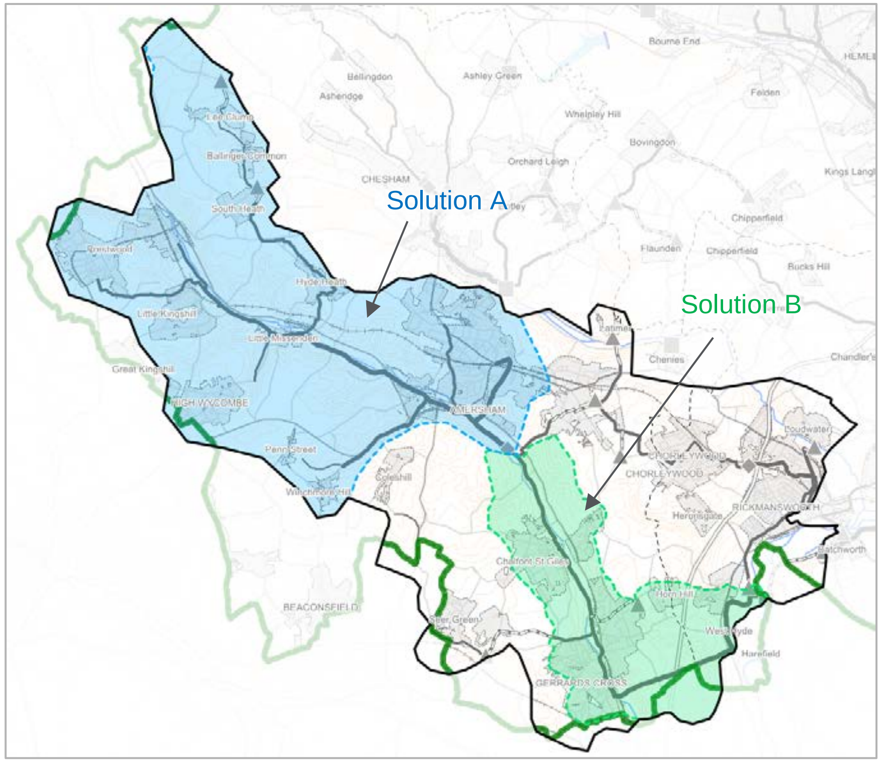


Figure 66 - Amersham & Misbourne Valley (1) Sub-catchment Solutions Plan

Solution A) Strategic STW Catchment Re-definition

Primary Functions

Secondary Function

Re-definition of the Maple Lodge STW catchment within the Amersham Valley could provide greater opportunities to balance investment in STW upgrades, reducing the net pressure on Maple Lodge STW from projected growth over much of Hertfordshire. This option would require the construction of an intermediate or terminal SPS on the main trunk sewer around the Amersham area which would pump flows out of the Amersham Valley, discharging into the Chesham STW (or nearby local sewers).

This re-definition could be implemented upstream of Amersham to limit the scale of investment or downstream of Amersham to maximise the potential benefit.

Planning & Implementation

As estimated implementation programme is shown below.

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation	■						
Design	■	■	■				
Implementation		■	■				

The design of this system would require the detailed evaluation of the operation, performance and condition of the trunk sewer network, including treatment capacity at Maple Lodge STW and Chesham STW. Thorough hydraulic modelling is essential within AMP6 to inform the design stage, ideally in AMP7.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on water quality (from foul discharges at CSOs and STWs).

Solution B) Strategic Trunk Sewer Upgrade / Intelligent Network Control System

Primary Function  Secondary Function 

Strategic trunk sewer upgrade to improve network capacity or the implementation of an intelligent network control system, commonly known as Active System Controls (ASC).

The ASC could be designed to address many aspects of sewerage management, helping to reduce foul discharges from CSOs in Amersham, alleviate surcharge in urban areas, prevent flooding, maximise the utilisation of existing storage capacity and reduce peak flows arriving at Maple Lodge STW.

Planning & Implementation

As estimated implementation programme is shown below.

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation	■						
Design	■	■	■				
Implementation		■	■	■			

The design of this system would require the detailed evaluation of the operation, performance and condition of the trunk sewer network, including Maple Lodge STW and catchment flow rates. Thorough hydraulic modelling would be essential within AMP6 to inform the design stage, spread across AMP7 and AMP8. The implementation strategy should be phased to enable the design to be adapted to optimise the performance of the system, as the early stages are complete.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on water quality (from foul discharges at CSOs and STWs).

Case Studies – Boulogne, Paris[24] / Portsmouth Early Warning System[25]

9.3 Ash Valley Rural Settlements (2)

9.3.1 Sub-catchment Overview

This sub-catchment has been defined based on the upper reaches of the Ash and Rib river basins, extending downstream to Widford and Wareside, comprised largely of villages and small towns, with a predominantly rural landscape. Most foul flow is served by small local networks linking a number of villages with dedicated STWs. There are no major trunk networks or sewage ancillaries.

The sub-catchment is entirely within East Hertfordshire, covering approximately one third of the district and including the following settlements:

- Puckeridge
- Standon
- Collier's End
- Barwick
- Wareside
- Great Hormead
- Braughing
- Little Hadham
- Much Hadham
- Petty Green

The strategic water infrastructure needs are the long-term management of foul and treated discharges and the availability of water. Growth is projected to be relatively minor and distributed, so broad adaptive improvements may be necessary by 2051, including potentially improving groundwater aquifer recharge.

It is likely that continual short-term investments should be sufficient to accommodate the majority of projected growth in this sub-catchment. This could include a programme of miss / illegal connections remediation and localised runoff separation schemes, to maximum the capacity of the current system.

More detailed information can be found in Section 8.3.

9.4 Berkhamsted (3)

9.4.1 Sub-catchment Overview

This sub-catchment has been defined based on the north and south lateral watersheds of the River Bulbourne, extending from Bourne End to Tring, and including the entire urban area of Berkhamsted. All foul flows are served by a single strategic trunk sewer which runs along the valley bottom, discharges into Berkhamsted STW.

The sub-catchment is largely within Dacorum but also include Ashley Green, which is in Chiltern. This sub-catchment includes the following settlements:

- Berkhamsted
- Northchurch
- Wigginton
- Dudswell
- Ashley Green
- Potten End

[24] Real Time Control of the Sewer System of Boulogne Billancourt – A Contribution to Improving the Water Quality of the Seine, (Link)

[25] Southern Water – Management of Wastewater in Portsmouth and Havant, 2011 (Link)

The strategic water infrastructure needs are primarily network capacity, potentially requiring major investment in 2031 and beyond to accommodate the projected growth.

The main trunk sewer and supporting ancillaries are constrained along the valley bottom, which highlights the necessity to consider addressing the source of flow as well as addressing any performance issues, through engineering upgrades to the capacity of the system.

The quantum of growth projected around Berkhamsted could also increase foul and treated discharges to the River Bulbourne and its tributaries by 2031

Future upgrades are likely to rely heavily on engineering upgrades although small-scale flow reduction schemes should be considered as part of any works to reduce discharge from CSOs / Berkhamsted STW.

9.5 Bishop’s Stortford (4)

9.5.1 Sub-catchment Overview

This sub-catchment covers Bishop’s Stortford and the immediate rural areas to the west, including the following settlements:

- Bishop’s Stortford
- Thorley
- Spellbrook

The strategic water infrastructure needs are likely limited to local ancillary upgrades to match growth in 2051. It is likely that continual short-term investments should be sufficient to accommodate projected growth in this sub-catchment, the specific requirements being detailed in Section 8.3.

9.6 Chesham and Upper Chess Valley (5)

9.6.1 Sub-catchment Overview

This sub-catchment has been defined based on the upper reaches of the River Chess valley basin, including the town of Chesham. All foul flows are served by a single sewer network which discharges into Chesham STW. The sub-catchment is largely within Chiltern, but also includes a small proportion of south west Dacorum, and the following settlements:

- Chesham
- Chartridge
- Buckland Common
- Bellingdon
- Bovingdon
- Chipperfield
- Ley Hill
- Flaunden

The strategic water infrastructure needs are likely to be limited to local network and ancillary upgrades to match growth projections from 2021 through to 2051.

It is likely that continual short-term investments should be sufficient to accommodate projected growth in this sub-catchment, the specific requirements being detailed in Section 8.1.

9.7 East Hatfield (6)

9.7.1 Sub-catchment Overview

This sub-catchment has been defined based on the Mill Green STW catchment, serving northern Hatfield and the western fringe of Welwyn Garden City. This sub-catchment is entirely within Welwyn Hatfield district.

The strategic water needs are primarily network and ancillary capacity in 2051. The scale of potential investment required to match the quantum of growth could be substantial and heavily focused around the western fringes of Welwyn Garden city. This area is constrained between Welwyn Garden City, Hatfield, the River Lee floodplain and the A1(M) transport corridor.

Growth in this region of Hertfordshire should be planned alongside strategic consideration for local flood risk and the capacity of the existing sewerage system.

More detailed information can be found in Section 8.10.

9.7.2 Sub-catchment Solutions

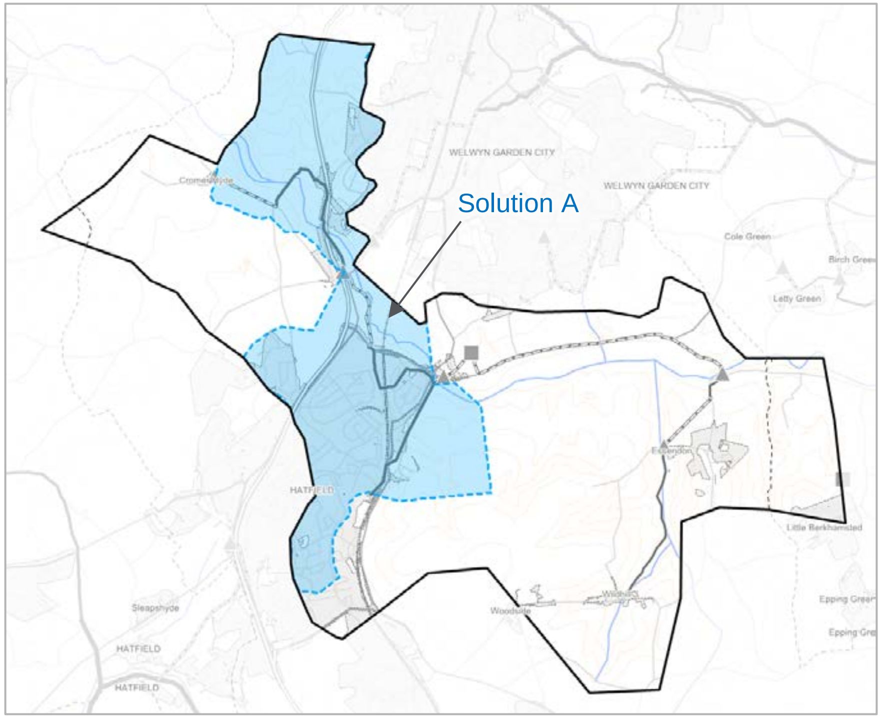


Figure 67 - East Hatfield (6) Sub-catchment Solutions Plan

Solution A) Strategic Blue-Green Development Corridor

Primary Function

Secondary Functions

Long-term development of a blue-green corridor adjacent to the River Lee between Hatfield and Welwyn Garden City to provide strategic and sustainable drainage infrastructure to support long-term growth proposals.

A strategic blue-green corridor could be developed adjacent to the River Lee, sensitively constructed within the existing natural environment to provide a platform for sustainable long-term local growth. The design could be based around the use of a series of detention basins, linked with the River Lee, the excavation material from which could be used to create elevated plateaus for potential developments sites (protecting them from fluvial flooding and opening up new development land closer to the watercourse).

The creation of a naturalised corridor would help maintain separation between Hatfield and Welwyn Garden City. It could also help preserve a wildlife corridor to boost local amenity and biodiversity.

For many areas along the Lower Lee, particularly through Hertford, the risk of flooding is likely to be critical in site selection. An effectively designed wetland and natural treatment processes along the Lee and Mimram could be integrated into a larger flood risk management strategy.

Planning & Implementation

As estimated implementation programme is shown below.

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping		■					
Consultation		■	■				
Design			■	■	■		
Implementation				■	■		

Such an approach would require extensive consultation and planning to integrate the needs and constrains of the local environment and community. The land take would likely require purchases from local land owners, plus ensuring any construction works would not significantly damage the local riverine and terrestrial ecosystems, or the river morphology or the Lee and Mimram.

This solution could be led by either Hertfordshire County Council or Welwyn Hatfield district. The Environment Agency would be key to the design and implementation of new blue-green components, specifically those aimed at promoting treatment and providing supplementary flood risk benefits. Thames Water would need to contribute to the design of collection systems and the long-term planning for potential development wastewater infrastructure.

9.8 Harpenden (7)

9.8.1 Sub-catchment Overview

This sub-catchment is based around Harpenden and the immediate rural areas to the southeast and east, including the following settlements:

- Harpenden
- Mackerye End
- Childwick Green

All foul flows are served by a single sewer network which discharges into Harpenden STW. The sub-catchment is located on the upper-middle reaches of the Lee Valley

The strategic water infrastructure needs are likely to be limited to local network upgrades, potentially requiring focused planning from 2021. It is likely that continual short-term investments should be sufficient to accommodate projected growth in this sub-catchment, the specific requirements being detailed in Section 8.6.

9.9 Hemel Hempstead and Bulbourne Valley (8)

9.9.1 Sub-catchment Overview

This sub-catchment has been defined based on the upper reaches of the River Bulbourne, extending downstream to the northwest fringes of Watford. All foul flows are served by a single sewer network, part of the larger strategic network which discharges into Maple Lodge STW.

The sub-catchment extends over the eastern half of Dacorum and northern areas of Three Rivers, and comprises a mixture of urban, rural and forested land.

This sub-catchment includes the following settlements:

- Hemel Hempstead
- Kings Langley
- Chandler's Cross
- Abbots Langley
- Bourne End
- Great Gaddesden
- Little Gaddesden

The strategic water infrastructure needs are likely to be short-term water quality, within the upper reaches of the River Gade through into central Hemel Hempstead, and long-term treatment capacity at Maple Lodge STW.

Water quality could become a major driver of investment due to the current poor classification of the River Gade (in this location) and the indicative growth areas within the northern area of Hemel Hempstead, which may increase foul discharges.

9.9.2 Sub-catchment Solutions

Solution A) Strategic Surface Water Storage

Primary Function

Secondary Function

New permanent surface water storage reservoir(s), with associated transfer pipelines and new WTW(s) or upgrades to existing WTW(s).

The construction of new surface water storage facilities could reduce the long-term reliance on water imports and help ensure the security of water supply during times of regional drought.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation		■	■	■			
Design			■	■			
Implementation			■	■	■		

The planning process is likely to be long so early consideration is essential. Detailed and extensive hazard and risk assessment is necessary. Water resource availability will require strategic intervention across the whole of Hertfordshire by 2051, and within the eastern districts by 2031.

This solution would be led by Affinity Water in consultation with the Environment Agency.

Case Studies – Lincolnshire[26] / Barrhead[27]

[26] Edie.net – Lincolnshire's new Reservoir to Secure Water Supply for Area's Growing Industry, 2013 (Link)

[27] Scottish Water – Major Project Progressing in East Renfrewshire, 2016 (Link)

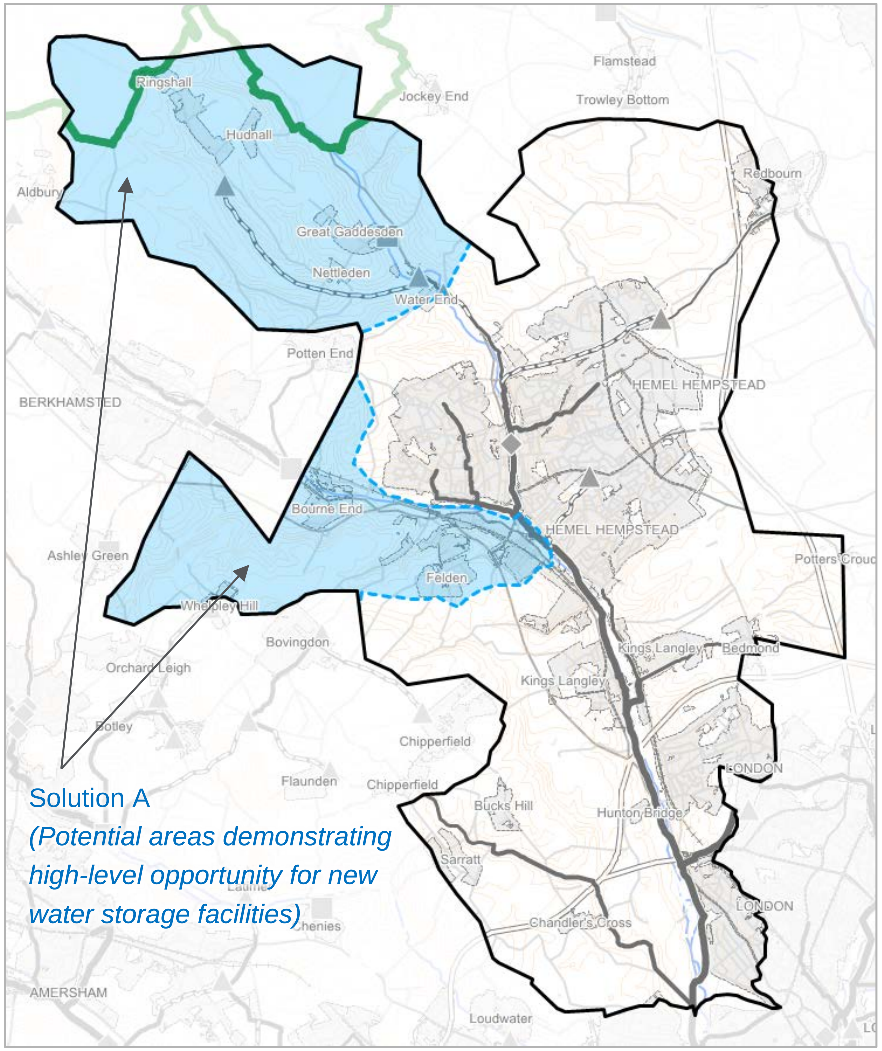


Figure 68 - Hemel Hempstead and Bulbourne Valley (8) Sub-catchment Solutions Plan

9.10 Hitchin and Letchworth Garden City (9)

9.10.1 Sub-catchment Overview

This sub-catchment has been defined based on the sewerage networks serving Hitchin and Letchworth Garden City, including surrounding rural areas. The sub-catchment is entirely within North Hertfordshire, covering the upper reaches of the River Hiz and Ivel, and including the following settlements:

- Hitchin
- Letchworth Garden City
- Baldock
- Charlton
- St Ippolyts
- Little Wymondley
- Graveley

The strategic water infrastructure needs are likely to primarily be local network capacity which may need focused planning to support growth for 2021 and beyond. More broadly, water quality may need strategic intervention in 2031, to address potential increases in foul discharges due to growth around the Hitchin and within Letchworth Garden City.

