



Basingstoke Water Cycle Study

Phase 2 Water cycle study report

Halcrow Group Limited

Burderop Park

Swindon

SN4 0QD

01793 812479

http://www.halcrow.com/html/our_markets/watercycleplanning.htm

October 2009

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Basingstoke
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Revision schedule

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Glossary of Terms

Annual Monitoring Report (AMR) - Assesses the implementation of the Local Development Scheme and the extent to which policies in Local Development Documents are being successfully implemented.

Appropriate Assessment – Required by the Habitats Directive (92/43/EEC) for all plans or projects which, either alone or in combination with other plans or projects, would be likely to have a significant effect on a European classified conservation site, and are not directly connected with the management of the site for nature conservation. Its purpose is to assess the implications of a proposal in respect to the site's conservation objectives. The assessment process is not specified by the regulations but is usually an iterative process at a level dependent on the location, size and significance of the proposed plan or project. English Nature can advise on whether a plan or project is likely to have a significant effect and thus require assessment.

Area Action Plans – Development Plan Documents that provide a planning framework for areas of change and areas of conservation.

Areas of Outstanding Natural Beauty (AONB) - Were brought into being by the same legislation as National Parks - the National Parks and Access to the Countryside Act of 1949. They are fine landscapes, of great variety in character and extent. The criteria for designation is their outstanding natural beauty. Many AONBs also fulfil a recreational role but, unlike national parks, this is not a designation criteria. The Countryside Agency and the Countryside Council for Wales are responsible for designating AONBs and advising Government on policies for their protection.

Asset Management Plan (AMP) - a plan for managing an water companies' infrastructure and other assets in order to deliver an agreed standard of service. The Asset Management Plans are submitted to Ofwat every 5 years and forms the basis by which water rates are set. These plans identify the timescales and levels of investment required to maintain and upgrade the serviceability of the assets.

Biodiversity Action Plans (BAPs) – The UK initiative, in response to the Rio Summit in 1992, to conserve and enhance biodiversity. The plan combines new and existing conservation initiatives with the emphasis on a partnership approach and seeks to promote public awareness.

BREEAM - The Building Research Establishment Environmental Assessment Method. A method for assessing the environmental sustainability of a new building. The BREEAM has been superseded by the Code for Sustainable homes for residential developments, but is still in common usage for non-residential developments.

Catchment Abstraction Management Strategy (CAMS) – a strategy to assess how much water can be abstracted to meet its many economic uses – agriculture, industry, and



drinking water supply – while leaving sufficient water in the environment to meet ecological needs.

Catchment Flood Management Plan (CFMP) – A strategic planning tool through which the Environment Agency seeks to work with other key decision-makers within a river catchment, to identify and agree policies for sustainable flood risk management.

Code for Sustainable Homes – the Code for Sustainable Homes - a new national standard for sustainable design and construction of new homes—was launched in December 2006. The code measures the sustainability of a new home against a range of sustainability criteria. The code sets minimum standards for energy and water use in new properties, and give homebuyers more information about the environmental impact of their new home.

Combined Sewer Overflow (CSO) - Combined sewer overflow is the discharge of untreated wastewater from a sewer system that carries both sewage and storm water (a combined sewerage system) during a rainfall event. The increased flow caused by the storm water runoff exceeds the sewerage system's capacity and the sewage is forced to overflow into streams and rivers through CSO outfalls.

Communities and Local Government (CLG) - Communities and Local Government is the government department responsible for policy on local government, housing, urban regeneration, planning and fire and rescue. They have responsibility for all race equality and community cohesion related issues in England and for building regulations, fire safety and some housing issues in England and Wales. The rest of their work applies only to England. (<http://www.communities.gov.uk/corporate/about/>)

Core Strategy - The Development Plan Document which sets the long-term spatial planning vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.

Diatoms - Diatoms are a major group of single celled algae, and are one of the most common types of phytoplankton. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and are commonly used in studies of water quality.

Development Plan - As set out in Section 38(6) of the Planning and Compulsory Purchase Act (2004), an authority's development plan consists of the relevant Regional Spatial Strategy (or the Spatial Development Strategy in London) and the Development Plan Documents contained within its Local Development Framework.

Development Plan Documents (DPDs) - Spatial planning documents within the Council's Local Development Framework which set out policies for development and the use of land. Together with the Regional Spatial Strategy they form the development plan for the area. They are subject to independent examination. They are required to include a



core strategy and a site allocations document, and may include area action plans if required; other DPDs may also be included, e.g. development control policies.

DEFRA - Department of Environment, Food and Rural Affairs Development.

Environment Agency - The leading public body for protecting and improving the environment in England and Wales. Flood management and defence are a statutory responsibility of the Environment Agency; it is consulted by local planning authorities on applications for development in flood risk areas, and also provides advice and support to those proposing developments and undertaking Flood Risk Assessments. The Environment Agency reports to DEFRA.

Environment Agency Flood Zones - Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency.

Flood Estimation Handbook - The latest hydrological approach for the estimate of flood flows in the UK.

Flood Risk Assessment – A site specific investigation usually carried out by the site developers to be submitted as part of their planning applications. It assesses both current flood risk to the site and the impact of development of the site to flood risk in the area.

Freshwater Fish Directive - The EC Directive on Freshwater Fish is designed to protect and improve the quality of rivers and lakes to encourage healthy fish populations. In 2013, this directive will be repealed. Waters currently designated as Fish Directive waters will become protected areas under the Water Framework Directive.

Future Water - The Government's new water strategy for England, Future Water was published 7 February 2008. This strategy sets out the Government's long-term vision for water and the framework for water management in England.
(<http://www.defra.gov.uk/Environment/water/strategy/index.htm>)

Habitats Regulation Assessment - An assessment of the potential effects of planning policies on European nature conservation sites, which lie within and outside the Borough

Infrastructure – The basic physical systems of a community's population, including roads, utilities, water, sewage, etc. These systems are considered essential for enabling productivity in the economy. Developing infrastructure often requires large initial investment, but the economies of scale tend to be significant. Water services infrastructure refers to infrastructure that provides clean water, urban drainage and wastewater services.

Inset appointment - An inset appointment is made when an existing water and/or sewerage undertaker is replaced by another as the supplier of water and/or sewerage services for one or more customers within a specified geographical area.



Local Authority or Local Planning Authority (LA or LPA) – the local authority or council that is empowered by law to exercise planning functions. Often the local borough or district council. National parks and the Broads authority are also considered to be local planning authorities. County councils are the authority for waste and minerals matters.

Local Development Documents (LDDs) – the collective term for Development Plan Documents and Supplementary Planning Documents.

Local Development Framework (LDF) - The name for the portfolio of Local Development Documents. It consists of the Local Development Scheme, a Statement of Community Involvement, Development Plan Documents, Supplementary Planning Documents, and the Annual Monitoring Report.

Local Development Scheme (LDS) - Sets out the programme for preparing Local Development Documents. All authorities must submit a Scheme to the Secretary of State for approval within six months of commencement of the 2004 Act (thus all authorities should now have submitted an LDS). LDSs are subject to review.

Lotic-invertebrate Index for Flow Evaluation (LIFE) - an indicator of river flow variability and lotic habitat structure

'Making Space for Water' (DEFRA 2004) - The Government's new evolving strategy to manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches, so as to: a) reduce the threat to people and their property; b) deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles, and c) secure efficient and reliable funding mechanisms that deliver the levels of investment required.

Mean Trophic Rank (MTR) - The Mean Trophic Rank has been developed for England and Wales to implement the EC Urban Waste Water Directive: it is used to assess the impact of point sources on the river. It is based on the combination of species at a site and, for each species, its indicator value and its abundance.

Ofwat – The Water Services Regulation Authority (Ofwat) is the body responsible for economic regulation of the privatised water and sewerage industry in England and Wales. Ofwat is primarily responsible for setting limits on the prices charged for water and sewerage services, taking into account proposed capital investment schemes (such as building new wastewater treatment works) and expected operational efficiency gains.

Planning Policy Statements (PPS) - The Government has updated its planning advice contained within Planning Policy Guidance Notes (PPGs) with the publication of new style Planning Policy Statements (PPSs), which set out its policy for a range of topics.