9.10.2 Sub-catchment Solutions

Growth is projected to be significant and broad adaptive improvements may be necessary by 2051. It is likely that continual short-term investments should be sufficient to accommodate the majority of projected growth.

More detailed information can be found in Section 8.5.

9.12 North East Hertfordshire Rural Settlements (10)

9.12.1 Sub-catchment Overview

This sub-catchment covers the largely rural areas of North Hertfordshire and East Hertfordshire not covered by other sub-catchments. This sub-catchment includes a variety of watercourses and number of villages, including the following:

- Royston
- Wallington
- Therfield
- Barley
- Reed
- Mill End
- Cottered
- Buntingford
- Wyddial
- Dane End

Foul flows are largely served by local sewer networks served by STWs.

The strategic water infrastructure needs are likely to be improved long-term management of foul and treated discharges and the availability of water. Growth is projected to be minor and relatively distributed. Broad adaptive improvements may be necessary by 2051, including improving groundwater aquifer recharge.

It is likely that continual short-term investments should be sufficient to accommodate the majority of projected growth.

This could include a programme of miss / illegal connections remediation and localised runoff separation schemes, to maximum the capacity of the current system.

More detailed information can be found in Section 8.3 and Section 8.5.

9.13 St Albans & Upper Colne Valley (11)

9.13.1 Sub-catchment Overview

This sub-catchment has been defined based on the extent of the trunk sewer network discharging to Maple Lodge STW, upstream of the Blackbirds SPS, which includes St Albans, Hatfield, Potters Bar, London Colney, Borehamwood and Radlett. It covers the majority of the St Albans district, the eastern half of Hertsmere and the south-west section of Welwyn Hatfield, and includes the following settlements:

- St Albans
- Hatfield (west)
- Potters Bar
- Borehamwood
- Radlett
- Brookhams Park
- Redbourn
- Shenley

The strategic water infrastructure needs are likely to primarily be network capacity, requiring specific intervention for 2021 and more widespread investment for 2051 to facilitate the extensive projected growth around St Albans, Potters Bar, Radley and South Colney.

9.13.2 Sub-catchment Solutions

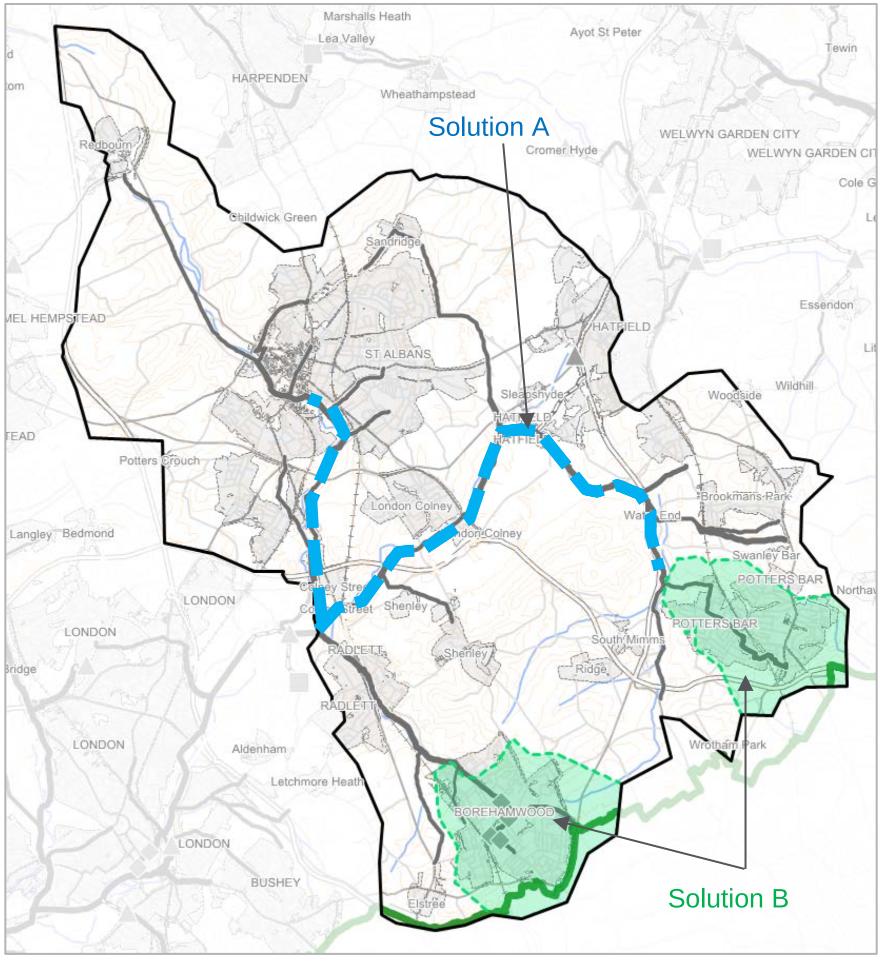


Figure 69 - St Albans & Upper Colne Valley (11) Sub-catchment Solutions Plan

Solution A) Blackbirds STW Intelligent Network Control System

Primary Function

Secondary Functions

An intelligent network control system, commonly known as Active System Controls (ASC) can be designed to address many aspects of sewerage management, helping to reduce foul discharges from CSOs and STWs, alleviate surcharge in urban areas, prevent flooding, maximise the utilisation of existing storage capacity and reduce peak flows arriving at Blackbirds STW and Maple Lodge STW.

An ASC system could control of foul flows within the three main tributaries serving St Albans, Borehamwood, Potters Bar and Hatfield, in order to better manage peak foul flows and storm conditions. The main aim of this option would be to fully utilise the capacity of the existing network and ancillaries.

Planning & Implementation

As estimated implementation programme is shown below.

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation	■						
Design	■	■	■				
Implementation		■	■	■			

The design of this system would require the detailed evaluation of the operation, performance and condition of the trunk sewer network, including Blackbirds SPS and catchment flow rates. Thorough hydraulic modelling would be essential within AMP6 to inform the design stage, spread across AMP7 and AMP8. The implementation strategy should be phased to enable the design to be adapted to optimise the performance of the system, as the early stages are complete.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on spills to the environment.

Case Studies – Boulogne, Paris[28] / Portsmouth Early Warning System[29]

Solution B) Regional Flow Reduction Interventions

Primary Functions  Secondary Functions 

Removal of non-foul flows (from the two catchments shown), focusing on separation of storm runoff, infiltration reduction and removal of illegal connections.

Delivering runoff reduction through separation can be undertaken as a strategic catchment investment or be more targeted, based on the needs of a specific function (e.g. reducing CSO discharges). Alternatively, or in addition to, gradual reductions in rainfall runoff could be achieved by separating drainage and delivering SuDS schemes in an opportunistic manner, through collaboration with developers, the Highways England and SuDS incentives.

Planning & Implementation

As estimated implementation programme is shown below.

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■	■	■	■	■		
Consultation	■				■		
Design	■	■			■	■	
Implementation	■	■			■	■	

The two areas of Borehamwood and Potters Bar should be implemented in a staged manner to allow innovative construction and funding approaches to be explored and fed back through the planning process.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on spills to the environment.

Case Studies – Dwr Cymru Welsh Water RainScape Solutions[30] / Malmo Urban Storm Water Management Project[31] / Portland Downspout Disconnection Programme[32]

[28] Real Time Control of the Sewer System of Boulogne Billancourt – A Contribution to Improving the Water Quality of the Seine, (Link)
[29] Southern Water – Management of Wastewater in Portsmouth and Havant, 2011 (Link)

[30] Dŵr Cymru / Welsh Water – RainScape (Link)
[31] European Climate Adaptation Platform – Urban Storm Water Management in Augustenborg, Malmo, 2014 (Link)
[32] City of Portland – Downspout Disconnection Programme (Link)

9.14 Stevenage & Rural Area (12)

9.14.1 Sub-catchment Overview

This sub-catchment has been defined based on the extent of the Stevenage wastewater drainage system, including the main trunk sewer to the south and rural areas it serves, including the following settlements:

- Stevenage
- Knebworth
- Watton at Stone
- Benington
- Hebing End

The strategic water needs are likely to primarily be network capacity, requiring specific intervention for 2021 and more widespread investment through 2031 and into 2051 to facilitate the projected growth in Stevenage.

9.14.2 Sub-catchment Solutions

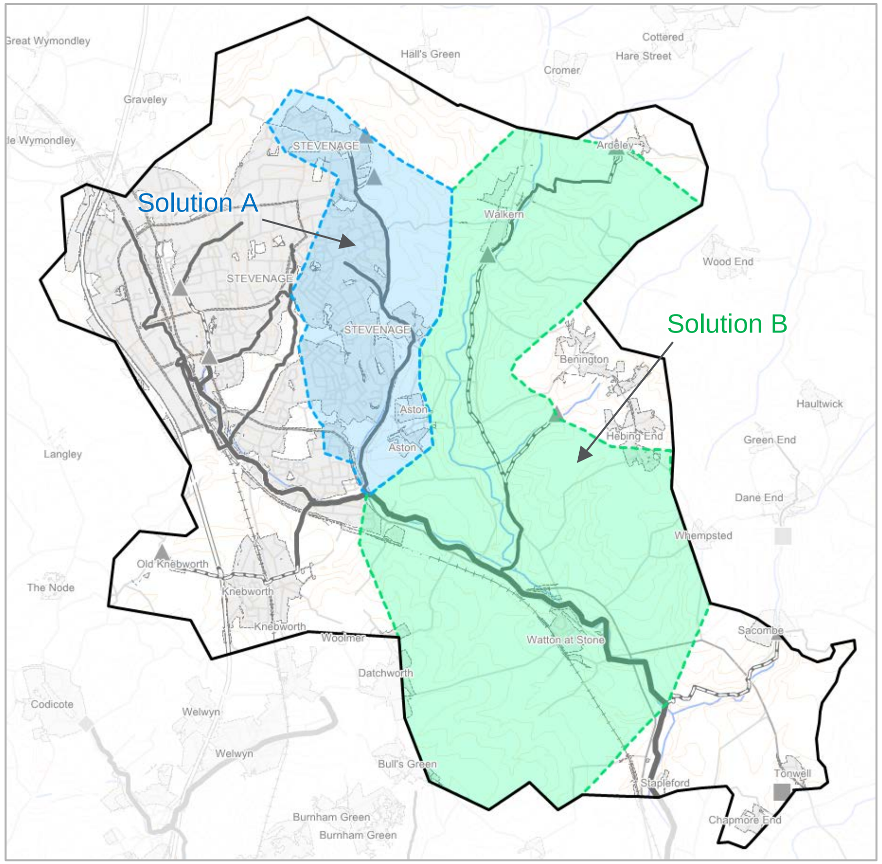


Figure 70 - Stevenage & Rural Area (12) Sub-catchment Solutions Plan

Solution A) Strategic Surface Water System Attenuation Retro-fit and Groundwater Reinjection

Primary Function  Secondary Functions 

The adaptation of the extensive surface water system within Stevenage to provide runoff for re-injection into the chalk aquifer, with the provision of SuDS systems within the catchment to provide additional capacity to support the projected growth.

This would involve the collection of surface water runoff from Stevenage within a series of impermeable attenuation basins, within the upper reaches of the Beane and along the north-eastern fringes of Stevenage. All runoff should be passed through semi-permeable constructed wetlands (for treatment), before being either re-injected into the groundwater aquifer or discharging into the Beane (depending on flow and rainfall conditions).

Schemes would include of a range of SuDS components within existing surface water networks and at key discharge locations, combining natural techniques with physical storage mechanisms. SuDS could be implemented throughout urban areas and designed to suit challenging urban constraints. Infiltrating SuDS mechanisms should be included with a SuDS management train at the lower end, allowing for natural treatment of typical urban pollutants such as hydrocarbons and contaminants.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■	■					
Consultation	■	■	■	■	■	■	
Design		■	■	■	■	■	
Implementation		■	■	■	■	■	■

All SuDS components are likely to be bespoke and the design stage will need to reflect this. A clear implementation strategy is necessary to inform the phased construction to deliver large-scale reductions.

A high-level assessment of potential locations, both within Stevenage and along it's periphery, is essential to prioritise planning and investment. Locations should be matched with development projections, to optimise their potential use, with the multi-benefit potential of SuDS forming the basis for design selection.

Open discussions with developers could be used to identify collaborative opportunities to develop water sensitive improvements to both the existing and new systems. All design approaches should prioritise SuDS over piped drainage.

Solution B) Intelligent Network Control System

Primary Function

Secondary Function

Intelligent network control system implemented within the main trunk sewer, with the aim of better managing peak foul and storm flows, fully utilising its current capacity and engaging greater attenuation upstream within Stevenage.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation	■						
Design	■	■	■				
Implementation		■	■	■			

The design of this system would require the detailed evaluation of the operation, performance and condition of the trunk sewer network, including Rye Meads STW and catchment flow rates. Thorough hydraulic modelling would be essential within AMP6 to inform the design stage, spread across AMP7 and AMP8. The implementation strategy should be phased to enable the design to be adapted to optimise the performance of the system, as the early stages are complete.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on water quality (from foul discharges at CSOs and STWs).

Solution C) River Bean Restoration

Primary Function

Secondary Function

Continued logistical and financial support of ongoing restoration projects aiming to re-naturalise the river catchment, helping to promote greater long-term groundwater aquifer recharge.

The planning and design should be undertaken in collaboration with the Living Rivers initiative, run by the Herts and Middlesex Wildlife Trust and the River Beane Restoration Association.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation	■						
Design		■					
Implementation		■	■	■	■	■	■

A phased approach to construction would be recommended. Long-term monitoring would be necessary to ensure it functions as expected and is contributing to aquifer recharge. Continual maintenance and upgrade works would be likely due to the dynamic nature of riverine systems, adapting to changing local and regional conditions and demands.

An extensive hydrological and ecological survey of the Beane would be necessary to understand morphological processes and how they could be restored. Key sections along the river where remediation works would be feasible, given constraints on land ownership and access, would need to be clearly identified.

A board partnership, potentially including local resident groups, would need to be developed to plan and steer the project.

9.15 Tring (13)

9.15.1 Sub-catchment Overview

This sub-catchment covers Tring and the rural area to the northwest, and is entirely within Dacorum.

The evaluation identified limited strategic water infrastructure need and it is considered highly likely that continual short-term investments should be sufficient to accommodate all projected growth in this sub-catchment, the specific requirements being detailed in Section 8.7.

9.16 Watford Urban Area (14)

9.16.1 Sub-catchment Overview

This sub-catchment has been defined to include the greater Watford urban area, from Maple Lodge STW upstream along the trunk sewer to the Blackbirds SPS (an intermediate SPS which diverts a proportion of foul flow to Blackbirds STW for treatment).

The strategic water and needs are likely to primarily be network capacity, requiring strategic intervention for 2031 and more widespread investment for 2051, to facilitate the extensive projected growth in Watford and upstream within both Welwyn Hatfield and Hertsmere districts.

9.16.2 Sub-catchment Solutions

A sub-catchment plan is shown in Figure 71.

Solution A) Regional Flow Reduction Initiatives

Primary Functions  Secondary Functions 

Removal of non-foul flows from the Northern Watford area, focusing on separation of storm runoff, infiltration reduction and removal of illegal connections.

Delivering runoff reduction through separation can be undertaken as a strategic catchment investment or be more targeted, based on the needs of a specific function (e.g. reducing CSO discharges). Alternatively, or in addition to, gradual reductions in rainfall runoff could be achieved by separating drainage and delivering SuDS schemes in an opportunistic manner, through collaboration with developers, the Highways England and SuDS incentives.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on spills to the environment.

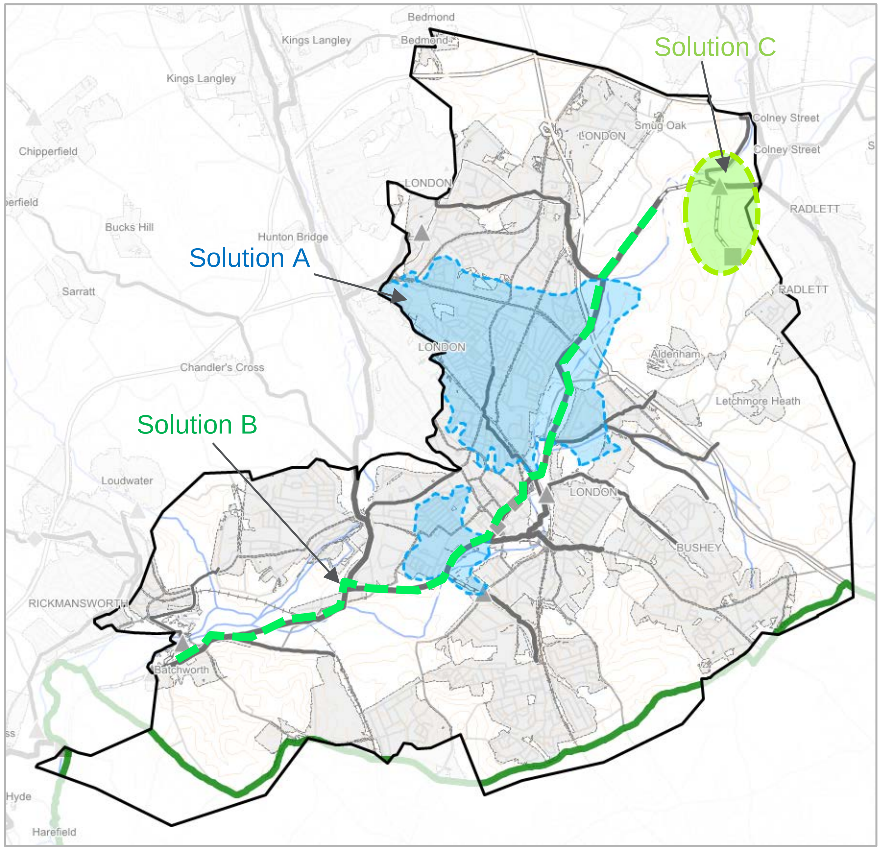


Figure 71 – Watford (14) Sub-catchment Solutions Plan

Solution B) Progressive Network Attenuation

Primary Function  Secondary Function 

Construction of storage facilities along the main trunk sewer to promote attenuation and better manage peak foul and storm flows, maximising the capacity of the existing system to support growth.