Pollutants – A substance or condition that contaminates air, water, or soil. Pollutants can be artificial substances, such as pesticides and PCBs, or naturally occurring substances,



such as oil or carbon dioxide, that occur in harmful concentrations in a given environment

Previously Developed (Brownfield) Land - Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example a house and its garden would be considered to be previously developed land. Land used for mineral working and not subject to restoration proposals can also be regarded as Brownfield land.

QMED – The median annual maximum flood flow.

Regional Spatial Strategy (RSS) - Sets out the region's policies in relation to the development and use of land and forms part of the development plan for local planning authorities.

River Basin Management Plan (RBMP) – A strategic tool introduced by the Water Framework Directive (2000/60/EC) which integrates the management of land and water within a river basin (river catchment or group of catchments). The river basin may cover several political areas.

River Quality Objective (RQO) – agreed by Government as targets for all rivers in England and Wales when the water industry was privatised in 1989. The targets specify the water quality needed in rivers if we are to be able to rely on them for water supplies, recreation and conservation.

Sites of Importance for Nature Conservation (SINCs) - is a designation used in many parts of the United Kingdom to protect areas of importance for wildlife at a county.

Site of Special Scientific Interest (SSSI) – a site identified under the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act 2000) as an area of special interest by reason of any of its flora, fauna, geological or physiographical features (basically, plants, animals, and natural features relating to the Earth's structure).

Source Protection Zones (SPZs) – The Environment Agency has defined Source Protection Zones (SPZs) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied to a groundwater source. (http://www.environment-agency.gov.uk/maps/info/groundwater/?version=1&lang=_e)

Statement of Community Involvement (SCI) - Sets out the standards which authorities will achieve with regard to involving local communities in the preparation of



local development documents and development control decisions. It is subject to independent examination.

Strategic Environmental Assessment (SEA) - A generic term used to describe environmental assessment as applied to policies, plans and programmes. The European ‘SEA Directive’ (2001/42/EC) requires a formal ‘environmental assessment of certain plans and programmes, including those in the field of planning and land use’.

Strategic Flood Risk Assessment (SFRA) – a Level 1 SFRA is a district-wide assessment of flood risk, usually carried out by a local authority to inform the preparation of its Local Development Documents (LDDs) and to provide the information necessary for applying the Sequential Test in planning development. A Level 2 SFRA is a more detailed assessment produced where the Exception Test is required for a potential development site, or to assist in evaluating windfall planning applications.

Strategic Housing Land Availability Assessment (SHLAA) - A SHLAA is an assessment of the potential of a borough to accommodate housing development over a period of 15 years from the date of adoption of the LDF Core Strategy. The SHLAA forms part of the evidence base for the emerging Local Development Framework (LDF), and inform the identification of potential new housing sites to be allocated in the LDF.

Super Output Areas (SOA) – a new national geography created by the Office for National Statistics (ONS) for collecting, aggregating and reporting statistics.

Supplementary Planning Documents (SPDs) - Provide supplementary information in respect of the policies in Development Plan Documents. They do not form part of the Development Plan and are not subject to independent statutory examination, but are normally subject to public consultation.

Sustainability Appraisal (SA) - Tool for appraising policies to ensure they reflect sustainable development objectives (i.e. social, environmental and economic factors) and required in the 2004 Act to be undertaken for all local development documents. It incorporates Strategic Environmental Assessment.

Sustainable Development – “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (The World Commission on Environment and Development, 1987).

Sustainable Drainage Systems (SUDS) – Surface water drainage systems which manage runoff in a more sustainable way than conventional drainage, through improved methods of managing flow rates, protecting or enhancing water quality and encouraging groundwater recharge. A variety of types are available and can be chosen as appropriate for the location and needs of the development, and many have added benefits such as enhancement of the environmental setting, provision of habitat for wildlife and amenity value for the community.



The Sequential Test - Informed by a Strategic Flood Risk Assessment, a planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.

UK Climate Impacts Programme (UKCIP) -UKCIP02 is a government funded programme which helps organisations to adapt to inevitable climate change. UKCIP publishes climate change scenarios on behalf of the Government.

Water Framework Directive (WFD) – a European Union directive which commits member states to making all water bodies (surface, estuarine and groundwater) of good qualitative and quantitative status by 2015.

Water neutrality - If a development is to be 'water neutral' then the total demand for water should be the same after the new development is built, as it was before. That is, the new demand for water should be offset in the existing community by making existing homes and buildings in the area more water efficient. (<http://www.environment-agency.gov.uk/research/library/publications/40737.aspx>)

Water stress - Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of freshwater resources in terms of quantity (e.g. aquifer overexploitation or dry rivers) and quality (eutrophication, organic matter pollution, and saline intrusion).

Water resource zone – a geographical area defined by the water supply/demand balance in the region such that all customers within it receive the same level of service in terms of reliability of water supply.

Water Resource Management Plans (WRMP) - Water companies in England and Wales have a statutory duty to prepare, consult, publish and maintain a water resources management plan under new sections of the Water Industry Act 1991, brought in by the Water Act of 2003. Water resource management plans show how the water companies intend to supply your water over the next 25 years. In doing so, they need to take into account population changes, climate change and protecting the environment from unnecessary damage caused by taking too much water for use.

Water resource zone – a geographical area defined by the water supply/demand balance in the region such that all customers within it receive the same level of service in terms of reliability of water supply.



1 Executive Summary

Water Cycle Studies (WCS) are required to ensure that proposed growth does not adversely impact on the existing water cycle environment and that new Water Services Infrastructure (WSI) can be planned for and provided alongside new development in a sustainable and cost effective manner. Due to the scale of development proposed for Basingstoke, a WCS is required to ensure that the proposed growth targets can be met without adversely impacting on the water environment and that required infrastructure can be planned for and brought online alongside new development, in a timely and phased manner.

The Regional Spatial Strategy (RSS) for the South East of England (known as the South East Plan) was published in May 2009 and sets out the long term spatial planning framework for the region over the years 2006-2026. The Plan is a key tool to help achieve more sustainable development, protect the environment and combat climate change.

The plan has set a housing allocation for Basingstoke and Deane of 915 (945) dwellings per year as an annual average, with a total of 18,300 (18,900) over the plan period¹. However, in light of concerns raised about environmental capacity the council have maintained their formal position of 740 dwellings per annum, and the plan specifically acknowledges the uncertainty about environmental capacity and wastewater treatment capacity, and states that:

Provision levels at Basingstoke, for locations within the catchment of Blackwater Sewage Treatment Works and any other locations where potential water quality, supply or treatment issues are identified will need to be informed by a water cycle study. Similarly, the distribution of development should be informed by strategic flood risk assessments. The results of these studies will need to be reflected in local development frameworks and future reviews of the RSS.

The issue of environmental capacity and wastewater treatment in particular had been raised by the Environment Agency in representations to the emerging South East Plan, and led to a phase 1 water cycle study to further investigate the issues. The phase 1 study completed in March 2007, and formed part of representations to the Examination in Public of the South East Plan. It recommended that a second phase study needed to be carried out to further reduce some of the uncertainties still remaining, and to work alongside the preparation of the LDF.

¹ The figures in brackets are the provisional allocation for the whole of the Basingstoke and Deane Borough. The first values are the provisional allocation for that part of the Borough that falls within the Blackwater and Western Corridor sub-region, including the principal urban area of Basingstoke.



In September 2007 Basingstoke and Deane Borough Council commissioned Halcrow to produce a phase 2 water cycle study, in accordance with the recommendations of the Phase 1 water cycle study. The study aim is to provide a water cycle strategy that:

- all partners can commit to;
- will show how water infrastructure can be put in place alongside development rather than afterwards;
- sets out design standards for sustainable drainage, and;
- builds on the work being done on the strategic flood risk assessment to reduce the risk and harmful impacts of flooding.

In addition to and in association with the water cycle study, Halcrow were commissioned in September 2007, to undertake an ecological and water quality modelling assessment.

This water cycle study and the associated ecology and water quality report form part of the evidence base for the Core Strategy, and will help ensure that the strategic allocations in the Core Strategy, and the phasing of these allocations are within environmental capacity. The study will also help inform the infrastructure delivery plan to ensure that water services infrastructure delivery is sustainable, and the infrastructure is delivered in advance of houses being occupied.