The flow control mechanisms in the system would attenuate flow within storage facilities, freeing up capacity downstream and reducing peak flow rates.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping							
Consultation							
Design							
Implementation							

High-level modelling is essential to develop a proof-of-concept design. Clarifying the location of proposed development is key to ensure attenuation is located appropriately, maximising and optimising the capacity of the system. The construction should be implemented in a phased approach, allowing staged assessment of its performance and adaptation of its operation.

Identification of key lengths of trunk sewer with suitable depths to enable gravity fed storage tanks is likely to be essential to prevent the need to pump, creating additional and unnecessary operational costs. This approach would require wide-spread and intensive construction works, typically along main roads and within urban areas which could cause significant disruption.

Solution C) Maple Lodge STW / Blackbirds STW Catchment Redefinition

Primary Function

Secondary Functions

Strategic upgrade at Blackbirds STW, enabling a greater proportion of the flows from the upstream catchment (Welwyn Hatfield and Hertsmere) to be diverted from the trunk sewer, freeing up capacity within Watford and alleviating the pressure of growth from Maple Lodge STW.

Blackbirds STW is located at a strategic point off the main trunk sewer to Maple Lodge STW which could serve approximately 30% of the total catchment currently served by Maple Lodge STW. At present, Blackbirds is estimated to treat 17% of the total flow in the main trunk sewer, which comprises foul flows from St Albans, London Colney, Hatfield, Potters Bar and Borehamwood.

An increase in capacity at Blackbirds STW would provide more resilient treatment opportunities, allowing flows to be balanced and processes to be optimised. This approach also accommodates some of the inherent uncertainty of development, especially for the 2051 scenario, splitting the responsibility between the two STWs. The Blackbirds STW site could be considered less constrained than the Maple Lodge STW site, with upgrades at Blackbirds STW potentially proving more cost effective.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■	■					
Consultation		■	■				
Design		■	■				
Implementation		■	■	■	■		

Major STW upgrade works will likely require significant planning and consultation, prior to design and implementation. The nature of the Blackbirds STW as an intermediate asset provides the opportunity for gradual upgrades, adapted to ongoing growth commitments.

A complete assessment of STW capacity and headroom, based on up-to-date projections, is essential for both Blackbirds STW and Maple Lodge STW to ensure an optimise and effective balancing strategic can be implemented. The Environment Agency should be engaged early in the process to secure approval for increase treatment discharges, as part of the overall balancing strategy.

Treated discharges at both STWs could be consented within a smart / catchment permitting initiative (*See Section 10.1*), to facilitate a more flexible operation regime.

Land take for upgrade works will need to be secured to ensure the viability of the option. A new discharge consent will be required for the additional treated flows at Blackbirds STW, including potential storm discharges (if they can't be accommodated on site).

9.17 Welwyn Garden City and Hertford Growth Area (15)

9.17.1 Sub-catchment Overview

This sub-catchment has been defined based broadly on the extent of indicative growth areas and covering the middle section the strategic trunk sewer network discharging to Rye Meads STW, linking Welwyn Garden City, Hertford and Ware. The sub-catchment extents include the broad watershed of the Lee and Mimram, extending upstream to Welwyn and Codicote. It also covers northern parts of Welwyn Hatfield and southern areas of East Hertfordshire.

This sub-catchment includes the following settlements:

- Welwyn Garden City
- Hertford
- Ware
- Sawbridge
- Codicote
- Welwyn
- Burnham Green
- Tewin
- Codicote
- Hunsdon

The strategic water needs are likely to primarily be strategic trunk network capacity in Hertford and north of Welwyn Garden City. Focused planning is likely to be needed in 2021 to ensure the current system can accommodate the quantum of growth projected for Welwyn Hatfield, Stevenage and southern parts of East Hertfordshire. The level of investment required could steadily grow by 2031 and up to 2051, at which point strategic intervention around Hertford looks to become critical.

9.17.2 Sub-catchment Solutions

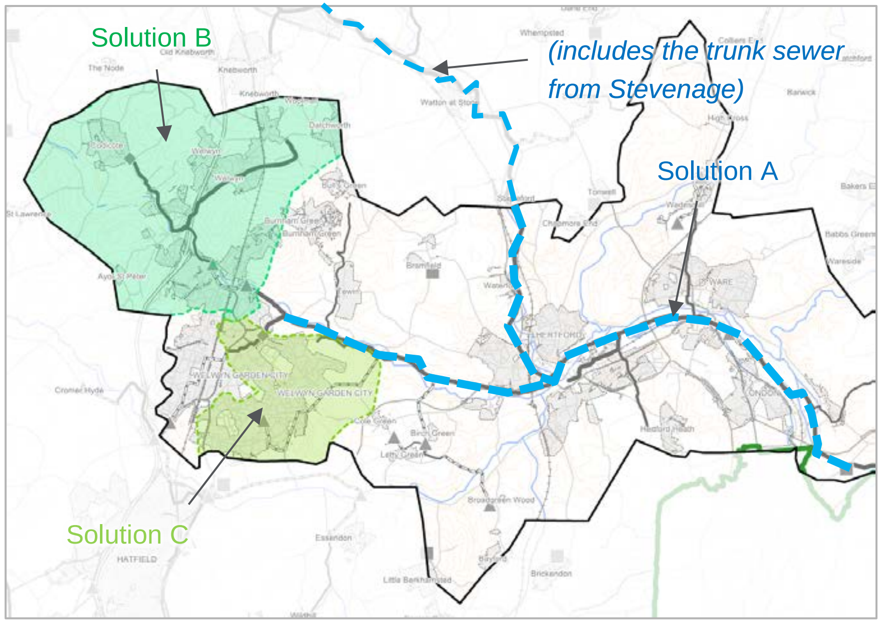


Figure 72 – Welwyn Garden City and Hertford Growth Area (15) Sub-catchment Solutions Plan

Solution A) Intelligent Network Control System

Primary Function  Secondary Functions 

Intelligent network control system, commonly known as Active System Controls (ASC), implemented within the main trunk sewer, with the aim of better managing peak foul and storm flows, fully utilising its current capacity and engaging greater attenuation across the network.

The ASC could be designed to address many aspects of sewerage management, helping to reduce foul discharges from CSOs in Amersham, alleviate surcharge in urban areas, prevent flooding, maximise the utilisation of existing storage capacity and reduce peak flows arriving at Rye Meads STW.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■						
Consultation	■						
Design	■	■	■				
Implementation		■	■	■			

The design of this system would require the detailed evaluation of the operation, performance and condition of the trunk sewer network, including Rye Meads STW and catchment flow rates. Thorough hydraulic modelling would be essential within AMP6 to inform the design stage, spread across AMP7 and AMP8. The implementation strategy should be phased to enable the design to be adapted to optimise the performance of the system, as the early stages are complete.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on water quality (from foul discharges at CSOs and STWs).

Case Studies – Boulogne, Paris[33] / Portsmouth Early Warning System[34]

Solution B) Regional Runoff Reduction Interventions

Primary Functions  Secondary Functions 

Removal of non-foul flows focusing on separation of storm runoff, infiltration reduction and removal of illegal connections.

Delivering runoff reduction through separation can be undertaken as a strategic catchment investment or be more targeted, based on the needs of a specific function (e.g. reducing CSO discharges). Alternatively, or in addition to, gradual reductions in rainfall runoff could be achieved by separating drainage and delivering SuDS schemes in an opportunistic manner, through collaboration with developers, the Highways England and SuDS incentives.

This system would be designed, implemented and operated by Thames Water. The planning and design of this system should be undertaken with support from the Environment Agency to understand it's potential impact on spills to the environment.

Case Studies – Dwr Cymru Welsh Water RainScape Solutions[35] / Malmo Urban Storm Water Management Project[36] / Portland Downspout Disconnection Programme[37]

[33] Real Time Control of the Sewer System of Boulogne Billancourt – A Contribution to Improving the Water Quality of the Seine, (Link)
[34] Southern Water – Management of Wastewater in Portsmouth and Havant, 2011 (Link)
[35] Dŵr Cymru / Welsh Water – RainScape (Link)
[36] European Climate Adaptation Platform – Urban Storm Water Management in Augustenborg, Malmo, 2014 (Link)
[37] City of Portland – Downspout Disconnection Programme (Link)

Solution C) Strategic Surface Water System Attenuation Retro-fit and Groundwater Reinjection

Primary Function | Secondary Functions

The adaptation of the main surface water network in Welwyn Garden City to provide runoff for re-injection into the groundwater aquifer, with the provision of SuDS systems within the catchment to provide additional capacity to support the projected growth.

Schemes would include of a range of SuDS components within existing surface water networks and at key discharge locations, combining natural techniques with physical storage mechanisms. SuDS could be implemented throughout urban areas and designed to suit challenging urban constraints. Infiltrating SuDS mechanisms should be included within a SuDS management train at the lower end, allowing for natural treatment of typical urban pollutants such as hydrocarbons and contaminants.

As estimated implementation programme is shown below.

Planning & Implementation

Stage	2020	2025	2030	2035	2040	2045	2050
Scoping	■	■					
Consultation	■	■	■	■	■	■	
Design		■	■	■	■	■	
Implementation		■	■	■	■	■	■

All SuDS components are likely to be bespoke and the design stage will need to reflect this. A clear implementation strategy is necessary to inform the phased construction to deliver large-scale reductions.

A high-level assessment of potential locations, both within Stevenage and along it's periphery, is essential to prioritise planning and investment. Locations should be matched with development projections, to optimise their potential use, with the multi-benefit potential of SuDS forming the basis for design selection.

Open discussions with developers could be used to identify collaborative opportunities to develop water sensitive improvements to both the existing and new systems. All design approaches should prioritise SuDS over piped drainage.

10 WATER MANAGEMENT AND POLICY PLANNING OPTIONS

To support the major water infrastructure needs and recommendations, as outlined in Section 8, and Section 9, a range of water management and policy planning options have also been proposed in this section. These options apply across the study area (and likely further afield) and should, in many cases, be promoted to help facilitate the implementation of strategic and long-term engineering options.

10.1 Current Context

10.1.1 Authority Responsibilities & Current Initiatives

Water Utility Companies

Responsible for managing elements of the entire water cycle and potentially have the broadest influence on facilitating improvements, in terms of effecting change through policy and investment.

The most relevant water management policies and initiatives currently being implemented and / or developed are as follows:

- **Programme of Universal Metering** (Affinity Water) – The Water Saving Programme aims to help customers reduce their consumption and save money. The programme aims to save over 29 Ml/d in the short-term
- **Education** (Affinity Water) – The education initiative engages local communities to grow perceptions of water as a valuable resource to be conserved, targeting both the general public and educational facilities
- **Water Efficiency** (Affinity Water) – Water efficiency devices (e.g. showerheads and tap inserts) are distributed at public engagement and education events (the distribution of 112,000 devices is planned for AMP6)
- **Home Water Efficiency Checks** (Affinity Water) – Provided for domestic customers, offering simple leak repairs, access to free water saving products installed free of charge and advice on water use
- **Water Transfer Agreements** (Affinity Water) – Agreed bulk supply import of water from neighbouring Water Utility Companies to offset local deficits in supply
- **Leakage Reduction Programme** (Affinity Water)
- **River Restoration** (Thames Water / Affinity Water) – Targeted investments in river morphology schemes, working with local communities and landowners to improve river function and support ambitious abstraction reductions. Schemes cover the Mimram, Bulbourne, Beane, Misbourne, Ver and Gade.

The Environment Agency

Manage the water and environmental quality, which includes water resources and wastewater treatment, covering the entire water abstraction and supply process.

The most relevant water management policies and initiatives currently being implemented and / or developed are as follows:

- **Wastewater Permitting** – Management and control of foul and treated effluent discharges to the watercourses
- **River Restoration** – Targeted investments in river morphology schemes, working with local communities and landowners to improve river function and support ambitious abstraction reductions. Schemes cover the Mimram, Bulbourne, Beane, Misbourne, Ver and Gade.

The District & County Councils

Largely limited to the water supply-demand balance, through engagement with local developers and responsibility for planning.

The most relevant water management policies and initiatives currently being implemented and / or developed are as follows:

- **Neighbourhood Planning** – Prepared by the local community and can include planning policies and land allocations, consistent with national and local planning policies
- **Community Infrastructure Levy** – Although not implemented within every district council it is used to give more certainty to developers as to how much their development will need to contribute to meeting the costs of infrastructure
- **SuDS Planning** – Approval body to ensure that SuDS are designed according to national standards

10.1.2 Water Cycle Functions

The potential water cycle function benefits (*See Section 7.1.1*) for all the current water management policies and initiatives can be seen in Figure 73. Aligning each policy and initiative within the water function cycle provides a practical understanding of where potential deficits could lie and may need to be addressed.

The extent of water management and planning policies in Hertfordshire is relatively robust and broadly matches current needs, both in terms of supporting development and managing water infrastructure.

Water availability is a particular focus, with the Affinity Water WRMP providing specific sustainability and resilience targets to address the potential impacts from the quantum of growth projected and climate change. For wastewater, there is a focus on SuDS and the provision of new water infrastructure through developer contributions.

Achieving a better balance across the water cycle functions is likely to require a greater focus on water quality and river catchment health, plus more effectual policies to support the implementation of SuDS.

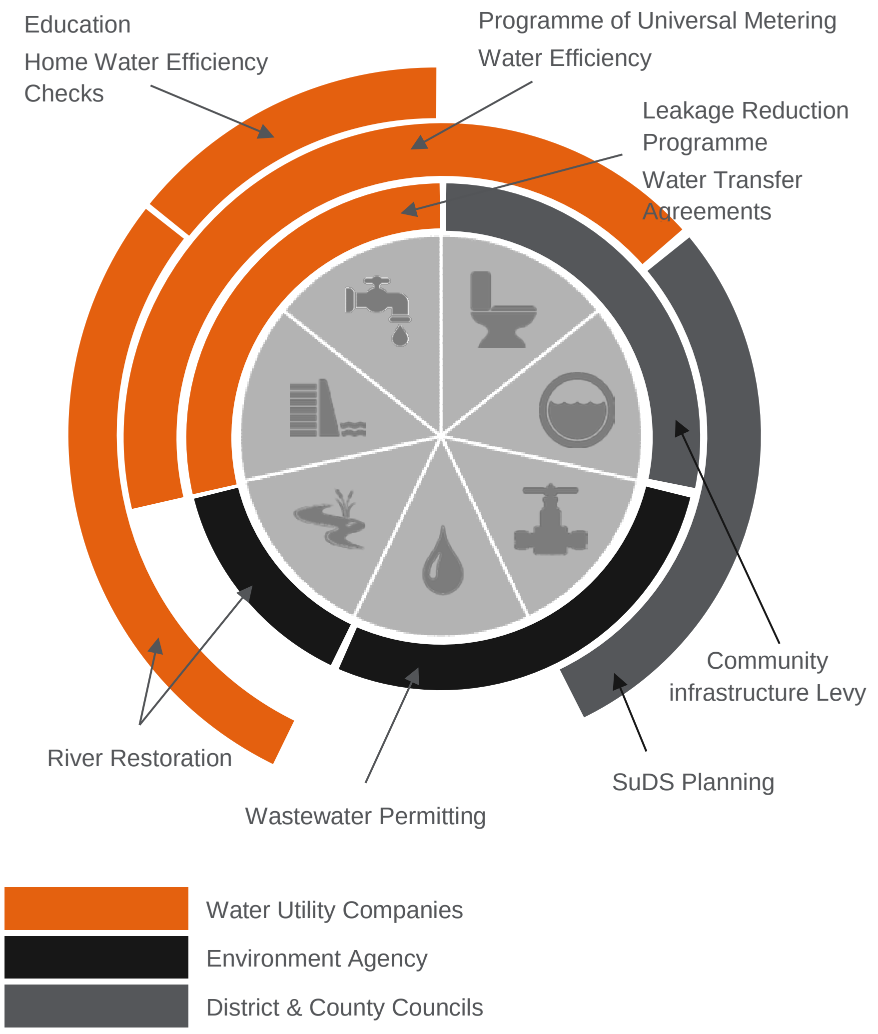


Figure 73 - Current Water Management Policies & Initiatives

10.3 Supporting Sustainable Development

Delivering growth through the concepts of sustainable planning as laid out in the Vision for Hertfordshire (*See Section 3*) is considered and critical to long-term prosperity. The main challenges of enhancing sustainability through the planning, design and implementation process is typically investment, regulatory control and public engagement. Growing a more sustainable attitude to construction, for both local developers and the public, will require technical, logistical and financial support from local authorities and the Water Utility Companies.

10.3.1 Blue-Green Infrastructure Planning

Primary Function 

Blue-green infrastructure planning provides a method to link urban regeneration with the challenges of groundwater recharge, water quality and sustainable drainage, facilitated by engaging communities and linking funding sources. A pragmatic strategy could be instrumental in securing acceptance for multi-use blue-green spaces, enabling extensive and innovate SuDS schemes to be considered and linked in urban regeneration schemes.

10.3.2 Fully Integrated Development Site Water Recycling and Drainage Strategies

Primary Function 

Engaging with local developers to promote the use of sustainable drainage and water supply approaches as a fundamental element of site design could help deliver developments with fully integrated systems. A fully integrated system could significantly reduce reliance on mains water, promote groundwater aquifer recharge and reduce foul flows in the wastewater system.

This would require new design guidance and planning policy, led by Hertfordshire County Council under their role as the SuDS body.

Implementing integrated SuDS system and / or shared community RWHSs requires investment but would demonstrate an exemplary sustainable attitude, allowing local developers and authorities to showcase alternative and environmentally sensitive approaches to water management.

10.3.3 Community Involvement Schemes

Primary Function  Secondary Functions 

Affinity Water run education initiatives which seek to address perceptions of water use, aiming to reduce water usage through behavioural changes. For wastewater and specifically the implementation of SuDS a similar level of engagement and education prove beneficial for securing community support for schemes in public land (i.e. parks).

A more targeting approach could be to directly involve local community members during the design and construction of SuDS schemes, as has been successfully implemented in Portland, Oregon[38].

10.3.4 New Settlements

Primary Function — Secondary Function

Consolidation of growth proposals into a designated new settlement(s), to provide localised treatment and water recycling facilities.

The planning and implementation of growth within a defined new town location would enable the Water Utility Companies to invest over the long-term. Focused development in this manor could reduce the inherent uncertainty over the location of growth, allowing the Water Utility Companies to plan regional investment within each AMP cycle with reference to long-term strategies linked to growth.

A new town approach would enable fully integrated, innovative and dedicated systems to be developed, serving the water needs of residents, business and the local environment. The application of sustainable drainage approaches and rainwater harvesting systems (RWHS) would reduce water demand whilst centralised runoff storage and reuse could limit the impacts of flooding and pollution to local watercourses.

A new settlement would require a holistic implementation masterplan, including a strategy covering all aspects of drainage, treatment and supply. To fully realise the potential benefits of an integrated sustainable water system aimed at achieving water neutrality (or as close as possible) it's implementation should be carefully planned in a phased approach, with the ability to continually adapt should growth targets or the economic climate change over time.

Hertfordshire County Council could work with the districts to promote and plan such an approach, which could serve much of the growth expectations within the study area. Thames Water and Affinity Water would lead the design and implementation of a new water system, in conjunction with the Environment Agency. The construction and operation of the wastewater treatment process could be managed via a separate wastewater undertaker.

Case Study – Bicester Eco-Town[39]

10.4 Securing Continued Investment in Wastewater Infrastructure

10.4.1 SuDS Incentivisation

Primary Function — Secondary Functions

The effective implementation of SuDS is challenging in the UK, largely due to issues around maintenance, investment and ownership. To overcome these issues a policy of incentivisation (typically financial) could be implemented.

Such a policy would require financial support and could utilise a fast-track planning process, subsidies and improvements to the surface water discount charge the Water Utility Companies currently offer.

[38] Depave (Link)

[39] North West Bicester (Link)

10.5 Addressing Water Availability

With no further licences being granted across Hertfordshire, water efficiency measures relating to the existing supply will need to be implemented to safeguard water supplies into the future. Further sustainability reductions may be required in the future to support the aspirations of the WFD. Development of additional resources, or increased efficiency through demand management, will be required to maintain the supply required for new developments.

10.5.1 Natural Catchment Management

Primary Function | Secondary Functions

Natural Catchment Management (NCM) is the concept of working with natural hydrological and morphological process, features and characteristics to manage sources and pathways of water. The techniques typically include restoration, enhancement and alteration of natural and modified watercourses and drainage channels, but excludes the use of engineering work that disrupts natural processes.

NCM offers a broad and sustainable mechanism to better manage water resources by integrating the different administrative, planning and regulatory systems based solely on the needs of a catchment. It also recognises the inherent links between the health of the chalk aquifer and Hertfordshire's Chalk rivers, and land use.

10.5.2 Water Transfer Agreements

Primary Function | Secondary Functions

Increasing the volumes of water traded between Water Utility Companies is a key Government initiative, designed to increase flexibility in supply systems and the efficiency with which available resources are used. It was also a key principle of the Water Resources in the South East (WRSE) project, which sought to provide a regional solution for the South East of England where the available resources were shared for the benefit of customers.

The current arrangements should be maintained to provide resilience and facilitate efforts to improve the health of the groundwater aquifers.

10.6 Maintaining Healthy Supply-Demand Balance

10.6.1 New Build / Re-development Rainwater Harvesting Systems

Primary Function

Rain Water Harvesting Systems (RWHS) have the potential to provide a wide range of benefits to various water functions and contribute significantly to the long-term resilience of water availability. The main benefit would be significant reductions in water demand and reduced rainfall runoff flows.

There is clear value in this approach if it could be implemented at a suitable scale, providing robust reductions in water demand. The likely scale of investment highlights the need for a robust funding arrangement to be created, support by all partners.

10.6.2 Retro-fit Rainwater Harvesting Systems

Primary Function

Retrofitting RWHS to existing properties provides a significant opportunity to drive long-term sustainable reductions in water demand, if a wide-scale implementation strategy could be adequately funded.

A UK-leading programme of RWHS installation would be required, delivered over a 35-year period to achieve potential demand reductions of up to 2%.

10.6.3 Smart Metering

Primary Function

Secondary Functions

The Affinity Water programme of universal metering is based the installation of traditional meters, measured purely as consumption. The installation of meters across Hertfordshire could deliver significant water usage savings in the short to medium-term, as planning for by Affinity Water. In the long-term upgrading residents to smart meters could provide even greater benefits to potentially offset the growing pressures of growth and water availability, at a regional scale.

The additional features of smart meters would allow customers to better understand their usage, which can increase efficiency and help to change behaviour attitudes to water use. A smart metering system could also allow Water Utility Companies to introduce volumetric pricing and / or more sophisticated pricing, helping to fund long-term engineering investments to bridge the gap that water usage savings alone may not be able to address.

10.6.4 Water Appliance and Fittings Efficiency

Primary Function

Secondary Functions

Water efficiency devices are being distributed by Affinity Water but on a piecemeal basis, linked to water home efficiency checks and educational events. With the production and installation of such fittings considered small (compared to strategic engineering investments in water infrastructure) the implementation of catchment-wide programme, similar to the programme for water meters, could deliver highly cost-effective and sustainable improvements.

10.7 Improving Water Quality

The currently regulatory framework regarding discharges from the wastewater system is based on a national framework, built upon EU directives and legislation. It is expected that controls on discharge quality will be continually updated, in-line with EU and national policy, industry guidelines and scientific research.

10.7.1 Smart / Catchment Permitting

Primary Function

Secondary Functions

The regulatory system permits specific discharges, such as the number of spills from a CSO, to protect the quality of the receiving watercourse or waterbody. The concept of smart or catchment permitting is to provide the Water Utilities Companies flexibility to invest in their assets with the aim of managing water in a more holistic manner at a catchment scale. This approach could facilitate the use of Intelligent Network Control Systems *(See Section 9.2.2, Section 9.14.2 and Section 9.17.2)* which could vary discharges based on the net impact on the catchment.

Such an approach would require strategic support from the Environment Agency and an extensive catchment understanding to demonstrate its potential benefits.

11 FUNDING & INVESTMENT

11.1 Existing Funding Sources

11.1.1 Asset Capital Investment Process

The Water Utilities Companies are set targets by Ofwat for each AMP period (the next being AMP7, 2020-2025) within a Price Review (PR) process, for which an investment plan is approved. This plan provides the framework for investment over each 5-year period.

Many of the options outlined in this study will require long-term implementation plans due to the potential time required for consultation, planning and design, or the inherent economies of scale required to drive maximum cost-benefit. Ofwat have stated that they think Water Utility Companies do have opportunities to promote more structured and visible long-term planning within the PR process. This does include multi-period outcomes which could be used to assist the Water Utility Companies maintain their assets to deliver long-term benefits to customers and / or the environment.

Delivering strategic sub-catchment solutions will require long-term planning within approved within the next PR process (2019) and beyond. This will require the development of robust implementation plans, structured around stakeholder engagement and aimed at demonstrating net long-term benefit for the customer.

It is not recommended that funding is procured as separate budget items for sustainability programmes of work. Compartmentalising funding will perpetuate attitudes of sustainable versus traditional approaches to water infrastructure and resource management. It could create a challenging commercial environment where it becomes difficult to allocate sustainable funding due to the apparent higher risks and uncertainties involved, especially within the 5-year AMP delivery cycle.

11.1.2 Private Sector Contributions

Drawing funds from the private sector would be challenging but could provide an extensive range of opportunities, if properly secured. Some potential examples are shown below:

- On-site development costs controlled by planning conditions and governed by S106 agreements (including provision of land)
- Off-site financial contributions governed by S106 agreements (including commuted sums, contributions of land in lieu of payment and biodiversity / recreational land mitigation ‘banking’) and possible future development tariff (e.g. Community Infrastructure Levy)
- Water Industry Act requisition payments
- Land management and improvement funds
- Local business / organisation sponsorship and / or carbon offsetting

11.1.3 Hertfordshire Local Enterprise Partnership (LEP)[40]

The LEP operate as a strategic leader in developing the long-term vision for Hertfordshire’s economy, recently through securing £264m in investment from the governments Growth Deal, including £44 in January 2017.

The LEP has a proven track record in securing funding, prioritising strategic development areas and identifying gaps in infrastructure provision, with the aim of unlocking private sector investment.

[40] Hertfordshire Local Enterprise Partnership (Link)

A number of possible options to secure funding for the 2017/18 Growth Deal could include the following:

- **Green Regeneration Projects** – focusing on providing investment to develop functional blue-green infrastructure for areas requiring regeneration
- Community River Morphology Projects – Securing funding to support current projections and / or expand them to new areas of water stress
- **Stevenage Central Town Centre Framework / Hatfield 2030+** – Aligning water infrastructure needs with regeneration plans

11.1.4 Other Potential Sources

Community Infrastructure Levy[41]

The Community Infrastructure Levy (the levy) came into force in April 2010. It allows local authorities in England and Wales to raise funds from developers undertaking new building projects in their area. The money can be used to fund infrastructure needed as a result of development, including water infrastructure and water resource management schemes.

This funding could be utilised to develop regional runoff reduction strategies and surface water system SuDS retro-fit schemes, supporting numerous development sites concurrently.

Housing Infrastructure Fund

The Housing Infrastructure Fund is a £2.3bn capital grant programme to be introduced during 2017 with funds expected to support a variety of infrastructure projects, including water utilities. Bids for funding are likely to welcome cross-boundary strategic proposals, such as the possibilities identified as sub-catchment solutions.

Flood Defence Grant-in-Aid (FDGiA)[42]

FDGiA grants are aimed at supporting the following:

- EA flood risk management studies, strategies and projects
- Local authority flood risk management and coastal erosion management studies, strategies and projects
- Internal Drainage Board land drainage and flood risk management studies, strategies and projects

Under a Partnership, funding levels for flood and coastal defence schemes will relate directly to the number of households protected, the damages being prevented, plus the other benefits a scheme would deliver.

Although not specifically provide to support general infrastructure and water resource projects many of the options proposed will inherently provide increased flood risk benefits (or could be easily enhanced to include such benefits), such as strategic rainfall runoff reduction strategies, natural capital management, strategic surface water storage and SuDS retro-fit.

Large Sites and Housing Zones Capacity Fund

The Large Sites and Housing Zones Capacity Fund is an £18m fund that Department for Communities and Local Government and Homes and Communities Agency (HCA) have made available to local planning authorities, to aid housebuilding as part of large-scale developments via improvements to public and social infrastructure.

[41] Communities and local Government – Community Infrastructure Levy, 2011 (Link)

[42] Local Government Association – Current FCERM Income Sources, 2014 (Link)

Highways England's Environment Fund[43]

Highways England is the government company that manages motorways and major A roads. It manages around 6,500 miles of trunk roads that accommodate 33% of all road travel and 50% of lorry travel.

Over the next 5 years, Highways England's environment fund will invest £300 million in the existing strategic road network for environmental improvements, a proportion of this will address pollution from highway run-off.

Countrywide Stewardship[44]

Countryside Stewardship is a new scheme that is open to all eligible farmers, woodland owners, foresters and other land managers through a competitive application process. It is entirely voluntary and is part of a wider investment of £3.5 billion in England under the Common Agricultural Policy for 2016 to 2020. It will contribute £900 million of new funds to enhance the natural environment, particularly the diversity of wildlife and water quality. Of this funding, about £400 million will be invested over a 5-year period to improve water quality and increase resilience against flooding.

It will address soil management and reduce the effect of nutrients, sediment and faecal contamination. This will reduce the impact of eutrophication and benefit bathing waters, shellfish waters and drinking water. This is achieved through measures categorised by the following groups:

- **Enhanced field management**, including seasonal livestock exclusion, winter cover crops, buffer and riparian management strips next to watercourses and reduced nutrient applications from fertilisers
- **Land use change**, including woodland and wetland creation or converting arable land to grassland which requires less fertiliser
- **Water and woodland capital grants**, including sediment traps, fencing of watercourses and tree planting
- **Re-naturalising rivers** and coast defences, including making space for water and coastal realignment

Home Building Fund

The Home Building Fund is a £3bn fund administered by the HCA on behalf of government, offering development finance loans to fund infrastructure projects, including for infrastructure needed to enable housing to progress and to prepare land for development.

Loans of £250,000 to £250 million are available for developers, with smaller loans considered for innovative housing solutions and serviced plots for custom builders. A loan such as this, rather than a direct funding source, could help in the profiling of new infrastructure delivery.

Local Government Bonds

In July 2016, 19 local authorities approved the UK Bonds Agency's regulations, clearing the way for the first issue of municipal bonds that will raise funds for local councils. This is currently a proposal in its infancy but it could generate significant investment in future to support water infrastructure associated with regeneration projects, at affordable interest rates.

[43] Highways England – Our Plan to Protect and Increase Biodiversity, 2015 (Link)

[44] UK Government – Countryside Stewardship, 2015 (Link)

Payment for Ecosystem Services[45]

Payments for ecosystem services (PES) are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service. It is an economic system for the provision of environmental services through conditional payments to voluntary providers, aimed at promoting the conservation of natural resources in the marketplace.

In relation to the needs of this study PES could be effective in supporting Natural Capital Management.

11.2 Suggested Supplementary Investment Models

Independent infrastructure Fund Management Partnership

Managing infrastructure investment through a dedicated fund partnership would allow a centralised management of investment. Such a fund could seek private investment in water infrastructure and support district plans to implement ambitious long-term schemes to support their growth targets, incentivising developers and enabling more innovative approaches to be taken.

Water Discharge Credit Trading System

This investment model is driven by credit swapping, the funding from which could be used to finance blue-green infrastructure projects on across Hertfordshire. These 'credits' can be purchased on the free market by more land-constrained developers who may need the credits to meet their mandated runoff attenuation requirements. This could be activated by the tightening controls on water discharge to the environment, by both Hertfordshire County Council (as SuDS body) and the EA.

Case Study – The Nature Conservancy / Encourage Capital, Washington DC[46]

Comparable to carbon credits, with a 'cap and trade' principle set in place. The cap would be analogous with traditional green field runoff requirements.

Hertfordshire County Council could provide accreditation for developers being part of the scheme, contributing to their environmental credentials. It would allow inner city developments and regeneration schemes to be undertaken in a water sensitive way.

Water Sensitive Planning Incentive Fund

Water Utility Companies provide Hertfordshire County Council with a water infrastructure Fund, agreed with Ofwat as part of the PR process, to be used by district councils to incentivise developers to improve water efficiency of developments. This could cover the following:

- RWHS
- Fully integrated SuDS systems, which promote infiltration to assist with groundwater recharge

This fund could be drawn from a range of budgeted sectors, such as:

- Ensuring Reliable Water Supply
- Community Engagement

45 UK Government – Payment for Ecosystem Services, Best Practice Guide, 2013 (Link)

46 The Nature Conservancy– Washington D.C. Green Infrastructure Fund, (Link)

- Protecting the Environment
- Managing Water Resources

The process would require developers to apply for funding as part of their planning application. The fund would likely be used to support developer's investment plans when they can demonstrate that their site will employ a fully holistic SuDS strategy, and is deemed to benefit the wider water environment. The fund could also be used to subsidise property owners seeking to retro-fit RWHS in their property.

The total fund would need to be managed based on an assessment of the potential net benefit to the Water Utility Companies, in terms of both capital expenditure and long-term operational costs. Other organisations, such as Hertfordshire County Council, the Environment Agency and the LEP, could top-up the fund to support the wider ranging benefits of sustainable drainage.

12 CONCLUSION & NEXT STEPS

12.1 Study Conclusions

The primary aim of this study was to provide greater clarification in the short, medium and long-term provision of adequate sewerage infrastructure and water supply in Hertfordshire and to support the current and emerging local plans up to 2051. Through effective collaboration and consultation, a range of key outcomes have been derived which form the basis of the infrastructure evaluation, the conclusions listed in this section and to support the proposed next steps in Section 12.4.

The primary positive outcomes of this study which can be used to support the selection of development sites and strategies as part of the planning process at a district level are summarised as follows:

- Robust population projection for each district (and Hertfordshire as a whole, excluding Broxbourne) up until 2051, based on a range of data sources and planning expectations
- Indicative spatial context for growth, based on geographical constraints, planning expectations and future strategic transport infrastructure proposals
- Indication of potential timescales associated with water infrastructure need

The primary outcomes which could support Water Utility Company short-term (AMP cycles) and long-term planning are summarised as follows:

- Clarification of the potential impact of growth on the available capacity of existing networks and ancillaries, specifically where strategic intervention may be necessary
- Indication of timescale for strategic investment needs
- Holistic evaluation and assessment of regional and strategic water infrastructure requirements
- Broad appreciation for potential deficits in STW treatment capacity in the longer term, based on the quantum and expected geographical context of growth
- Identification of a broad range of options which could be used to address potential future water infrastructure deficits

All figures and results derived through the evaluations in the study form a snapshot in time, based on consultations during 2015 and 2016. Local plans are in continual flux (necessary due to the planning process) which asserts that any geographically specific conclusions need to be considered indicative at this stage, and subject to change.

The study was comprised of several key elements, as shown in Table 5.

Study Element	References
Proposal of a Vision for Hertfordshire to underpin the development of positive outcomes	*See Section 3*
Review and explanation of the background of the study, in terms of growth expectations and provision of adequate water infrastructure	*See Section 4*
Definition of the study scope, including clarification of key limitations and assumptions	*See Section 5*
Outline of the approach taken to assess the scale and location of expected growth for Hertfordshire and the assessment of water infrastructure need	*See Section 6*
Detailed evaluation of water infrastructure need at a district level, identifying the scale and timeframe for necessary strategic interventions	*See Section 7*
Proposal of a range of sub-catchment solutions to tie in strategic infrastructure need with the concepts of the	*See Section 9*

Study Element	References
Vision for Hertfordshire, as recommended strategies that could be explored to address long-term challenges	
Outline recommendations for policy based options and water management strategies that could be employed across the study area to address water efficiency and water supply-demand issues	*See Section 10*
Outline review of potential funding mechanisms that could be utilised to support the planning and implementation of strategic improvement works and the sub-catchment solutions	*See Section 11*

Table 5 - Main Study Elements

12.1.1 Main Conclusions

The conclusions and recommendations of this study are naturally diverse, due to the generally broad scope and variety of potential solutions to the many water infrastructure needs of the catchment. The primary outcomes of this study *(See Section 12.1)* provide a broad framework of 'what', 'where' and 'when', although provide only a high-level estimation of the 'how', in terms of investment and long-term planning.