The study area for this water cycle study is primarily set by the constraints identified in the phase 1 study. The phase 1 study identified that the critical risk to ongoing development was the environmental and infrastructure capacity for wastewater treatment. The urban area of Basingstoke, and the areas being tested for new development all drain towards the River Loddon. For this reason, this study focuses on the wastewater catchments that discharge to the River Loddon or its tributaries. As Chapter 2 explains, the impact of development, particularly the impact of additional treated effluent discharge, on the River Loddon was the primary cause of concern following the phase 1 study. The approximate study area is shown in Figure E1 below.

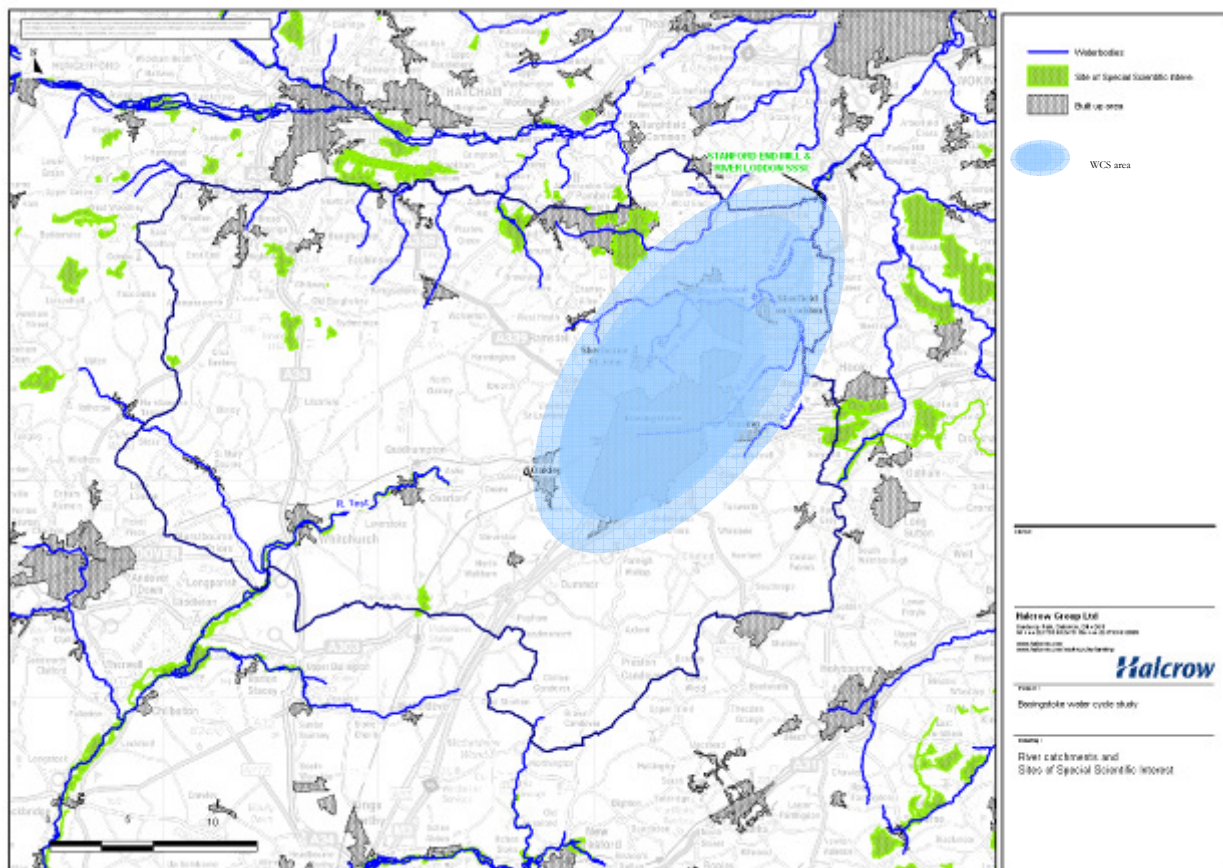



Figure E1 Water cycle study approximate boundary WCS study area denoted by 

Environmental capacity assessment

The River Loddon catchment downstream of the Basingstoke urban area is not compliant with the Water Framework Directive good ecological status. Based on analysis of the classification data presented, the reasons for this are primarily due to treated sewage effluent discharges into the River Loddon catchment from the Basingstoke urban area, and in particular, the phosphate discharged from Basingstoke and Deane STW.

Even though Basingstoke sewage treatment treats to a very high standard, the scale of the failure of the WFD phosphate target downstream is significant. The phase 1 study identified that the observed phosphate quality in the River Loddon is approximately six times higher than the WFD standard for good status, and the modelling in this study supports that conclusion.

In terms of future population growth, sensitivity testing has been undertaken, based on levels of housing growth arising from the emerging South East Plan. This assesses provision on the basis of the Borough Council's formal position on housing numbers (740 dwellings per year), and the recently published South East Plan (945 dwellings per year, of which 915 fall within the Blackwater and Western Corridor sub-region).



A detailed water quality assessment was carried out to assess the current water quality in the catchment, and to assess the potential impact of growth on water quality. The water quality assessment has been closely linked to the ecological survey carried out by Halcrow, to help build up an over-arching understanding of the catchment.

The baseline assessment suggests water quality in the Loddon catchment is generally very good, and for the most part complies with all statutory river standards and WFD targets. The only consistent failure to achieve a standard was the failure of one component of physicochemical class due to phosphate levels downstream of sewage treatment works discharges, and a failure of the biology classification due to the diatom analysis in 2008.

Despite these failures many of the indicators of water quality and ecological quality are very good. The baseline ecological survey work also indicated that the River Loddon ecological quality was within the top 10% for rivers of its type according to one of the methods used (Mean Trophic Rank for a Type II River Community “rivers flowing in catchments dominated by clay”)

The modelling in the WCS has shown that the impact of additional treated sewage effluent from the additional development scenarios modelled is unlikely to cause a deterioration of current physicochemical status in the River Loddon. Whilst there is confidence that there will be no deterioration in chemical or physico-chemical status, there remains uncertainty regarding the impact upon biological status that may result from additional developments and an ongoing monitoring program is recommended to manage this risk.

The WCS looked at a number of possible options to meet ‘good status’ and identified that it is not possible to meet good ecological status for phosphate in the River Loddon with current available sewage treatment technology. The results also show that the different population scenarios assessed do not affect the consent changes that would be required to achieve good ecological status.

The River Loddon is already in good ecological status for Biochemical Oxygen Demand (BOD) and ammonia. To achieve good status for phosphate would require the STW to treat to standards significantly better than that achieved within conventional technology within the UK. The consent would need to be tightened from the current 1mg/l to 0.13mg/l as an annual average. There are no sewage treatment works in the UK designed to treat wastewater to meet this standard of discharge, and to treat to this standard would require the application of novel technology, with the associated uncertainties and risks. Such novel technology would require significant investment, both in terms of finance, and in terms of the carbon and energy required over the life of any plant.

The study has concluded that there will not be a deterioration in chemical or physicochemical status due to the levels of growth assessed. It has also identified a small, but unquantifiable risk that minor deterioration in phosphate levels due to growth may



cause a deterioration in diatom quality which may in turn lead to a subsequent deterioration in biological classification. Despite the extensive survey and modelling work undertaken over the last three years, it is impossible to quantify this risk with modelling, and an ongoing risk assessment and monitoring procedure is recommended to manage this risk.

Wastewater treatment infrastructure capacity assessment

In order to allow informed planning decisions to be made with respect to location and extent of housing development in Basingstoke & Deane BC area, we have looked at sewerage and sewage treatment capacity in a number of settlements.

The results of this capacity assessment shows that in general, capacity is currently limited, but that the water companies have plans and funding to provide additional infrastructure when strategic allocations are made.

Specifically, at Basingstoke STW, Thames Water have also advised that they have assessed the requirement to provide capacity to serve growth until 2021 as part of the recent assessment of capacity, and that between £10m and £20m is required to be spent on infrastructure to ensure that the STW can treat all growth until 2021. The delivery of this infrastructure has been split into two phases and Thames Water are planning this infrastructure to be funded through their asset management plan. Phase 1 of the improvements are planned to be delivered between 2010 and 2015, subject to agreement by their financial regulator in the final determination of their business plan. Phase 2 has been deferred until the next planning period 2015 – 2020.

Flood risk and urban drainage

The proposed options and areas already at risk from flooding are shown in Chapter 7. They illustrate that some development areas lie within Environment Agency Flood Zone 3. As per the PPS25 practice guide the sequential test should be used to ensure development is located in the areas at lowest risk, and that development should only occur in flood zones 2 and 3 if there are no alternative suitable sites in flood zone 1. Furthermore in zones 2 and 3 PPS25 practice guide specifies different types of land uses which are suitable depending on the flood zone. However, the WCS considers that there is enough land available for development outwith flood zones 2 and 3 for the scale of growth tested.

The WCS has also assessed the potential for proposed development options to increase downstream flood risk, for all sources of flooding. An assessment has been made of:

- foul network capacity and the potential to increase foul flooding (using critical drainage areas identified in SFRA);



- mitigation options to minimise increases in flood risk due to increase in final effluent discharge from Basingstoke STW, and;
- surface water flooding – this has been undertaken by assessing the runoff rates and volumes from the proposed development options to ensure surface water is effectively managed.

Conclusions

The WCS has identified that the River Loddon catchment is already failing to meet good status, as required under the WFD, and that achieving good status by 2027 is a significant challenge with respect to one chemical pollutant, orthophosphate. Furthermore the evidence shows that achieving good status cannot be done by controlling diffuse pollution; rather it can only be achieved through tightening discharges from sewage effluent beyond currently accepted best available technology.

The WCS has principally assessed whether growth would cause deterioration of the current water quality and ecology in the River Loddon catchment. The water quality assessment has shown that the change in pollutant load is not significant with respect to observation and modelling uncertainty and that none of the growth scenarios examined would cause a deterioration in WFD physicochemical class². Although there is no significant deterioration in the chemical quality of the river system caused by additional treated effluent being discharged into the river, it has not been possible to quantify the impact these small changes may have on biological quality. Based on this assessment, the WCS has shown that planned growth of between 14,800 and 18,900 dwellings can be accommodated without causing significant additional pressure on Water Framework Directive physico-chemical status, although ongoing monitoring will be required to identify potential changes in biological classification. To facilitate this, ongoing ecological surveys are recommended to monitor the impact of the development over time and create a long term (10-year) record to allow correlation of ecology, water quality and hydrology.

Water resources are not considered to be a critical issue for growth. However, the region is water stressed, and firm implementation of the water efficiency standards in the Code for Sustainable Homes through the B&DBC Design and Sustainability Supplementary Planning Document (SPD) is essential to manage demand on the water environment.

This study has shown that there is planned infrastructure capacity in Basingstoke for planned allocations and commitments up until 2016, and that strategic water services infrastructure has been assessed up to 2021.

² There may be deterioration in numerical water quality, but there will not be deterioration of class



The assessment of urban drainage and flood risk has built on the findings of the SFRA, and has identified key constraints and requirements for the proposed development options.

The principal existing groundwater and fluvial flood risk issues in the catchment lie to the east of Basingstoke, and development in this area will need to mitigate against these risks. To the east of Basingstoke (area 7) development can be located away from Flood Zone 3, but in area 6 residential development is not recommended due to the combination of groundwater and fluvial flood risk.

Development to the west is constrained by existing capacity issues in the foul network in this part of the catchment. In the north-west there is capacity in the foul network due to the construction of additional sewage capacity in the area.

In the west and north-west, because the current infiltration regime is high, it will be difficult to maintain greenfield rate and volume from the site; this could lead to increases in runoff rate and volume to the culverted section of the Loddon, with a corresponding impact on surface water flood risk upstream of the culvert. Furthermore development West of Basingstoke will also probably lead to a reduction in groundwater recharge to aquifer, even with excellent implementation of the SUDS train. This will impact on the available developable land within these areas. It is recommended that a strategic approach to surface water drainage is adopted if development is allocated in this area, which will help to address some of the drainage concerns.

If good design standards are implemented for surface water drainage and demand management measures proposed in the Design and Sustainability SPD enforced, this study considers it unlikely that development will cause a deterioration of the ecological status of the River Loddon. The requirement to provide attenuation to manage surface water runoff provides an opportunity to create new wetland habitat as part of any development, and mitigate for any loss of habitat as part of the development

A strategic environmental assessment of the impacts on designated sites of biodiversity importance and BAP habitats is being undertaken by the council's biodiversity officers. Therefore, the risk to priority BAP habitat from impacts other than water quality and changes in hydrological regime will be assessed through this process. Site specific policies for ecological and biodiversity protection, such as policies to protect and enhance the river corridor and minimise habitat fragmentation will be developed if these sites are included within a Local Development Framework allocation policy.



The water cycle study has identified a number of policy themes to be further explored through the Core Strategy and LDF process. We have recommended that specific policies are development that cover:

Implementation of a monitoring programme

Phasing of development & intervention mechanism

Biodiversity protection and enhancement

Implementation of SPD on design and sustainability

Flood risk and surface water management

Water services infrastructure

Development near to a sewage treatment works





2 The background to Basingstoke water cycle study

2.1 *Introduction*

Building new homes is not simply a matter of constructing the buildings themselves. To operate effectively as a home, and as part of a wider community, each building is also dependant on a range of services, and the infrastructure necessary to provide these. A critical component of this infrastructure is associated with water; the provision of clean water for drinking and washing; the safe disposal of waste water; and protection from flooding.

The addition of a small number of new homes may not represent a significant additional burden on existing water infrastructure. However when large numbers of houses are built, there is a risk that existing infrastructure will be overwhelmed, and both the environment and people's quality of life, will suffer.

There is a finite capacity within the environment, and it cannot simply provide more and more water to serve new development. Equally, there is a limit to the amount of waste water that can be safely returned to our rivers and the sea without having a detrimental impact on the environment. Furthermore, we know that extreme rainfall can overwhelm drains and overtop flood defences. Climate change is bringing fresh challenges as patterns of rainfall are predicted to change, with more intense rainfall events. We must also make sure that water infrastructure contributes to the shift to a low carbon economy that is essential if greenhouse gas emissions are to be reduced. Planning for water has to take into account these natural constraints, and factors such as the timing and location imposed by the development itself.

Water Cycle Studies (WCS) are required to ensure that proposed growth does not adversely impact on the existing water cycle environment and that new Water Services Infrastructure (WSI) can be planned for and provided alongside new development in a sustainable and cost effective manner. Due to the scale of development proposed for Basingstoke, a WCS is required to ensure that the proposed growth targets can be met without adversely impacting on the water environment and that required infrastructure can be planned for and brought online alongside new development, in a timely and phased manner.

2.2 *Water cycle processes*

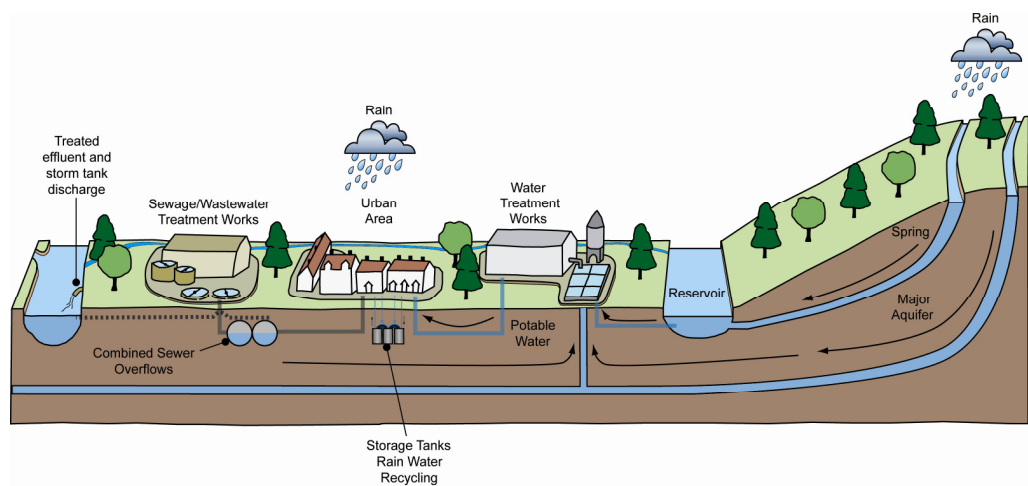
The water cycle includes the processes and systems that collect, store, or transport water in the environment. Water cycle processes are both above and below ground level, and can be either natural or man-made. In an undeveloped area, the water cycle includes rainfall landing on the ground, where it is either transferred into above ground streams, rivers, wetlands, floodplains, and estuaries to the sea, or is absorbed into the soil, ending



up in groundwater storage aquifers. The cycle is completed by evaporation from these systems back into the atmosphere.