A summary of the main conclusions in relation to the overall scope of the study are as follows:

- The derivation of robust growth projections up until 2051, consolidating local plan figures and regional projections, has shown that ensuring adequate water infrastructure capacity is critical to support the projected quantum of growth
- The development of a holistic understanding of potential sewerage infrastructure and water resource needs for Hertfordshire up until 2051 has helped to unlock some of the uncertainty over the timing of potential interventions, albeit without provided any clarify on cost or technical feasibility at this stage
- Indicative conformation that current growth strategies are broadly robust, supported by some judicious investment in the next AMP period (AMP7)
- Proposal of a broad framework for continued partnership collaboration to facilitate the development of robust long-term planning which could potentially feed into the Water Utility Company AMP planning process
- Clarification of the inherent challenges in linking long-term infrastructure planning with investment, including the exploration of potential funding mechanisms
- The definition of a broad range of options that can be used as effective evidence to support short-term investment planning for AMP7 and AMP8, while also creating opportunities to support long-term planning.

Immediate Considerations

In the short-term (2021) sewerage infrastructure capacity is likely to need targeted investigation to understand whether strategic investment is required to support current planned development, as listed in Table 6.

Location	Water Infrastructure Needs
Around the Amersham Valley (Chiltern district)	• Evaluation of trunk sewer capacity / upgrade works • Evaluate potential for new strategic trunk sewer • CSO evaluation / improvement works
South of Stevenage (Stevenage & East Hertfordshire districts)	• Evaluation of trunk sewer capacity / upgrade works • Strategic evaluation of rainfall runoff flows

Location	Water Infrastructure Needs
Across the southwest Watford area (Watford & Three Rivers districts)	• Evaluation of trunk sewer capacity / upgrade works • Strategic evaluation of rainfall runoff flows
Hertfordshire	• Strategic investigations and / or investment in treatment at Rye Meads STW

Table 6 - Short-term Considerations

The evaluation of sewerage infrastructure used a conservative approach so the strategic interventions identified in the District Summaries (*See Section 8.1 to Section 8.10*) should not be considered to represent actual deficit, prior to confirmation through detailed hydraulic modelling and / or collaborative investigations with the Water Utility Companies.

Overall, the growth projections and indicative locations, based on the growth strategies embedded in emerging Local Plans, are considered to be broadly robust and achievable, with no major constraints on development likely until 2031. Targeted investments in AMP6 and AMP7 may be necessary but will likely be accommodated within the current Water Utility Company planning process.

Longer-term Planning Considerations

In the longer-term (2031-2051) it is highly likely that the overall projected quantum of growth will require strategic investment at most of the major STWs and key sewerage ancillaries across Hertfordshire, including Maple Lodge STW and Rye Meads STW. A broad outline of potential investment required to support the proposed growth is shown in Table 7.

The clarification of water infrastructure need becomes more uncertain and complex to plan and implement for the long-term. Any improvement works recommended within this study only provide a broad context of what could be used to address future deficits. Recommendations do not inherently incorporate the potential evolution of the socio-economical background and / or changes to the regulatory framework, both of which can alter the planning process.

Projected growth for 2051 should only be considered indicative for the purposes of evaluating the broad implications of long-term growth. The indicative growth areas created for this study do not define specific locations where growth should or will be located.

Location	Water Infrastructure Needs
Around the greater Berkhamsted area (Dacorum district)	• Strategic trunk sewer upgrade works • Strategic rainfall runoff reduction investment (• Upgrade of DWF capacity at Maple Lodge STW • Strategic SWS to reduce foul discharges to local watercourses
Northeast of Letchworth Garden City (North Hertfordshire)	• Trunk sewer upgrade works • Targeted rainfall runoff reduction projects • Strategic rainfall runoff reduction investment
WRZ5 (East Hertfordshire district)	• Strategic additional resource / reduced demand investment
Stevenage (Stevenage district)	• Evaluation / upgrade of DWF capacity • Strategic rainfall runoff reduction investment

Location	Water Infrastructure Needs
Welwyn Garden City (Welwyn Hatfield district)	• Trunk sewer upgrade works • SPS upgrade schemes
Hertford and Ware (East Hertfordshire district)	• Evaluation of trunk sewer capacity • Evaluate new strategic trunk sewer • Strategic rainfall runoff reduction investment
Hertfordshire	• Strategic additional resource / reduced demand investment • Strategic investment in treatment capacity at Rye Meads STW and Maple Lodge STW

Table 7 - Longer-term Planning

More broadly, a significant water resource deficit across eastern parts of Hertfordshire becomes a significant risk, potentially impacting major indicative growth areas around Hertford, Letchworth Garden City, Hitchin, Stevenage and Welwyn Hatfield.

Conversely, the evaluation of need indicates there are some relatively unconstrained (by sewerage infrastructure) growth opportunities in Hertfordshire, the main areas being listed below:

- North-west of Hitchin (North Hertfordshire district)
- Rural area between Welwyn Garden City and Hatfield (Welwyn Hatfield district)
- Many rural areas in East Hertfordshire (including East End, Stocking Pelham and Brent Pelham)

Additional areas including Harpenden and its surrounding rural areas (in the upper Lee Valley in St Albans district), Tring, the upper Chesham Valley area (including Chesham) and northern areas of Amersham, which all show encouraging potential for development without the need for long-term strategic investment.

These areas have only been identified based on sewerage infrastructure capacity, and do not consider other potential socio-economic factors that will affect the selection of development sites.

The outcomes of this study also feed into the recent agenda prescribed by the government regarding barriers that may be preventing housing delivery, as set out in February's White Paper "Fixing our Broken Housing Market". The government's aim is to promote a robust process is out in place for securing the provision of water infrastructure and resources to support development. This will require the alignment of investment in the provision of utilities with local development planning to help speed up the timely connection for new homes.

This study could be considered the first illustration of what such collaboration might and how it could help remove barriers which might prevent the delivery of housing growth.

12.1.2 Specific Conclusions

Conclusion	Comments & Discussion
Short-term Development Planning Vs. Long-Term Infrastructure Investment	One of the greatest uncertainties which can disrupt the identification and implementation of innovative and sustainable sub-catchment scale solutions is the reluctance of Water Utility Companies to fund new infrastructure until planning permission has been approved. The planning and delivery of infrastructure improvements under this paradigm does not allow the Water Utility Companies to contribute to the planning process prior to planning approval, which typically does not consider (in sufficient detail) water infrastructure and resource needs. Piecemeal upgrades are then implemented to support this growth which are unlikely to provide any broad or holistic benefits, other than specifically ensuring major sewers and ancillaries are not significantly compromised in the short-term. This study provides a broad framework for water companies to explore the provision of infrastructure in advance of planned development, although it does not identify an alternate decision-making process to address this specific issue.
Greater Need for Greater a More Self-reliant Water Resource Strategy	In-line with the concepts of the Vision for Hertfordshire *(See Section 3)*, aiming to achieve greater resilience to support long-term prosperity, it is recommended that Hertfordshire's reliance on water imports should be reduced. All neighbouring regions are subject to comparable changes to the overall water cycle, specifically the prevalence of drought conditions. The reduction in water availability for import will inevitably make water imports the less-favourable (or potentially the least-favourable) option to ensure continuity of water supply. The potential long-term planning necessary to implement many of the alternative solutions highlights the importance of selecting the most resilient strategy in the short-term, given parts of the county have been evaluated to potentially be in deficit by 2031.
Geographical Working	Working within a sub-catchment context, with boundaries specified based on both the natural water environment and artificial water infrastructure, has been instrumental in identifying potential solutions to large-scale long-term deficits associated with growth.
Active District Contribution to the Water Utility Company Planning Process	Undertaking long-term sewerage infrastructure planning at a sub-catchments level, rather than within discrete administrative areas and / or river catchments, has been shown to be a more robust and pragmatic approach to long-term planning in many cases. However, the inherent uncertainty in growth projections increases the financial risk in committing to long-term investment in sub-catchment solutions, reducing their appeal and / or precluding them from consideration in most cases. This uncertainty is rooted in the miss-alignment of the local planning process and intermittent revision of local plans across the districts, resulting in an expected level of growth which is in continual flux. Through the consultation stage it became apparent that the districts maintain a range of useful information regarding the development of their growth plans which could be invaluable for the Water Utility Companies for long-term planning. Greater transparency of this planning data, specifically related to expectations for growth locations, would enable network planning models developed by the Water Utility Companies to provide more robust and precise predictions of deficit.

Conclusion	Comments & Discussion
Benefits of Consolidating Growth Proposals into Geographically Discrete Areas	The growth strategies agreed through consultation with the districts *(See Section 6.1.4)* indicated the primary preference and / or expectation was for urban extensions and intensification / infilling. These two approaches to growth rely more heavily on the upgrade of existing sewerage infrastructure as they are inherently linked to existing settlements. This approach to growth can be said to be relatively effectively at facilitating development in a piecemeal fashion, requiring more minor upgrades to existing systems. However, this approach does not provide an effective planning strategy within which to incorporate the most sustainable and robust water management technologies that could deliver significant and long-term benefits. Retro-fitting sustainable methods of managing water within existing systems can be more complex, expensive and uncertain than designing largely self-contained systems to serve new developments. Delivering growth as new settlements could provide Water Utility Companies more clarity to support investments in strategic infrastructure while districts could be more confident delivering their targets. Supporting growth in this manner would provide a range of holistic benefits, including, but not limited to, the following: • Opportunities to design and implement fully integrated water management systems, enabling effective improvements to the health of the groundwater aquifer and reductions in water demand • Could provide Water Utility Companies with greater certainty over future growth, enabling them to secure funding to support major and sustainable infrastructure • Ensure growth is as self-sufficient as possible. This could significantly support reduction in water demand (through RWHS linked to shared storage mechanisms), reduction in foul flows (water efficiency devices) and improving aquifer recharge (greater surface water storage and runoff management) • Water Utility Companies could segment their investment plans to secure funding for long-term development, whilst supporting continued piecemeal growth
Water Management and Policy Based Options	The current range of water management initiatives which seek to address water availability and supply are considered relatively robust and provide a firm framework for the long-term management of the supply-demand balance. Supporting the long-term investment in wastewater infrastructure is likely to require more specific and delivery-focused policies on SuDS, potentially led by Hertfordshire County Council within their role as SuDS body.
Scale of Intervention	Addressing many of the fundamental issues in the long-term will likely require extensive intervention across the majority of the water cycle, both artificial and natural. This scale of intervention (and investment) is very unlikely to be achieved solely through strategic sub-catchment solutions delivered by the Water Utility Companies due to the prohibitively high levels of investment likely required. Promoting water efficiency measures and increasing the inclusion of sustainable drainage mechanisms within development sites across Hertfordshire should become a fundamental element of the planning process. This should include the consideration of

Conclusion	Comments & Discussion
	RWHS *(See Section 10.6.1 and Section 10.6.2)* and retro-fitting SuDS as part of long-term infrastructure upgrades, urban regeneration projects and green infrastructure planning
Long-term Capacity Building Essential to Address Underlying Water Infrastructure Challenges	Many of the major challenges facing Hertfordshire (and most councils in the UK) are inherently linked to the extensive nature of water infrastructure assets and the need for continual upgrade and maintenance. The evaluation of need has indicated that investment in the long-term is likely to be widespread and cover most aspects of the water cycle, including elements which can only be addressed indirectly by the Water Utility Companies (e.g. water efficiencies, water usage, the health of the groundwater aquifer etc.). Influencing improvements to these underlying will require long-term investment and planning, facilitated by greater clarify of growth projections emerging from the districts planning process. In addition, strategic improvements to treatment capacity at major STWs (such as Maple Lodge and Rye Meads) will underpin how the district's plan the location of growth, ultimately affecting the prosperity of the region.
Long-term Planning Needs an Effective link to Short-term Investment	The privatisation of the 10 UK regional water authorities in 1989 was largely driven by the challenge of funding asset maintenance and improvement works with growing limits on public sector borrowing and increasing costs of meeting new environmental directives set by the European Union (EU). The regulatory framework formed, essential to manage the natural monopolies that were created (i.e. customers could not change their provider of water), was based on a five-year review (AMP) period to control water bills and set service levels. This regulatory mechanism (Ofwat) inherently focuses all investment within each five-year AMP period based on needs identified at the end of the last five-year AMP period. Defining what to include within in each AMP period is largely based the highest priority needs, promoting investment that addresses the most pressing or current issues (reactive planning). This approach, although a pragmatic process to ensure the Water Utility Companies meet their regulatory requirements, does not provide an effective platform for long-term (proactive planning). Funding for schemes that could address many issues and provide sub-catchment scale improvements to help facilitate growth will also require greater certainty than short-term investments, which can be very difficult to attain. It is essential that a greater understanding of what funding options are available, how they could be applied to Hertfordshire and the nature of long-term planning required to secure it (i.e. level of confidence in growth, commitments, delivery risk etc.). The Water Utility Companies do maintain long-term plans (25 years) but they typically only provide broad directional guidance. Over the last few AMP periods Ofwat priorities, in terms of required improvements and efficiencies, have changed which creates a 'moving-target' for the Water Utility Companies to aim their long-term planning. As a result, they are unlikely to include any effective mechanisms which link them to short-term planning within the AMP planning process due to this uncertainty over potential investment requirements within future AMP period. This can mean long-term issues are be unlikely to attract sufficient investment.
Cooperation, Collaboration,	The nature of the challenges facing Hertfordshire in the long-term are varied and intrinsically linked to the function of the whole water cycle. As the pressures of development and climate change continue to grow the reliance on traditional engineering and

Conclusion	Comments & Discussion
Information and Innovation are Key to Long-term Resilience	design approaches will become less resilient, while the investment likely needed to continue to upgrade existing assets could become unaffordable. Providing adequate sewerage and water supply should become a more shared responsibility (at within high-level planning) when considering the potential impacts of non-cooperation in the long-term. Moreover, for local authorities there is effectively a duty to co-operate with the Water Utility Companies to inform their long-term planning and link uncertainty with the decision-making process. Innovation is a key component of any strategy to address a changing environment like this. Many of the options presented in this study would require reliance on uncertain and novel techniques, many of which are not widely used in either the UK or internationally at present. However, the inherent benefits of such options highlight the need to innovate to provide resilient water infrastructure. Key to the success of long-term planning is the management and organisation of data and information. Planning at this scale will require a comprehensive understanding of proposed development site locations, water infrastructure, groundwater conditions, etc., the data for which will be spread across a range of organisations and locations.
Benefits of a Collective Voice	The outcomes of this study provide a strong collective voice to support any lobbying for change, in terms of regulatory (Ofwat / EA) and financial (UK Government / local developers). Lobbying and direct contact with policymakers are critical components to support campaigns that can be instrumental in achieving policy change. Many of the water management and policy based options suggested would require such a collective approach.
Difficult to Incorporate the Intangible Elements of the Development Planning Process when Identifying the Geographical Context of Growth	The methodology employed to create a geographical context from which the derived growth projections could be using in the modelling proved effective and broadly robust. However, consultations with the districts indicated significant discrepancies in some locations between the indicative growth areas identified and actual expectations. These discrepancies were largely due to intangible expectations or aspirations of development which could not be incorporated into the methodology or growth being placed in-between two existing settlements. These factors were considered during consultations and some indicative growth areas were removed, but all potential unrealistic locations could not be feasibly removed. Although this has added a certain degree of uncertainty the no alternative methodology could be identified within the time restrictions of the study. This uncertainty remains the largest issue with planning for long-term water infrastructure, that will require further investigation and clarification during Phase 2.

12.2 District Conclusions

Overall conclusions for each district have been outlined in Table 8 to support the development of local plans and infrastructure delivery plans. More detailed information on the specific outcomes of the evaluation, indicative growth areas and water cycle function requirements can be found in Section 7.

District	Conclusions
Chiltern *(See Section 8.1)*	The success of growth along the Amersham valley (Inc. in Amersham, Chalfont St Giles and Gerrards Cross) is linked to the maintenance of sufficient capacity in the strategic trunk sewer network. In and around Chesham, growth is relatively unconstrained (by water infrastructure) and balancing this available capacity with potential deficits in the Amersham Valley could provide a resilience long-term strategy to support growth.
Dacorum *(See Section 8.2)*	The need for strategic intervention in the Berkhamsted area in the medium-term places an emphasis on sensitive planning and collaboration with the Water Utility Companies, to avoid developing significant deficits in the long-term. The potential for water quality to be impacted by development of the upper Gade river basin and northern parts of Hemel Hempstead highlights the need to promote sustainable and water efficient development. Hemel Hempstead demonstrates reasonable opportunity for effective unconstrained (by water infrastructure) development / re-development in the short and medium-term.
East Hertfordshire *(See Section 8.3)*	Short and medium-term growth expectations look robust and achievable, with the need for few judicious investments in local infrastructure (potentially linked to investments in Stevenage and Welwyn Hatfield).
Hertsmere *(See Section 8.4)*	Short-term growth expectations look robust and achievable, with the need for few judicious investments in local infrastructure. In the medium and longer-term the disparate expected nature of growth is likely to place various pressures on local sewer networks, ancillaries and water quality, all which will need addressing through well planned interventions.
North Hertfordshire *(See Section 8.5)*	Growth expectations indicate large potential areas of urban extension. However, the derivation of indicative growth areas is considered to be over-conservative, when considering other factors in the planning process (See Section 8.5.1). The water infrastructure appears to be largely resilient to the quantum of growth projected, although further investigation is recommended to clarify the assumptions of growth locations during Phase 2.
St Albans *(See Section 8.6)*	With the majority of growth expected to be delivered in new development areas the capacity of the key trunk sewer networks is vital. The evaluation has broadly demonstrated that they are likely to be sufficient to accommodate growth in the short and medium-term, with the need for few judicious investments in local infrastructure.
Stevenage *(See Section 8.7)*	The nature of existing development in this district focuses the primary water infrastructure need at the effective capacity of the strategic trunk sewer network serving the whole district, and elements of the network downstream in Hertford. Investments to improve capacity and resilience will likely be significant (due mainly to the urbanised nature of the district). This highlights the importance of promoting sustainable and water efficient development.