In a developed area, the natural processes and systems are sometimes adapted for development or public health reasons. For example, water is taken from rivers, treated, and piped via water supply systems into urban areas. Wastewater produced by houses is collected in a below ground sewerage system, where it is transported to a wastewater treatment works before being discharged to the sea, rivers or to groundwater.

The natural processes are extremely important for wildlife and ecology, and even man made systems can have biodiversity and wildlife interest. It is important that when building new homes, or even redeveloping existing areas we understand the impact on the natural environment.

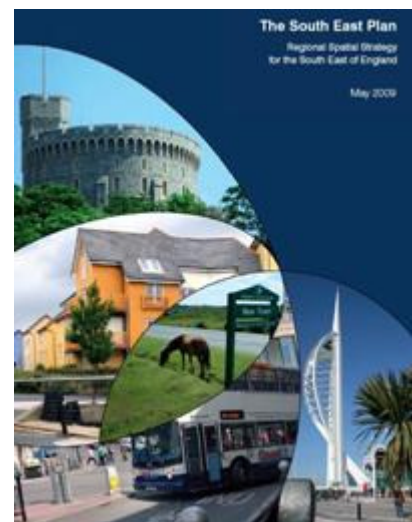


2.3

The south east plan and water cycle studies

The Regional Spatial Strategy (RSS) for the South East of England (known as the South East Plan) was published in May 2009 and sets out the long term spatial planning framework for the region over the years 2006-2026. The Plan is a key tool to help achieve more sustainable development, protect the environment and combat climate change. It provides a spatial context within which Local Development Frameworks need to be prepared, as well as other regional and sub-regional strategies and programmes that have a bearing on land use activities.

The plan has set a housing allocation for Basingstoke and Deane of 915 (945) dwellings per year as an annual average, with a total of 18,300





(18,900) over the plan period³. However, the plan specifically acknowledges the uncertainty about environmental capacity and wastewater treatment capacity, and states that:

Provision levels at Basingstoke, for locations within the catchment of Blackwater Sewage Treatment Works and any other locations where potential water quality, supply or treatment issues are identified will need to be informed by a water cycle study. Similarly, the distribution of development should be informed by strategic flood risk assessments. The results of these studies will need to be reflected in local development frameworks and future reviews of the RSS.

The issue of environmental capacity and wastewater treatment in particular had been raised by the Environment Agency in representations to the emerging South East Plan, and led to a phase 1 water cycle study to further investigate the issues.

2.4

The phase 1 water cycle study

The phase 1 study completed in March 2007, and formed part of representations to the Examination in Public of the South East Plan. The summary findings of the phase 1 WCS were that:

- Development in Basingstoke can be accommodated without causing a failure of statutory environmental water quality objectives, subject to infrastructure being funded and delivered in the right place and at the right time.
- The River Loddon currently fails proposed draft standards for nutrients in a river of this type to meet good ecological status under the draft WFD standards, and also fails to meet guideline standards for chalk rivers. It is not known whether the ecology of the river has been harmed by the current high levels of phosphorus, although the development scenarios assessed cause only a minor increase in the modelled nutrient levels in the river.
- The use of greater demand management techniques may be used to offset the requirement for some water cycle infrastructure, or delay the time by which it is needed; although this would require strong incentives and enabling mechanisms and may require a change in legislation.
- The exact location and phasing of development will need to be determined as part of the Basingstoke & Deane Borough local development framework (LDF) process to ensure that infrastructure is provided in the right place and at the right time.

³ The figures in brackets are the provisional allocation for the whole of the Basingstoke and Deane Borough. The first values are the provisional allocation for that part of the Borough that falls within the Blackwater and Western Corridor sub-region, including the principal urban area of Basingstoke.



And recommended that:

- A second phase study needs to be carried out to further reduce some of the uncertainties still remaining, and to work alongside the preparation of the LDF
- The extent to which water quality and ecology should be seen as a barrier to development in Basingstoke is not yet known. It is strongly recommended that further work be carried out to identify all sources of orthophosphate in the catchment, to assess the long term feasibility of reducing nutrient levels in the catchment.
- A strategic flood risk assessment should be carried out as part of the Phase 2 of this project to inform the LDF, and ensure that new developments are sympathetic to flood risk.
-

2.5

The phase 2 water cycle study requirements

In September 2007 Basingstoke and Deane Borough Council commissioned Halcrow to produce a phase 2 water cycle study, in accordance with the recommendations of the Phase 1 water cycle study. The study aim is to provide a water cycle strategy that:

- all partners can commit to;
- will show how water infrastructure can be put in place alongside development rather than afterwards;
- sets out design standards for sustainable drainage, and;
- builds on the work being done on the strategic flood risk assessment to reduce the risk and harmful impacts of flooding.

2.6

Ecology and water quality consultancy

In addition to and in association with the water cycle study, Halcrow were commissioned in September 2007, to undertake an ecological and water quality modelling assessment.

The appraisal focuses on the current ecological quality of the River Loddon and a tributary, the Lyde River, with review of historic ecological data where available. The study was commissioned to address the uncertainties in the understanding of the condition and extent of the existing ecological features, and in particular how the ecology has been affected by the current high levels of phosphorus in the river, a recommendation of the Phase 1 WCS. The second phase ecological appraisal looks at the condition of the existing ecology and assesses the potential impacts of changes in water quality and flow associated with development and climate change. The study also identifies opportunities for habitat creation, enhancement and restoration. The report is available under separate cover from Basingstoke and Deane Borough Council.



3 Basingstoke and Deane Borough

3.1 Basingstoke and Deane Borough in context

The Western Corridor and Blackwater Valley (WCBV) sub-region, in which the majority of the Basingstoke and Deane Borough lies, extends from the western edge of London to the boundary of the South West region in the Swindon area (http://www.gos.gov.uk/497648/docs/171301/815607/815696/Pages_from_RSS_Section_C.pdf). It adjoins the London Fringe, and lies close to the Central Oxfordshire and Milton Keynes & Aylesbury Vale sub-regions. In addition to Basingstoke and Deane Borough, the WCBV sub-region includes all or part of the administrative areas of the following local authorities: West Berkshire, Reading, Wokingham, Bracknell Forest, Windsor and Maidenhead, Slough, South Bucks, Wycombe, Surrey Heath, Guildford, Hart and Rushmoor.



Figure 3-1 Western Corridor and Blackwater Valley sub region

The Borough of Basingstoke and Deane covers an area of 245 square miles. It is predominantly a rural borough with less than 8% of the land built up. Over 75% is either agricultural land or non-wooded Greenfield and a further 15% is covered by woodland or forest.

The population of Basingstoke and Deane was estimated to be 160,000 in 2007. Approximately 60% of this population live within the main urban settlement of Basingstoke. The remaining 40% live within a scattering of rural towns and villages, although in the main concentrating on a few larger rural settlements namely Tadley, Baughurst, Pamber Heath, Bramley, Whitchurch, Overton, Oakley and Kingsclere.

3.2 Local Planning Policy

3.2.1 Local Development Framework

In accordance with the Planning and Compulsory Purchase Act 2004, Basingstoke and Deane Borough Council is preparing the Local Development Framework (LDF). This consists of Development Plan Documents (including a Core Strategy), Supplementary Planning Documents, a Statement of Community Involvement, the Local Development Scheme and Annual Monitoring Reports.



The documents in the LDF will gradually replace the current Basingstoke and Deane Borough Adopted Local Plan 1996-2011.

The Core Strategy sets out the vision and objectives of the LDF. The first stage of preparing the Core Strategy was the production of an Issues and Options document, which sets out Basingstoke and Deane's strategic planning issues and the possible options for tackling them. Consultation on this stage ran from 28th January 2008 to 10th March 2008. The results are helping to inform the next stages of the Core Strategy's development, which will be the publication of a Preferred Approach consultation document, in the autumn 2009.

The Local Development Scheme (LDS) is the project plan for the LDF, outlining what documents will be produced, in what order and when. The current LDS for Basingstoke and Deane (March 2009) is available on the borough council's website at <http://www.basingstoke.gov.uk/planning/ldf/localdevelopmentscheme.htm>.

Information on the Council's current adopted planning policies and progress with the LDF can be accessed on the website at: <http://www.basingstoke.gov.uk/planning/>.

This water cycle study and the associated ecology and water quality report form part of the evidence base for the Core Strategy, and will help ensure that the strategic allocations in the Core Strategy, and the phasing of these allocations are within environmental capacity. The study will also help inform the infrastructure delivery plan to ensure that water services infrastructure delivery is sustainable, and the infrastructure is delivered in advance of houses being built.

Furthermore there is uncertainty as to the level of housing growth which can be accommodated within Basingstoke and Deane Borough. The water cycle study has tested two different housing scenarios:

- The council's formal position of 740 dwelling per annum between 2006 and 2026; and
- The Secretary of State's proposed changes to the South East plan (now confirmed in the final South East Plan) of 945 dwellings/annum

Therefore the water cycle study provides an opportunity to understand the implications of different levels of housing on environmental and infrastructure capacity.

3.3

Development scenarios

In terms of future population growth, sensitivity testing has been undertaken, based on three possible levels of housing growth arising from the emerging South East Plan. This assesses provision on the basis of the Borough Council's formal position on housing numbers (740 dwellings per year), the view of the Panel following the examination (895



dwellings per year) and the recently published South East Plan (945 dwellings per year, of which 915 fall within the Blackwater and Western Corridor sub-region).

Figure 4-12 provides a map of allocated and committed development sites, and the development sites identified by the draft Strategic Housing Land Availability Assessment (SHLAA) that have been tested by this study. The SHLAA forms part of the evidence base for the LDF, identifying the potential within the borough to meet future housing needs. It provides an initial assessment of sites based on a broad set of principles and identifies which should be considered further as part of the LDF process. Government guidance on SHLAA's indicates that the aim is to identify as many sites with housing potential in and around as many settlements as possible. Using the draft SHLAA as a basis for testing within this study is therefore important as it reflects the highest level of housing development potential within the borough. It is however recognised that not all the sites will be developed as further more detailed assessments, as part of the LDF process, will mean that some will not continue to be available or deliverable.

A draft SHLAA was consulted on between September to October 2008. A revised SHLAA is due to be published in Autumn 2009.

3.3.1

Design and sustainability supplementary planning document

The Council has adopted a Supplementary Planning Document (SPD) on Design and Sustainability⁴. This SPD primarily supports policy E1 of the Basingstoke and Deane Borough Local Plan 1996-2011, which was adopted in July 2006. The document provides additional guidance to ensure that design and sustainability are fully considered in new developments and incorporates a number of detailed appendices. Some of these appendices replace previously adopted design advice, such as 'Extending Your Home' and 'Places to Live'.

The SPD requires residential development of greater than 10 dwellings to comply with the Code for Sustainable Homes level 3. This has a mandatory maximum per capita consumption target of 105 litres per head per day, which provide 3 credits under the assessment criteria. There are also a further 2 credits available should a development on average be designed for less than 80l/h/d (Code for Sustainable Homes level 6). The text box below is taken from Appendix 5 of the SPD.

The approach to water consumption will be reviewed and considered as part of the emerging Core Strategy.

⁴ See <http://www.basingstoke.gov.uk/planning/localplan/spd/designandsustainabilityspd.htm> for full details of the SPD.



Appendix 5 - Construction Statements

Note: This document forms an appendix to the SPD on Design and Sustainability, which can be viewed on the Borough Council's website at the following address: www.basingstoke.gov.uk/planning/localplan/spd/designandsustainabilityspd
Copies can also be obtained from the Forward Planning Team on (01256) 845532 or 845796.

1. A Construction Statement is needed for all new development that meets the type and scale criteria described below.
2. Schemes of greater than 1 dwelling and less than 10 dwellings, or for non-residential development of greater than 100m² and less than 1,000m² floorspace must complete the checklist form below, setting out how the proposals have considered sustainability and the minimisation of resource use and taken into account the guidance in the Design and Sustainability SPD. The completed checklist (which should form part of the Planning Statement submitted with a planning application) constitutes the Construction Statement for this type of development. Sufficient detail should be included in the checklist to verify the answers given including reasons why an issue has not been addressed. Details submitted will be taken into account in determining planning applications, in respect of accordance with policy E1(v): 'All development proposals should: incorporate features to minimise the energy consumed in the construction and future use of the building, conserve water and minimise water use'.
3. Major schemes of 10 dwellings or more or 1,000m² of floor space or greater for non-residential proposals should either achieve a minimum Level 3 of the Code for Sustainable Homes or at least a 'very good' rating under the BREEAM classification. In each case, full details of the accreditation as set out below will form the construction statement.

Figure 3-2 Extract from SPD on Design and Sustainability

4 Water cycle study environmental context

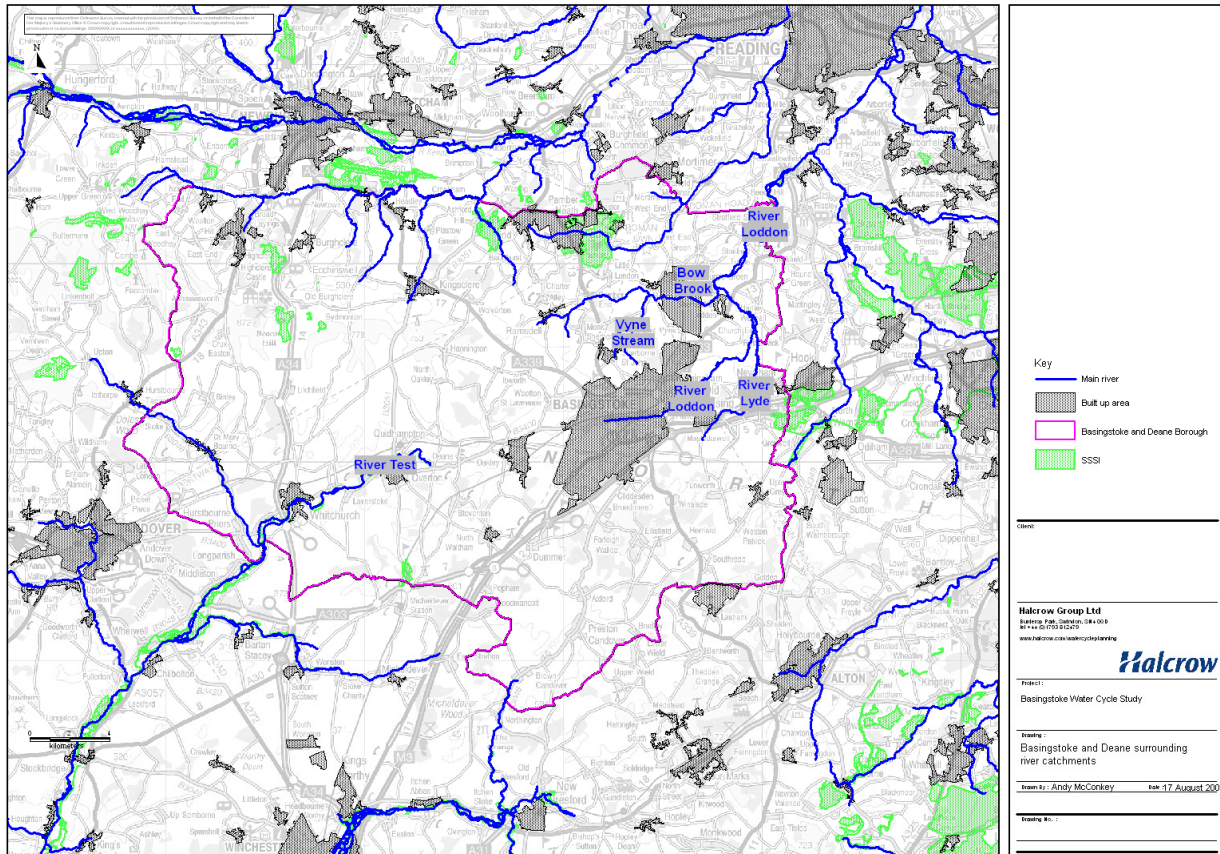
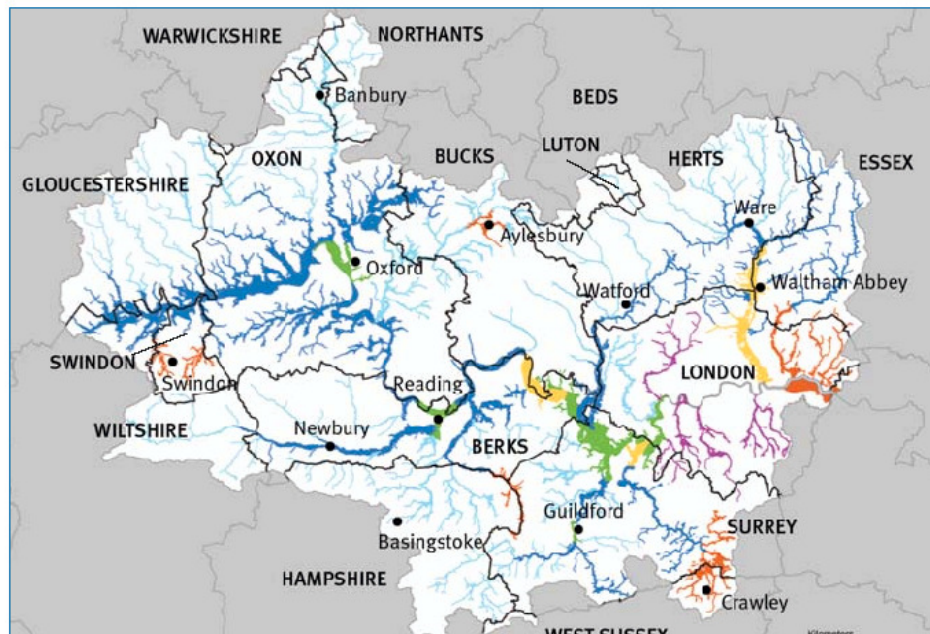