District	Conclusions
Three Rivers *(See Section 8.8)*	The main two areas of expected growth, around northwest and southwest Watford look largely unrestricted (by water infrastructure), showing encouraging opportunity for growth across the district. Around Rickmansworth the capacity of the trunk sewers, serving this area, Watford, Hemel Hempstead and St Albans, is strategically important. Significant investment is likely to be necessary to facilitate the quantum of growth across all these areas. Addressing potential future capacity deficits should look to combine upgrade works with sustainable flow reduction strategies.
Watford *(See Section 8.9)*	The nature of existing development in this district focuses the primary water infrastructure need at the effective capacity of the strategic trunk sewer network serving the whole district, and catchments upstream (Inc. Hemel Hempstead and St Albans). Investments to improve capacity and resilience will likely be significant (due mainly to the urbanised nature of the district). This highlights the importance of promoting sustainable and water efficient development.
Welwyn Hatfield *(See Section 8.10)*	Growth expectations in this district are varied, although relatively limited in the short-term. In the medium-term growth expectations look robust and achievable, with the need for few judicious investments in local infrastructure and limiting foul flows. In the long-term potential strategic investment in the sewer network and ancillaries around Welwyn Garden City and Hatfield look to become necessary. However, indications are that the indicative growth areas identified in this area could be over-conservative, and the scale of strategic intervention could be relatively limited.

Table 8 - District Conclusions

12.3 Sub-catchment Conclusions

Overall conclusions for each sub-catchment have been outlined in Table 9 to support the assessment of infrastructure need and the sub-catchment solutions proposed, related to the Water Utility Company short-term and long-term planning.

Sub-catchment	Conclusions
Amersham and Misbourne Valley (1) *(See Section 9.2)*	This sub-catchment is served by an inherently linear sewer network, discharging directly to Maple Lodge STW. This linearity infers that investment in increased capacity, to support growth expectations, is likely to focus increased pressures on Maple Lodge STW as flows is passed downstream more effectively. Addressing this will likely require balancing growth in this sub-catchment with the Chesham and Upper Chess sub-catchment (Solution A) and / or employing strategies to manage foul flows within the catchment (Solution B). This focus on a single linear trunk network could also be addressed through the support of growth within a more defined geographical context, served by dedicated water infrastructure systems (Solution C).
Ash Valley Rural Settlements (2)	The rural nature of tis sub-catchment effectively precludes the recommendation for major strategic infrastructure, which would not comply with the concepts of the Vision for Hertfordshire. Local judicious investments in sewerage ancillaries and reducing foul flows (through water saving initiatives and policies) are likely to be sufficient to support local growth.

Sub-catchment	Conclusions
(See Section 9.3)	
Berkhamsted (3) *(See Section 9.4)*	A long-term strategy to ensure growth does not adversely affect water quality is recommended for this sub-catchment.
Bishop's Stortford (4) *(See Section 9.5)*	As outlined in Section 9.5 it is likely that continual short-term investments (such as those listed in Section 8.3) should be sufficient to accommodate projected growth in this sub-catchment.
Chesham and Upper Chess Valley (5) *(See Section 9.6)*	As outlined in Section 9.6 it is likely that continual short-term investments (such as those listed in Section 8.1) should be sufficient to accommodate projected growth in this sub-catchment.
East Hatfield (6) *(See Section 9.7)*	The indicative growth areas were focused around the western fringes of Welwyn Garden City and Hatfield, and look likely (if growth is promoted in these areas) to require a strategic intervention. Local flood risk from the Lee would make infrastructure works challenging and potentially costly, given the potential future impact of climate change on rainfall. Consolidating growth into discrete development areas implemented as part of a blue-green corridor (Solution A), which would align flood risk management with water quality needs, could provide an opportunity to harmonise growth and water infrastructure. Such a strategy will require long-term planning, integrating district plans with short-term and long-term Water Utility Company Investment.
Harpenden (7) *(See Section 9.8)*	As outlined in Section 9.8 it is likely that continual short-term investments (such as those listed in Section 8.3) should be sufficient to accommodate projected growth in this sub-catchment.
Hemel Hempstead and Bulbourne Valley (8) *(See Section 9.9)*	The primary need in this sub-catchment is water quality, within the upper reaches of the River Gade. It has not been possible to clarify the likely severity of any impact on water quality within this study but the current poor classification of this watercourse (in this area) indicates it is likely to be highly sensitive to future changes. Although not directly related to the needs of this sub-catchment there is opportunity to explore the creation of new surface water storage facilities (Solution A), within the aim of addressing some of the wider challenges of water availability and recommendations made in Section 9.9.
Hitchin and Letchworth Garden City (9) *(See Section 9.10)*	As outlined in Section 9.10 it is likely that continual short-term investments (such as those listed in Section 8.5) should be sufficient to accommodate projected growth in this sub-catchment. However, since the growth projections are considered over-conservative *(See Section 8.5)* further investigations are recommended for this sub-catchment.

Sub-catchment	Conclusions
North East Hertfordshire Rural Settlements (10) *(See Section 9.11)*	The rural nature of tis sub-catchment effectively precludes the recommendation for major strategic infrastructure, which would not comply with the concepts of the Vision for Hertfordshire. As outlined in Section 9.11 it is likely that continual short-term investments *(such as those listed in Section 8.5)* should be sufficient to accommodate projected growth in this sub-catchment.
St Albans and Upper Colne Valley (11) *(See Section 9.13)*	This sub-catchment forms the upper extent of the Maple Lodge STW catchment, east of Watford. Due to the relatively size of the sub-catchment and desperate nature of the sewerage system it could provide a range of opportunities to better manage and / or reduce foul flows (Solution B). The encouraging potential to expand Blackbirds STWs to accommodate a larger proportion of foul flow from this sub-catchment (Solution A), reducing the impact of future growth expectations on the capacity of Maple Lodge STW, should be explored to address long-term pressures.
Stevenage and Rural Area (12) *(See Section 9.14)*	Addressing water infrastructure need in this sub-catchment will likely rely on strategic improvement (Solution B), as outlined for the Stevenage district *(See Section 8.7)*. The issue of water availability is locally important due to the potential impacts of abstraction on local chalk watercourses, such as the River Bean. Current efforts to improve river morphology should be maintained and expanded to incorporate better groundwater aquifer recharge through better catchment management (Solution C). In addition, the use of the extensive surface water system to support groundwater aquifer recharge should be explored (Solution A), potentially as part of long-term urban regeneration plans.
Tring (13) *(See Section 9.15)*	As outlined in Section 9.15 it is likely that continual short-term investments (such as those listed in Section 8.2) should be sufficient to accommodate projected growth in this sub-catchment.
Watford Urban Area (14) *(See Section 9.16)*	Addressing water infrastructure need in this sub-catchment will likely rely on strategic improvement (Solution B), as outlined for the Watford district *(See Section 8.9)*. Due to the urbanised nature of the sub-catchment and since it's located on the strategic sewer network serving most of Welwyn Hatfield, St Albans and Hertsmere, effort to reduce foul flows and improve water efficiency (Solution A and Solution C) within the city should become part of a long-term resilience strategy.
Welwyn Garden City and Hertford Growth Area (15) *(See Section 9.17)*	The capacity of the strategic trunk sewers serving Welwyn Garden City, Hertford and Ware form the lower section of the wider Rye Meads network, which includes Stevenage, are critical to support the projected quantum of growth. Supporting the indicative growth areas clustered around Hertford may require significant investment in reducing and managing foul flows in the trunk sewers (Solution A and Solution C). Any major trunk sewer upgrade works should be planning and implemented with consideration for the water infrastructure needs in Stevenage and at Rye Meads STW downstream.

Table 9 - Sub-catchment Conclusions

12.3.1 Proposed Strategy for Hertfordshire

To identify, design and implement any of the sub-catchment solutions outlined in Section 9 within the guiding philosophy of the Water Vision for Hertfordshire, as outlined in Section 3, planning needs to be undertaken as part of overarching catchment strategy.

Due to the inherent complexity of addressing water infrastructure over 35 years within broad partnership an operating strategy should be inherently dynamic, easily adaptable to changing environmental, commercial and social-economic factors. This study does not set out to define a specific strategy. An outline proposal has been derived for the purpose of instigating discussions, and is shown in Figure 74.

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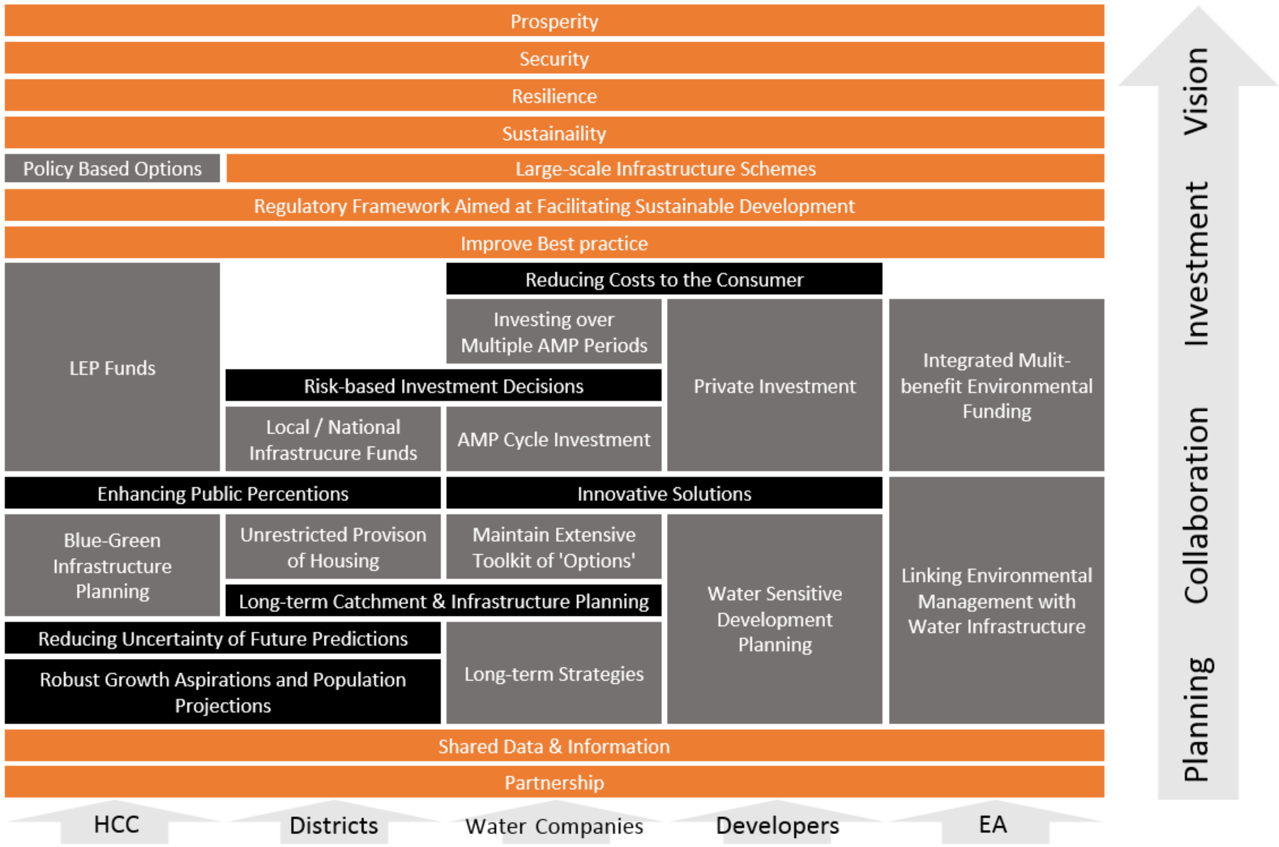


Figure 74 - Hertfordshire Proposed Strategy Map

12.4 Next Steps

This study was conceived as the first phase or a (at least) two-phase project, the second focused around clarifying assumptions and proving feasibility of design.

Converting the outcomes of this study into effective planning and policy will require the extension of the current partnership to provide continued collaboration, plan any promoted stage two investigations, and support the AMP7 planning process. The specific roles and responsibilities for each partner will need greater clarify within a structured reporting system, facilitated through regular meetings, reporting and interactive discussions to explore issues and opportunities.

To provide an effective mechanism to explore sustainable drainage and water efficiency measures, linked to long-term planning (and targets), key property developers active within Hertfordshire should be engaged and included within the scope of the partnership.

The five-point action plan, shown in Section 12.4.1, has been developed to recommend a way forward, covering the anticipated AMP7 planning process, specifically identifying how the outcomes of this study could be used to inform that process.

12.4.1 Five-Point Action Plan

This study has been planned and delivered as a discrete study, with the aim of developing a report detailing broad recommendations, implementation strategies and proposing a conceptual road map for sustainable growth, a buoyant economy and a generally more prosperous Hertfordshire up to 2051. Translating the positive outcomes of this study into a practical framework, essential to support the funding of proposed infrastructure schemes, requires the creation of a long-term collaborative partnership, based on the principles agreed to support this study.

Going forwards, this partnership should to expanded to include members of other key public authorities, local economic groups, local major businesses and environmental management organisations (e.g. local wildlife trusts), identified through open discussions. The partnership may want to develop a set of guiding principles or philosophies, aimed at steering the continued exploration of integrated sub-catchment solutions and supporting planning activities.

In addition to the partnership it is recommended that growth risk profiles *(See Section 12.4.4)* and an integrated planning portal are developed to support the Water Utility Companies planning activities for AMP7 (as laid out in

Figure 76), with the aim of securing any initial Water Utility Company investment within the PR19 timetable (September 2018).

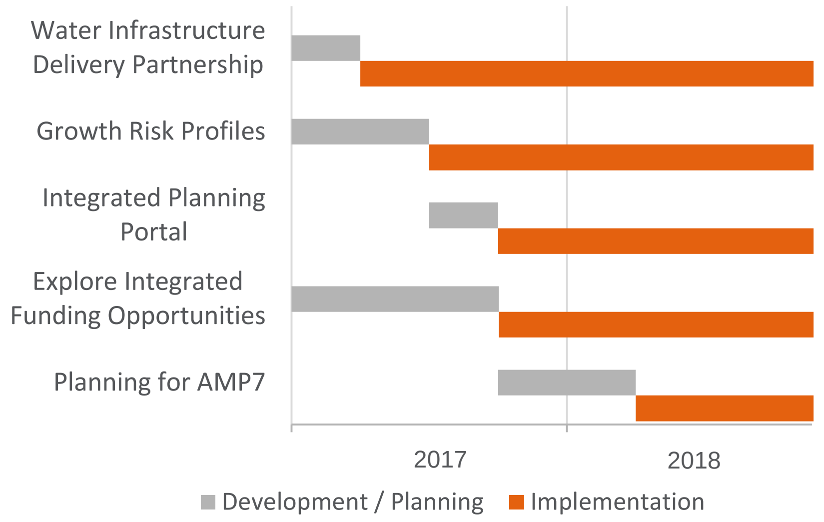


Figure 75 - Next Steps, Recommended Action Plan Timeframe

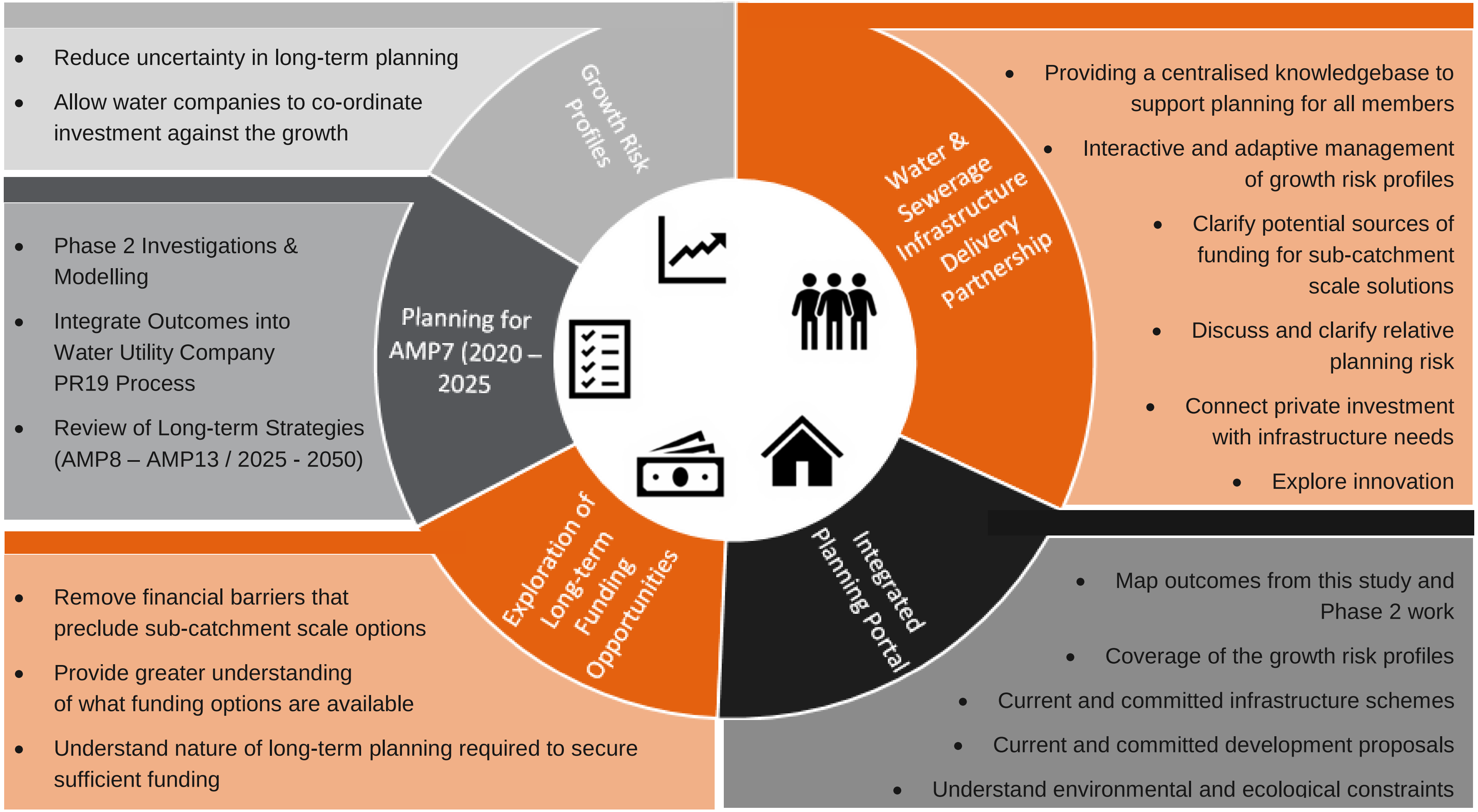


Figure 76 - Next Steps, Recommended Action Plan

12.4.2 Water & Sewerage Infrastructure Delivery Partnership

It is recommended that the partnership is expanded into broader a public-private initiative, to include a range of other relevant public and private stakeholders. The partnership should be led by a dedicated Water Liaison Officer in Hertfordshire County Council and run as a catalyst for innovation and collaboration, having an emphasis on the following key elements:

- Understanding growth and development, reducing uncertainty and providing a centralised knowledgebase to support planning for all partners and stakeholders
- Clarify and support bidding for potential sources of funding for sub-catchment scale solutions
- Discussing and clarifying relative planning risk
- Connecting private investment with Appendix C infrastructure needs
- Exploring innovation and sustainability

The current partners should form the core partnership, supported by a range of other local and regional stakeholders (as appropriate), suggestions as follows:

- Local & National Property Developers
- Hertfordshire Association of Parish and Town Councils
- River Lee Catchment Partnership
- University of Hertfordshire
- Highways England
- Natural England
- Canal & Rivers Trust
- Forestry Commission

A suggested set of key roles and responsibilities for each of the core partners has been laid out in Table 10.