Figure 4-1 River catchments in Basingstoke and Deane Borough.

With two distinctive geological areas, the Thames Basin and the Hampshire Downs, the north of the borough contrasts strongly with the south. The southern two-thirds is dominated by chalk downland, a large proportion of which forms part of the Test and Itchen catchment. The northern part is influenced by deposits of clay and sand and is generally more impermeable, except for the chalk in the River Loddon at Basingstoke. The northern and eastern areas, including the principal urban area of Basingstoke, form part of the River Thames catchment and in contrast to the southern frequently dry, groundwater-fed watercourses, it contains a complex network of rivers and streams.



Key

The colours on the map above represent the different types of flood plain in Thames Region.

- Undeveloped natural flood plain
- Developed flood plain with no built flood defences
- Developed flood plain with built flood defences
- Developed flood plain with typically concrete river channels
- Major urban expansion in or close to flood plains
- Narrow flood plains and mixed land use



Figure 4-2 River Thames Catchment Flood Management Plan boundary

The River Loddon and tributaries rise in the northeast part of the study area and the River Enbourne from the northwest.

There are 19 Sites of Special Scientific Interest (SSSIs) and 767 Sites of Importance for Nature (SINCs) that are either wholly or partly sited within the borough, the extent of which results in 1.3% of the borough's whole area being covered by SSSI designation and 9.4% of the borough covered by a SINC designation. The borough is also located within Hampshire, a county that has more river and wetland sites of national importance for wildlife than any other county in England.

The River Loddon is classified as a high quality chalk river warranting special protection of both the water quality and ecology. The Loddon contains many important wetland and floodplain habitats which have been designated as SINCs. It is also subject to the European Union (EU) Freshwater Fish Directive and designated as an EU salmonid



river. A 4km stretch of the River Loddon from Stanford End to Swallowfield is designated under the Wildlife and Countryside Act 1981 (as amended) as a Site of Special Scientific Interest (SSSI). This is to protect the Loddon pondweed (*Potamogeton nodosus*), a rare species for which this reach of the Loddon is a national stronghold.

The River Test, a nationally famous chalk river, rises upstream of Overton and runs through the southwest portion of the borough. It joins with its tributary, the Bourne rivulet, just before it exits the study area. Candover Stream is also a chalk watercourse and a tributary of the River Itchen, which rises at the southeast corner of the borough.

4.1

Phase 1 study

As identified in Chapter 2, the requirements and objectives for this water cycle study have emerged from the phase 1 water cycle. The phase 1 study looked at strategic water resources, wastewater treatment and water quality, and urban drainage and flood risk, and identified at a high level the principal constraints to development in the Basingstoke urban area.

The conclusions of the phase 1 study were:

- Additional resources identified in the WRMP will not impact on the hydrology of the River Loddon, and therefore do not need to be considered within the flood risk or water quality sections of this report.
- All development scenarios assessed can be supplied without extra water resource development, beyond that currently planned by the water companies strategic water resource plans.
- The need for new resources could be offset by adopting greater water efficiency and demand management measures, but this would need to be supported with strong enabling mechanisms and incentives, and may need a change in legislation covering water companies and planning authorities.
- A twin track approach to demand management is therefore recommended via demand management, to constrain demand, in parallel with developing additional resources when required.
- The current statutory water quality objective (RQO) of the River Loddon can be maintained for any of the development scenarios assessed, with a future tightening of the consent to levels deemed feasible. The BOD consent will need to be tightened, but the current ammonia consent will ensure compliance with the RQO and Freshwater fish directive standards for all of the development scenarios.
- The River Loddon currently fails proposed standards for nutrients in a river of this type to meet good ecological status under proposed WFD standards. It is not known whether the ecology has been harmed by the current high levels of phosphorus. The development scenarios assessed cause only a minor increase in the modelled nutrient levels in the river.



- The extent to which water quality and ecology should be seen as a barrier to development in Basingstoke is not yet known. It is recommended that further work be carried out to identify all sources of orthophosphate in the catchment, to assess the long term feasibility of reducing nutrient levels in the catchment.
- Flood risk need not be an absolute barrier to any of the development scenarios assessed. A strategic flood risk assessment needs to be carried out alongside the preparation of the local development framework to ensure that development does not increase flood risk.
- New impermeable area within chalk catchments, ie where infiltration potential is good should use where possible infiltration type SuDS to reduce the impact on groundwater recharge. However, this needs to be balanced with the impact on groundwater flooding and on groundwater quality.
- Where infiltration is poor the runoff from any new impermeable area should be attenuated with SuDS solutions to ensure that the runoff is equivalent to the pre development runoff rate and volume.

4.2 Requirement for phase 2 study

The primary reason for carrying out the detailed phase 2 water cycle study was to attempt to resolve the uncertainty surrounding the extent to which water quality and ecology should be seen as a barrier to development, and to resolve the uncertainties surrounding the implementation of the Water Framework Directive.

In addition to removing the uncertainty surrounding the water quality, ecology and implementation of the WFD, a secondary aim of the phase 2 study was to identify how the implementation of planning policies could help ensure that any potential environmental constraints could be overcome by provision of infrastructure or implementation of management policies.

4.3 Phase 2 study area

The study area for this water cycle study is primarily set by the constraints identified in the phase 1 study. The phase 1 study identified that the critical risk to ongoing development was the environmental and infrastructure capacity for wastewater treatment.

The urban area of Basingstoke, and the areas being tested for new development all drain towards the River Loddon. For this reason, this study focuses on the wastewater catchments that discharge to the River Loddon or its tributaries. As Chapter 2 explains, the impact of development, particularly the impact of additional treated effluent discharge, on the River Loddon was the primary cause of concern following the phase 1 study. Therefore this phase 2 study, and the associated ecology survey project and report, focus on the River Loddon catchment. The approximate study area is shown in Figure 4-3 below.