Partner	Role & Responsibility
Hertfordshire County Council	• Provide overview and coordination, including facilitating the sharing of data and information • Driving collaboration between parties and stakeholders on issues of common interest and concern
District Councils	• Maintain and share robust growth figures • Develop long-term growth aspirations (beyond local plans), working with neighbouring districts and the Water Utility Companies to develop a shared view of growth • Provide the Water Utility Companies greater clarify and confidence of development at defined time horizons • Work jointly with neighbouring districts at the sub-catchment level
Water Utility Companies	• Provide open and transparent information on infrastructure capacity deficits, planning and investment • Incorporate district planning into short-term and long-term plans as part of a regular revision process
Environment Agency	• Support the Water Utility Companies plan and manage discharges to the environment through early engagement on development planning • Support Hertfordshire County Council promoting and prioritising sustainable standards for local developers
Hertfordshire LEP	• Support the Water Utility Companies, local developers and businesses implement innovative water technologies • Explore investment strategies for major long-term water infrastructure projects to support housing delivery

Partner	Role & Responsibility
Hertfordshire HIPP	• Promote collaboration on water infrastructure and investment as part of the Hertfordshire Vision

Table 10 - Roles & Responsibilities

12.4.3 Shared Planning Portal

To support the work of the partnership in the long-term it is recommended that a GIS-based infrastructure and planning portal is established as a singular source of information.

The primary aim of this would be to help facilitate more transparent collaboration and provide partners with up-to-date technical information to support both joint and dedicated planning activities.

The portal should include the following:

- Mapped outcomes from this study
- Coverage of the growth risk profiles, including Low / Med / High classifications
- Current and committed infrastructure schemes
- Current and committed development proposals
- Environmental and ecological constraints

A binding agreement should be formed to formalise the usage of the system. This agreement will need to include a procedure to ensure that district development planning information is maintained up-to-date. This will provide the Water Utility Companies with certainty of growth projections to support their investments in long-term planning.

12.4.4 Growth Risk Profiles

Profiling growth would help emerging local plan growth strategies to be assessed for their risk, in terms of impact on the existing water and sewerage network by removing some of the uncertainty from long-term water infrastructure planning. This would allow water companies to co-ordinate investment against the growth strategy, which would improve planning of such investment in future AMP periods. Alternatively, it could be used to provide alternate growth strategies may be more cost effective or easier to implement, from a water infrastructure perspective.

Growth numbers for distinct areas of each district, the sub-catchments defined here or based on another definition, could be distributed based on Low, Med and High risk bands. Levels of confidence across the AMP periods would allow the Water Utility Companies to match investment with the quantum of growth. Clarifying risk in this manner would support the consideration of more long-term sub-catchment scale solutions, possibly to be implemented over a number of AMP periods to accommodate the planning, design and implementation.

A graphic representation of this approach has been shown in Figure 77.

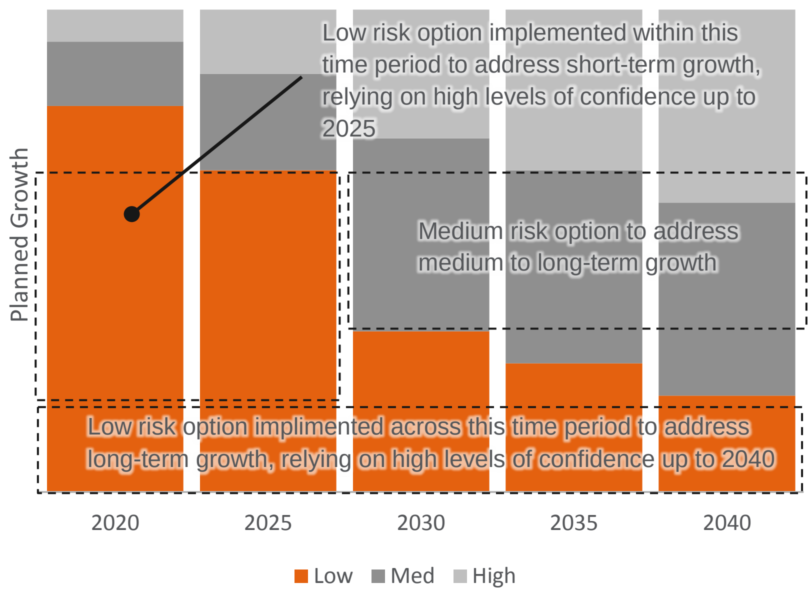


Figure 77 - Potential Growth Agreement Arrangements, Agreed Growth Risk Profiles

Once a Water Utility Company commits to invest in infrastructure beyond the current planning period the growth area(s) and figures become 'fixed' and can only change for the following AMP period subject to consultation with the Water Utility Company. As each AMP period finishes, the level of confidence in the figures for each successive period should gradually increase (as expected growth areas and figures become more defined), ensuring Water Utility Company commitments remain in the low risk category and any ongoing infrastructure planning and design can continue unaffected by changes to growth plans.

Any figures could be linked to defined areas and managed within the Integrated Planning Portal, as discussed in Section 12.4.3.

12.4.5 Exploration of Long-term Funding Opportunities

Funding opportunities for long-term infrastructure improvements are diverse and have been extensively evaluated in Section 11. Given this diversity, no specific mechanism or approach has been recommended at this stage. Funding should be a main agenda item for regular partnership meetings.

It is recommended that a dedicated infrastructure funding study is commissioned to further explore the options available and the potential to secure private investment, tied to the PR19 process and districts long-term planning activities.

12.4.6 Planning for AMP7 (2020 – 2025)

Phase 2 Investigations & Modelling

As laid out by during the early scoping stages by Hertfordshire County Council this study would form Phase 1 of a two-phase approach. The second phase would be informed by the outputs of the first (this study) and the nature of the work required would need be evaluated, following review of the conclusions.

The Phase 2 work should build upon the outcomes of the Phase 1, focusing on more detailed hydraulic analysis and scoping of potential interventions, and the clarification of specific development proposals (where possible). The projected growth figures and indicative development areas identified in this study should be used as the basis of assessment. However, all growth projections should be checked against the latest local plans through a similar process as was used in this study.

A proposed outline framework for any Phase 2 works has been provided in Appendix H.

Integrate Outcomes into Water Utility Company PR19 Process

During the PR19 process the Water Utility Companies will review the health and performance of their assets across the region to define their investment plan for AMP7 (2020-2025). The assessment of health and performance should take into consideration the outcomes of this study (where applicable) and use the assessment of growth areas to support more detailed hydraulic modelling of target areas and assets. This modelling should focus on clarifying the assumptions made in this study, specifically in terms of operational performance of ancillaries, environmental impact of foul discharges and the feasibility of the range of options proposed, in terms of engineering and cost-benefit.

Any Phase 2 investigations will need to be incorporated into this process to ensure funding can be allocated should any schemes be considered viable.

Review of Long-term Strategies (AMP8 – AMP13 / 2025 - 2050)

The long-term strategies will be instrumental in demonstrating Water Utility Company policy for the long-term and how it supports sub-catchment scale solutions. It is recommended that this strategy document is reviewed in parallel to recommendations within the PR19 process.

The document should consider the outcomes of the Growth Risk Profiles *(See Section 12.4.4)* and Exploration of Long-term Funding Opportunities (See Section 12.4.5).

12.4.7 Other Suggested Considerations

Considerations	Description
Update Hertfordshire Strategic Green Infrastructure Plan (SGIP)	The integration of the outcomes of this study into the SGIP plan should be undertaken to explore and highlight any functional synergies, both engineering and financial. Many of the sub-catchment solutions and policy options are based on the concept of multi-functional green spaces, for which the SGIP could provide a broader framework to enhance option cost-benefit and support the decision-making process.
Strategic Surface Water Reinjection Technology Research and Development	The re-injection of surface water, from urban runoff, as proposed for a number of sub-catchment could provide significant water resilience across the catchment in the long-term. Re-injection technologies are well established but linking them to traditional surface water networks is not widely practiced, especially in Europe. Schemes have been implemented in Australia which demonstrate the underlying feasibility and practicality of this approach. Further research will need to be undertaken to ensure this approach is relevant to the UK and Hertfordshire.
Public Facing Engagement Initiative	It is recommended that Hertfordshire County Council consider running a public engagement initiative to demonstrate the commitment of the partnership to ensuring water security for Hertfordshire. This could provide an interface with potential private investors and the public in general, from which a better understanding of public opinion could be generated to help identify any social barriers to successful interventions.

13 GLOSSARY

Word	Description
Abstraction	The process of removing water from a river or other source, such as groundwater
Active System Controls (ASC)	Active Systems Controls are intelligent network control systems using centralised data systems aimed at optimising efficiency of wastewater and water distribution networks.
Ancillary	A civil and / or mechanical component of necessary support to the primary activities or operation of the whole sewerage and water distribution system.
Anthropological	Human induced
Aquifer	A body of permeable rock which can contain or transmit groundwater
Asset Management Period (AMP)	A period of five years in which Water Utility Companies implement planned upgrades and improvements to their asset base. For example, AMP6 is 2015-2020.
Average Trunk Sewer Capacity	Effective pipe capacity, derived from dimensions extracted from the Water Utility Company network data and standard hydraulic calculations.
Borehole	A borehole is a narrow shaft bored in the ground, either vertically or horizontally. A borehole may be constructed for many different purposes, including the extraction of water.
Calibration	The process by which numerical models are refined by comparing model results with actual measured data.
Catchment Abstraction Management Strategies (CAMS)	The production of a strategy by the Environment Agency (EA) to assess and improve the amount of water that is available on a catchment scale. The latest CAMS strategies can be found at: https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process.
The Community Infrastructure Levy (CIL)	The Community Infrastructure Levy is a planning charge, introduced by the Planning Act 2008 as a tool for local authorities in England and Wales to help deliver infrastructure to support the development of their area. It came into force on 6 April 2010 through the Community Infrastructure Levy Regulations 2010.
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.

Word	Description
CSOs Formula ‘A’ Compliance	Assumption that CSOs will spill once Formula ‘A’ flows are reached
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 Environment Agency 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.
Dry Weather Flow (DWF)	An estimation of the flow of wastewater to a Water Recycling Centre during a period of dry weather. This is based on the 20th percentile of daily flow through the works over a rolling 3-year period.
CAPEX	Capital Investment Cost
End-of-pipe	Methods used to reduce flow and volume, or remove pollutants affecting water quality, implemented at the last stage of a process before discharge to a receptor (watercourse / resident water supply).
Estimated Peak Pump Rates	Estimated maximum combined operational flow capacity of the pumps in a SPS.
Eutrophication	The depletion of oxygen in a water body, which kills aquatic animals. It is a response to the addition of excess nutrients, mainly phosphates, which induces explosive growth of plants and algae, the decaying of which consumes oxygen from the water.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.
Grassy Swale	A grassy swale is a graded and engineered landscape feature appearing as a shallow open channel. The swale is vegetated with flood tolerant, erosion resistant plants. The design of grassed swales promotes the conveyance of storm water at a slower, controlled rate and acts as a filter medium removing pollutants and allowing stormwater infiltration.
Groundwater	Water found underground in the cracks and spaces in soil, sand and rock, moving slowly through aquifers
Hertfordshire County Council	Hertfordshire County Council

Word	Description
Headroom	Effective function capacity of an ancillary to accommodate greater levels of flow / demand that at present, typically measured as a population equivalent figure (i.e. the number of additional people required to maximise the ancillary capacity)
Headwaters	A tributary stream of a river close to or forming part of its source
Infiltration	Infiltration is the process by which water on the ground surface enters the soil.
Infrastructure	Consists of what is built to pump, divert, transport, store, treat, and deliver water to communities i.e. sewer networks and pumping stations.
l/h/d	Litres per Head (person) per day. This is the unit used to compare the average water consumption per person per day.
Local Plan	A document outlining the spatial planning strategy for each local authority. The Local Plan will contain a number of statutory documents setting out the long-term planning and land use policies for a given area
Ml (Mega Litre)	The unit used to measure abstraction rates equivalent to 1 Ml is equivalent to 1,000,000 l
Numerical Modelling	Mathematical modelling that use a numerical time-stepping procedure to obtain a models behaviour over time, the solution being represented by a generated tabular or graphic data
Ofwat	Regulates water and sewerage providers in England and Wales.
OPEX	Operating Costs
Optant	In terms of water supply the term optant is used to describe customer driven water reducing measures. A customer can choose to use these measures under recommendation from the water supplier.
Passive Systems	A system that operates based on pre-defined logical controls or physical structures to manage the flow of water.
Peak Dry Weather Flow	3 X DWF, representing a typical peak dry weather flow condition.
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).
Percolation	The slow movement of water through the pores in soil or permeable rock.

Word	Description
Population Equivalent	Is a method of measuring the loading on a Water Recycling Centre, 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.
PR19	Water Utility Company price review process that sets the price, investment and service package that customers receive for the AMP7 management period (2020 – 2025). This includes controlling the prices the companies can charge their customers.
Rainfall Runoff	9 X DWF, representing an estimate of peak flow conditions during a significant rainfall event.
RHWS	Rain Water Harvesting Systems, designed to store rainwater from roofs and hard surfaces and reused as non-potable water, which can also be used to reduce the rates and volumes of runoff.
Riparian Landowner	The owner of land adjacent to a watercourse.
River Basin Management Plans (RBMP)	Documents being produced for consultation by each of the Environment Agency 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 Morphology	Describes the shape of a river channel and how it changes in shape and direction over time.
Runoff	The draining away of water from the surface of an area of land, a building or structure, etc.
Sewer Ancillaries	Non-network (e.g. pipes) infrastructure, including SPSs, CSOS and storage tanks.
Sewage Pumping Stations (SPS)	Pumping stations necessary to ‘lift’ and transport wastewater short or large distances, where a gravity piped network wouldn’t be possible. Only SPSs located on the trunk sewer network have been evaluated for this study.
Sewage Treatment Works (STW)	Facility which treats wastewater through a combination of physical, biological and chemical processes.
Smart Meter	A smart meter is an electronic device that records consumption of water and communicates that information at least daily back to the utility for monitoring and billing.

Word	Description
Soakaways	Soakaways are square or circular excavations either filled with rubble or lined with brickwork, pre-cast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They allow the storage of immediate run-off from roofs and hard surfaces and then the dispersion of collected water into the surrounding soil.
STW Capacity Figures	Effective population that can be served.
Source Protection Zones (SPZ)	Zones designated around public drinking water abstractions and sensitive receptors which detail risk to the groundwater zone they protect.
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.
Trunk Sewers	The main skeletal network of sewer pipes, typically >300mm diameter, which convey wastewater to the sewage treatment works (STW) for treatment.
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.
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: • 2015 - Meet environmental objectives / First management cycle ends / Second river basin management plan and first flood risk management plan • 2021 - Second management cycle ends • 2027 - Third management cycle ends / final deadline for meeting objectives
Water Resource Management Plan (WRMP)	Water Utility Companies prepare WRMPs that look ahead 25 years or more. Sets out the investment needed to ensure Water Utility Companies have sufficient water to continue supplying customers.
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. Defined within WRMPs.

Word	Description
Water Stress	water stress is defined as a region where the current or future demand for household water is, or is likely to be, a high proportion of the effective rainfall which is available to meet that demand, and can cause deterioration of fresh water resources in terms of quantity (aquifer over-exploitation, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.).
Water Treatment Works (WTW)	A facility that treats abstracted raw water to bring it up to potable standards.
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.
Winterbourne	Streams which often run dry, or partially dry, in late summer because of lack of rainfall recharging the aquifer.

APPENDIX A

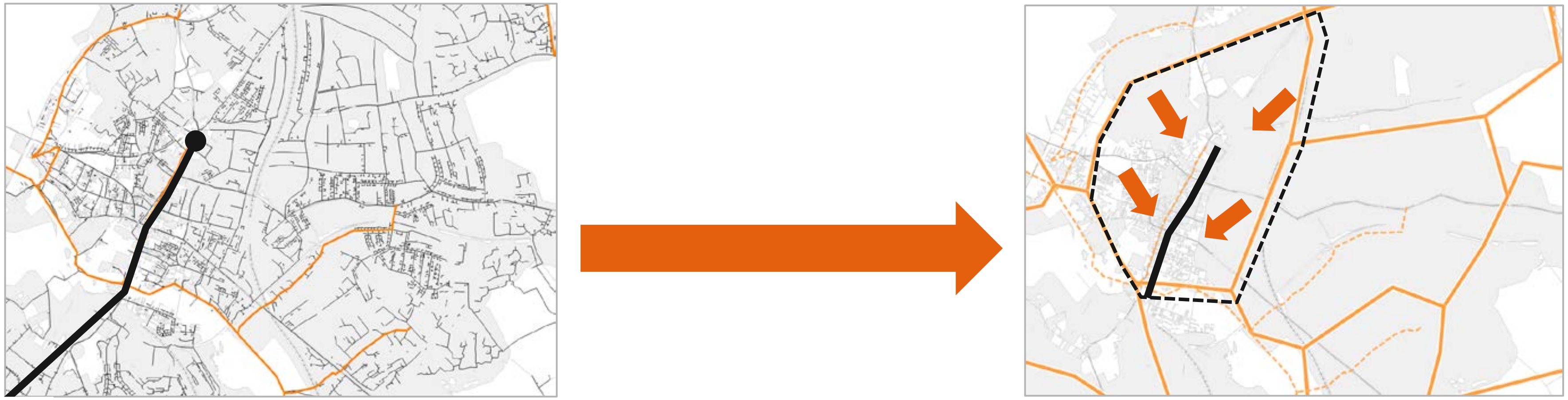
Wastewater System Schematisation

Wastewater Schematic

Sewer network data covering Hertfordshire was obtained from Thames Water and Anglian Water and used as the basis to define the schematic. Key trunk sewer lengths were identified based on their diameter and relative criticality within the overall network (i.e. they collect flows from a significant number of minor sewers). A similar approach was applied to identify sewer ancillaries, including SPSs, CSOs and STWs.

Water Function Catchments

For each trunk sewer length and sewer ancillary an effective drainage catchment, the area which it drains (or would likely be drained by gravity if development occurred there), was derived. A graphical demonstration of the process used to identify the trunk sewer network and network catchments is shown below.



Simplification of the Network		Network Sub-catchments	
Schematic trunk sewers		Schematic trunk sewers	
All public sewers		Trunk sewer sub-catchments	

APPENDIX B

Definitions of Classification of Need for the Wastewater System

Class	Wastewater Network	Wastewater Ancillaries	Wastewater Treatment	Wastewater Flows
Strategic Intervention	Major upsizing, potentially requirement tunnelling, major storage facilities and / or strategic surface water separation >30% pipe full capacity remaining during DWF > -10% pipe full capacity remaining during rainfall (deficit)	Major new ancillary construction, such as new terminal / transfer SPSs and / or major rising main construction > -20% effective operating capacity (deficit)	Major upgrade works / new STWs serving a significant area of Hertfordshire, including new process streams and / or improve discharge quality > -25% treatment headroom (deficit)	Major sewer upsizing and / or new trunk sewers to convey significant increases in sewer flow and prevent flooding
Focused Planning	Targeted open-cut upsizing and / or online storage >50% pipe full capacity remaining during DWF >5% pipe full capacity remaining during rainfall	Pump upgrade schemes, rising main rehabilitation and minor local storage = effective operating capacity	Optimisation investigations to improve process capacity and / or provided additional storage = treatment capacity	Targeted improvement works to maximise the capacity of existing assets / provide sufficient headroom to accommodate growth
Routine Investment	Sewer remediation and maintenance, with potential minor corrective or upgrade works >75% pipe full capacity remaining during DWF >20% pipe full capacity remaining during rainfall	General rehabilitation and upgrade works >25% effective operating capacity remaining	Continual investment in day-to-day optimisation of STW processes > 20% treatment headroom available	General sewer maintenance, including sewer replacement, rehabilitation and relining

Note: The numerical model assumptions used to define the Classification of Need for each wastewater function is shown in italics

Definitions of Classification of Need for Water Resources

Class	Water Supply	Water Resource	Water Quality
Strategic Intervention	Strategic Intervention in supply at a wider scale. At this scale, multiple Water Utility Companies are involved and water trading and transfers are widespread.	Strategic regional investment in abstraction capacity and / or drives to significantly reduce public water use	Development of regional partnerships / investigations, plus large-scale river morphology schemes and reductions in CSO discharges.
Focused Planning	Focus on areas with high water usage, retrofitting smart metering, source optimising and identifying new sources of water for supply.	Targeted sustainability reductions (lowered volumes within abstraction licences) and efficiency measures.	Catchment based river morphology schemes and / or reductions in sewerage discharges.
Routine Investment	Continued routine investment in leakage reduction, metering and water efficiency (i.e. lower use appliances).	Continued routine investment in monitoring and licencing.	Continued local routine investment in monitoring and licencing to ensure no deterioration in water quality.

APPENDIX C

Numerical Modelling Capacity and Performance Assessment

The key flow figures used are as follows:

- **Dry Weather Flow (DWF)** – net flow based on resident foul flows, tourist foul flows, infiltration and trade flows.
- **Peak Dry Weather Flow** – 3 X DWF, representing a typical peak dry weather flow condition.
- **Rainfall Runoff** – 9 X DWF, representing an estimate of peak flow conditions during a significant rainfall event.

A range of capacity indicators have been included to help define when components are expected to either fail or become non-compliant. This enabled a better understanding of the available headroom in the system and identification of which future horizon are likely to require interventions.

The main capacity indicators used are as follows:

- **Average Trunk Sewer Capacity** – effective pipe capacity, derived from dimensions extracted from the Water Utility Company network data and standard hydraulic calculations.
- **STW Capacity Figures** – effective population that can be served
- **Estimated Peak Pump Rates**
- **CSOs Formula 'A' Compliance** – assumption that CSOs will spill to the environment once Formula 'A'[47] flows are reached

The results of the modelling were transposed onto the wastewater function catchments and schematic (as discussed in Appendix A) and have been presented graphically within the district summaries (See Section 8) to allow the Classification of Need to be geographically evaluated.

[47] Scottish Environment Protection Agency - Regulatory Method Sewer Overflows, 2014 (Link)

APPENDIX D

Hydraulic Modelling Methodology

The STW catchments modelled were as follows:

- Buntingford STW (TW region)
- Chesham STW (TW region)
- Maple Lodge STW (TW region)
- Letchworth STW (AW region)
- Royston STW (AW region)

Supplementary information was also provided to support the calibration of the numerical model, including STW capacity information (showing current headroom) and ancillary information cards (showing operational capacities and flow rates).

Infiltration Rate

The infiltration figures provided for each STW catchment were used to derive a relationship between upstream population and infiltration rate (as a percentage). This percentage was then applied to all trunk sewers and ancillaries based on the calculated population it serves, forming part of the DWF calculation.

STW Treatment Capacity

The STW headroom figures provided have been used to define the effective operating capacity from which future increases in flow have been measured against, to enable to Classification of Need.

APPENDIX E

Mathematical Derivation of Population Projections

For each district, the 2021 baseline future was based on the 50th percentile unless this was less than the 2021 OAN figure, in which case that figure was used.

The 2031 and 2051 percentiles used to derive the future scenarios are as follows:

Scenario	Derivation Calculation
Low Scenario	5th percentile, representing the lowest expected level of growth
Med Scenario	Average or the Low and Med Scenarios
High Scenario	95th percentile, representing the maximum expected level of growth Or OAN figures, in cases where it is the most conservative projection (i.e. higher than the 95th percentile)

The use of the OAN figures to define the 2021 figure and High Scenario ensures the maximum expected scale of development is being tested. This was discussed and agreed with the district authorities during consultation.

A demonstration of the relationship between the source data and projections, and the scenario percentile projections can be seen in Figure 11.

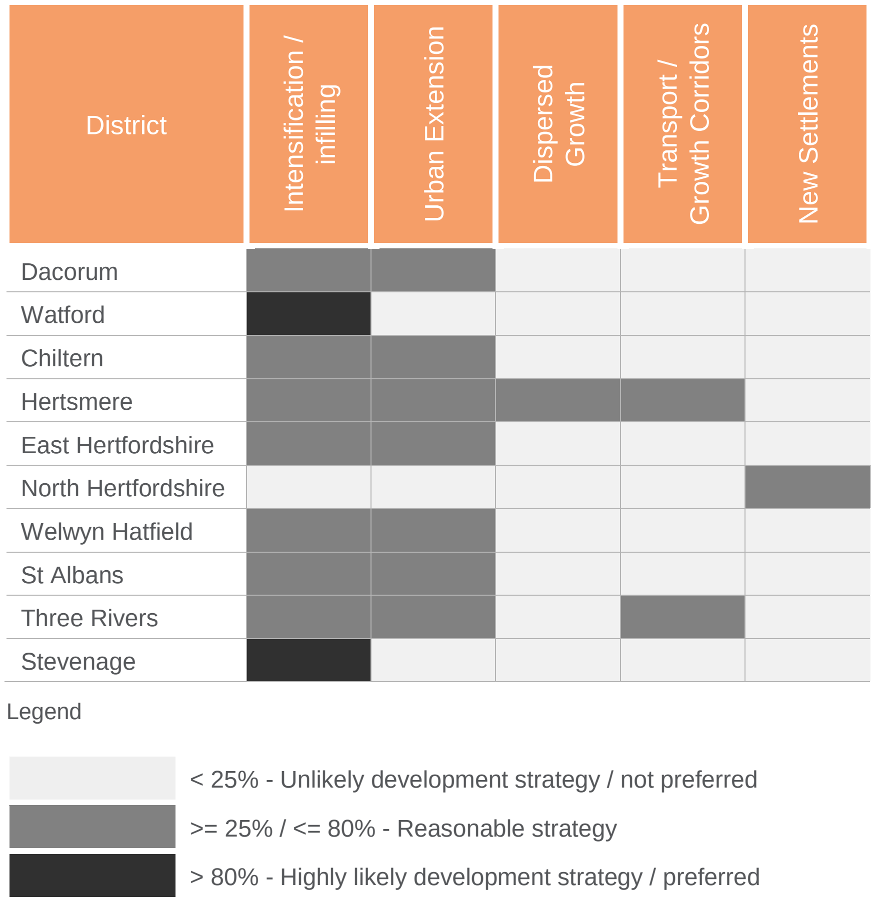
APPENDIX F

District Growth Strategies

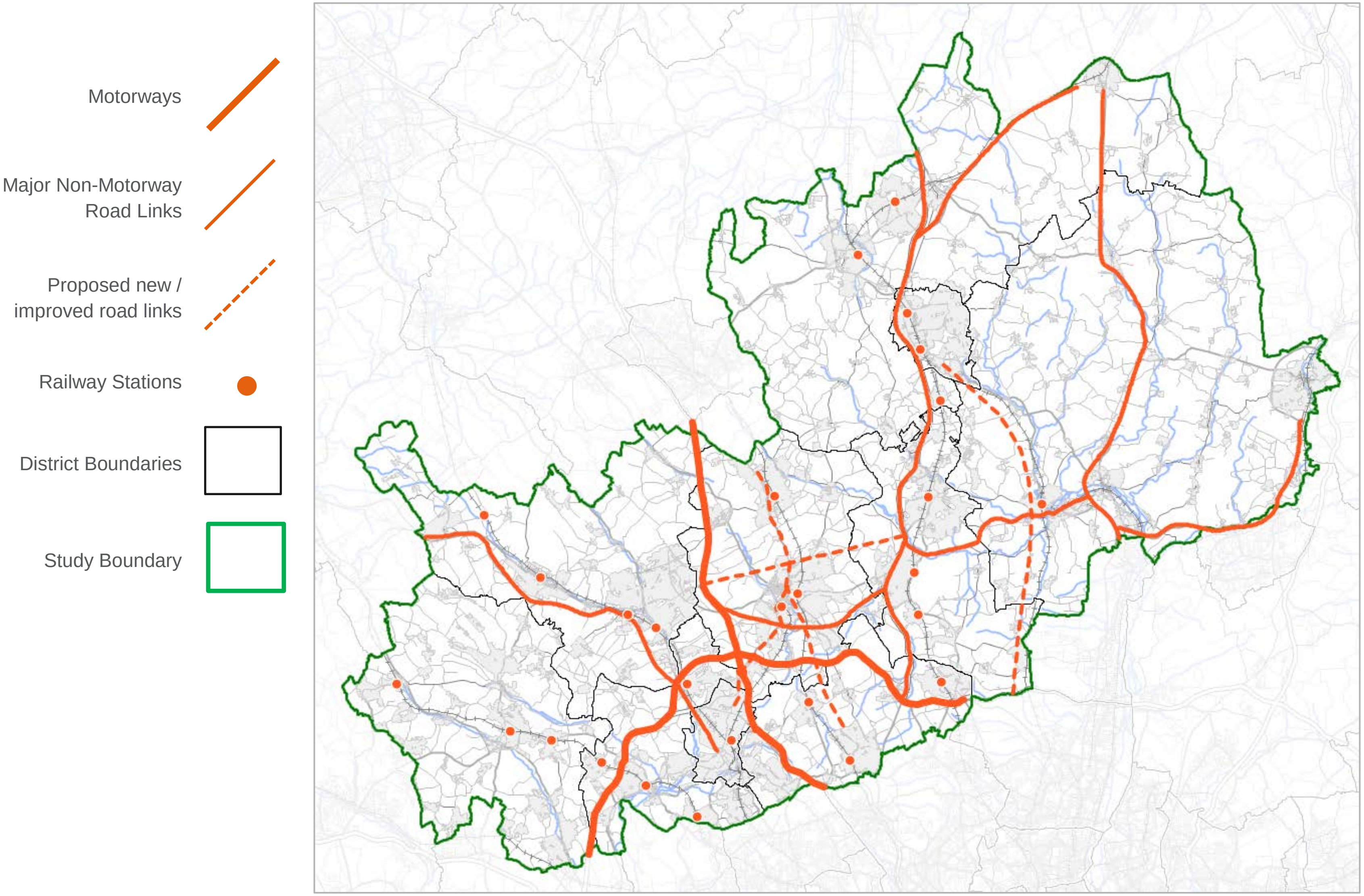
During Partnership consultations, each district stated their expected / preferred growth strategies, based on the following five key concepts defined by Hertfordshire County Council:

- **Urban Extensions** – Urban fringe growth which increases the overall footprint of existing settlements.
- **Intensification / Infilling** – Development and / or re-development of existing settlements, increasing population density without significant new land take. This strategy will be essential for Stevenage and Watford districts due to existing constraints on developable land.
- **Dispersed Growth** – Non-specific, bespoke and / or unplanned development, relatively evenly distributed.
- **Transport / Growth Corridors** – Development within defined or prospective transport corridors, particularly those meeting the needs of residents commuting outside of the area, such as to London. The 2050 Transport Vision envisages significant investment in the local transport network, providing greater opportunities to improve linkages and facilitate growth.
- **New Settlements** – Strategic new towns likely to be built discretely from existing infrastructure. Due to their nature, such areas are difficult to predict and are likely to introduce large uncertainties pertaining to the development of the water infrastructure.

The outcome of this consultation, which was used to support the definition of indicative growth areas *(See Section 6.1.5)* and the distribution of the population projections is shown opposite, as a weighting (percentage).



Growth / Transport Corridor Strategy



APPENDIX G

Interpretation of District Need Summary Plans

The district need summary plans show the Classification of Need based on the wastewater network catchments, developed to evaluate network need *(See Section 6.2.5 and Appendix A)*.

Classification of Need

For the 2021 scenario, the plans have three colour codes relating to the evaluated Classification of Need *(See Section 7.2)*.

For the 2031 and 2051 scenarios, colour coding demonstrates both the Classification of Need and its variability across the three uncertainty scenarios *(See Section 6.1.2)*. Three examples are shown below:

Time Horizon	Example 1	Example 2	Example 3
2021			
2031			
2051			

Example 1

The Classification of Need at each time horizon was evaluated as the same for across the three uncertainty scenarios, hence the colour coding is not hashed.

Example 2

The Classification of Need for the 2031 time horizon has been evaluated to be either Routine Planning (as for 2021) or Focused Investment (as for 2051), based on the difference between the Low, Med and High uncertainty scenarios. This shows that for 2031 the there is some uncertainty in what is needed.

Example 3

For both the 2031 and 2051 time horizons the Classification of Need evaluated across the three uncertainty scenarios differed, introducing uncertainty, hence the hashing. For 2031 the Classification of Need is between Routine Planning and Focused Investment, and for 2051 the Classification of Need is between Focus Planning and Strategic Intervention.

Indicative Growth Areas

The indicative growth areas *(See Section 6.1.5)* derived to facilitate the modelling are included on the maps for reference, represented as filled circles. Their locations are based on a composite of the indicative growth area identified for each uncertainty scenario, representing the complete extent of assumed development.

The circle sizes have been themed based on their approximate area, not projected population. Their coverage and exact location are only representative and served primarily to guide the inclusion of projected population during the modelling.

Where an indicative growth area is located within a wastewater network sub-catchment classified as needing Strategic Intervention, within the medium uncertainty scenario only (i.e. colour coded orange or hashed orange), it has been colour coded orange. This is only for reference. Each indicate growth area should be considered independently with respect to the wastewater network sub-catchments Classification of Need, irrespective of its own colour coding.

Trunk Network & Sewerage Ancillaries

The wastewater network catchments *(See Section 6.2.5)* have been used to provide the geographical context for the Classification of Need for the trunk sewer network and sewerage ancillaries, given they are inherently linked and overlapping. The catchments represent areas which are or would be served (if they were developed) by the lengths of trunk sewer within or the sewerage ancillary immediately downstream.

Water Cycle Functions

Where strategic intervention has been evaluated the specific water cycle function symbol need has been shown on the plan, identifying the catchments. The water cycle function symbol is only shown on the time horizon that strategic intervention first arises, and is not shown for subsequent time horizons (expect if a different water cycle function is evaluated to require strategic intervention).

APPENDIX H

Phase 2 Investigations & Modelling

Key Objectives

There are potentially a range of key objectives for Phase 2, depending on specific partner and planning needs. The primary objectives will include the following:

- Clarification of indicative growth area expectations
- Understanding practicality and feasibility of proposed sub-catchment solutions
- Exploration of potential funding opportunities
- Support AMP7 planning (PR19)
- Contribute to revised Water Utility Company long-term plans
- Support clarification / revision of water transfer agreements

Potential Study / Projects

Study / Project	Suggested Lead Partner(s)	Supporting Partner(s)	Possible Approach	Potential Outcomes
Strategic STW Review	Thames Water / Anglian Water	Hertfordshire County Council	Review of strategically important STWs based on growth expectations developed in Phase 1	Re-definition of process capacity headroom, clarifying timeframe for potential upgrade works
Detailed Growth Areas Assessment	Hertfordshire County Council	Districts	Review and clarification of growth area expectation developed in Phase 1	Detailed understanding of likely growth areas and constraints, providing the Water Utility Companies with greater confidence for their AMP7 planning. This could also feed into the growth risk profiles suggested in 12.4.4
Targeted Network Hydraulic Capacity Assessments	Thames Water / Anglian Water	Districts	Hydraulic assessment of network capacity and headroom, based on growth expectations	Hydraulic assessment will assist Water Utility Companies AMP7 planning
Strategic Sewer Discharge Assessment	Thames Water / Anglian Water	Environment Agency	Review of sewer overflow operation in future, based on growth expectations developed in Phase 1, in relation to water quality and compliance	Appreciation of the location and nature of potential water quality impacts due as a result of growth

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