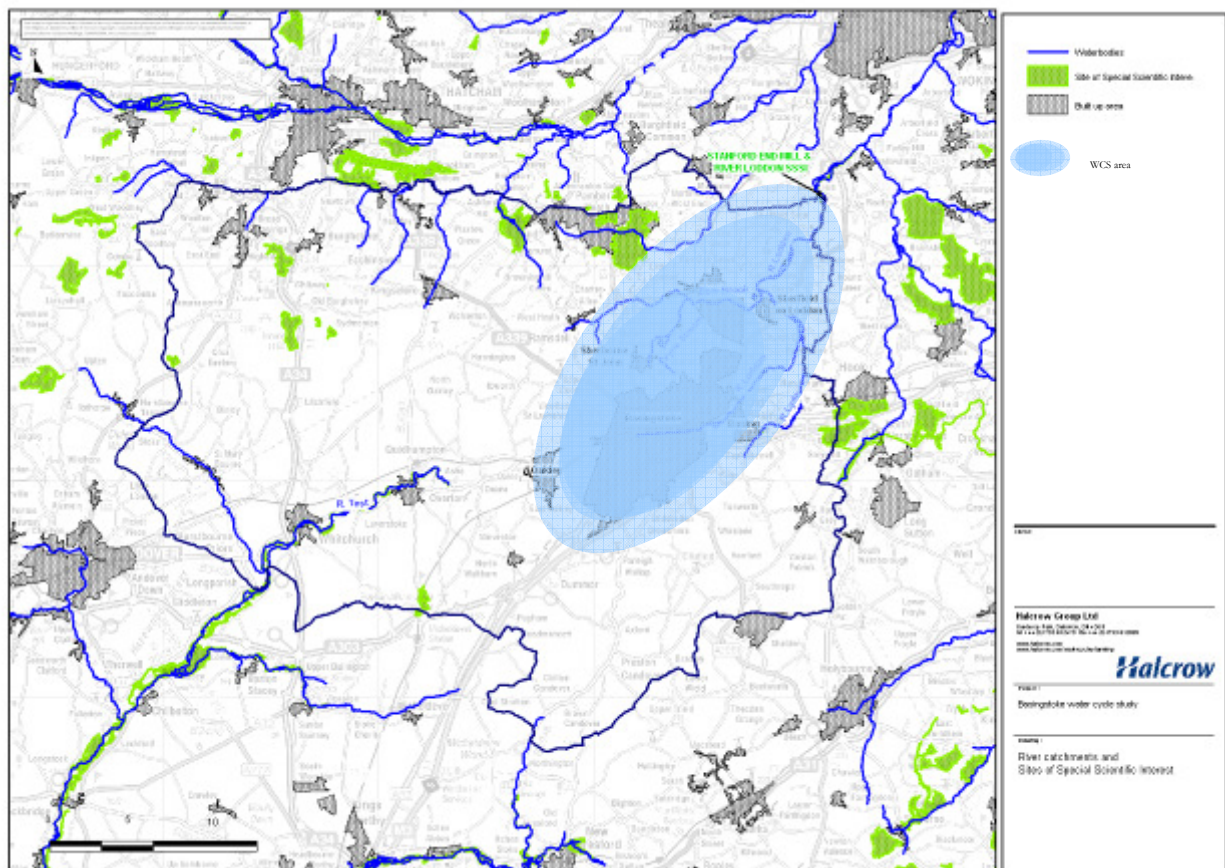



Figure 4-3 Water cycle study approximate boundary WCS study area denoted by 

4.4 Water environmental standards

The phase 1 study identified that the greatest risk to the ongoing development of Basingstoke was the potential failure of water quality standards in the River Loddon. The greatest concern was the impact that the discharge from Basingstoke sewage treatment works had on the River Loddon catchment.

4.4.1 River quality objectives (RQO)

The River Quality Objectives (RQOs) were agreed by Government as targets for all rivers in England and Wales when the water industry was privatised in 1989. The targets specified, at the time, the water quality needed in rivers if we are to be able to rely on them for water supplies, recreation and conservation.

The RQOs are expressed in terms of the River Ecosystem (RE) class, with an RQO of RE1 signifying a river a high chemical quality objective, and RE5 signifying a low or poor objective. The compliance with the RQO is assessed by the Environment Agency based on their river quality sampling programme. The Phase 1 study showed that, in 2006, according to the monitoring results published by the Environment Agency, for the period 2003 – 2005, all river reaches within the Borough area are compliant with the RQO.



The phase 1 study acknowledged that the RQO does not monitor or assess compliance for all substances that may exert an impact on ecological water quality, for example nutrients such as phosphorus and nitrates, and hazardous or priority list substances. Whilst there is no evidence that the River Loddon catchment is at risk of priority substances causing a deterioration in water or ecological quality, the river did suffer from elevated nutrient levels which may be increased further by additional development in Basingstoke.

4.4.2 *Common Standards for chalk rivers*

The Joint Nature Conservation Committee have proposed standards for chalk streams⁵. The Environment Agency, Natural England (formally English Nature) and Countryside Council for Wales agreed on guideline standards for Special Areas of Conservation (SAC) designated under the Habitats Directive. These standards are guidance only, and non-statutory. However, given the ecological importance and sensitivities of the River Loddon as a chalk river, the phase 1 study assessed how the river system compared against the guidelines. The phase 1 study found that:

- The existing treated sewage effluent causes the River Loddon immediately downstream of the discharge to fail the RE1 value described in the guideline chalk river standards.
- Any additional effluent discharged from the STW will have the impact of making this failure worse, although there are no significant differences between the three development scenarios assessed.
- The river currently significantly fails the orthophosphate target, both immediately downstream of the discharge and within the SSSI.
- the orthophosphate concentrations in the River Loddon, immediately downstream of the STW are significantly higher than the levels recommended in the common standards for chalk rivers.
- the orthophosphate value immediately upstream of the SSSI at Stanford End Mill is also higher than the guideline value.

4.5 *The Water Framework Directive*

The Water Framework Directive (WFD) came into force in December 2000, and was transposed into UK law in December 2003. It is the most substantial piece of European Commission water legislation to date and is designed to improve and integrate the way water bodies are managed throughout Europe. Under the WFD all Member States must:

⁵ Common standards for Chalk Rivers

These are non statutory standards prepared by the Joint Nature Conservation Committee (JNCC) for designated sites (www.JNCC.gov.uk).

The orthophosphate standards contained in the common standards was derived from Environment Agency proposed standards (as presented in the EA Eutrophication Strategy, 2000), and are closely aligned with Environment Agency guideline phosphorus standards for SAC rivers and emerging Water Framework Directive standards.



- prevent deterioration in the classification status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- aim to achieve at least good status for all waters. Where this is not possible, good status should be achieved by 2021 or 2027;
- promote sustainable use of water as a natural resource;
- conserve habitats and species that depend directly on water;
- progressively reduce or phase out releases individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants, and;
- contribute to mitigating the effects of floods and droughts.

4.5.1

No deterioration

The first principle of the WFD is to prevent deterioration in aquatic ecosystems. No deterioration must be met in all but very exceptional circumstances. Exceptional circumstances apply when the deterioration is caused by physical modifications to the waterbody, for example for flood risk management reasons, or the result of sustainable new human development activities. Even in such cases it is necessary to demonstrate that there was no better way to achieve the desired development, that there are no possible mitigation measures, and that it is technically infeasible or disproportionately expensive to do so. In addition, no deterioration requires that a water body does not deteriorate from its current ecological or chemical classification, and applies to individual pollutants within a water body. The Directive allows for deterioration within the limits of a status or classification. For example, if dissolved oxygen was currently classified as moderate status, then the first principle of the WFD would be to ensure no deterioration from moderate class, and the limited numerical deterioration acceptable within each classification or status would not constitute a breach of the Directive or be reported as deterioration. In exceptional circumstances only, it is acceptable to allow a deterioration of chemical status from high to good status only.

Box 4.1 shows article 4.7 of the Directive which covers the exemptions from no deterioration

Box 4.1: Text of Water Framework Directive Article 4.7

Member States will not be in breach of this Directive when:

- *failure to achieve good groundwater status, good ecological status or, where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water or groundwater is the result of new modifications to the physical characteristics of a surface water body or alterations to the level of bodies of groundwater, or*
- *failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities*



and all the following conditions are met:

- (a) all practicable steps are taken to mitigate the adverse impact on the status of the body of water;
- (b) the reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 and the objectives are reviewed every six years;
- (c) the reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives set out in paragraph 1 are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development, and
- (d) the beneficial objectives served by those modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option.

4.5.2

Good status

Under the WFD the objective is for all water bodies to meet good ecological status by 2015. For surface waters (rivers, lakes, transitional waters), good ecological status can be defined as:

- good chemical status for the relevant substances (there are also a series of daughter directives);
- good physico-chemical status on the scale high, good, moderate, poor and bad;
- good biological class, and;
- good hydro-morphological class.

The status of a water body is measured through a series of specific standards and targets that have been developed by the UK administrations, supported by the WFD UK Technical Advisory Group (www.wfduk.org).

The manner in which overall status is assessed is by using a 'one out, all out' approach. That is, the status is determined by the lowest common denominator. The following diagram shows how this works in practice.



Determining Water body Status

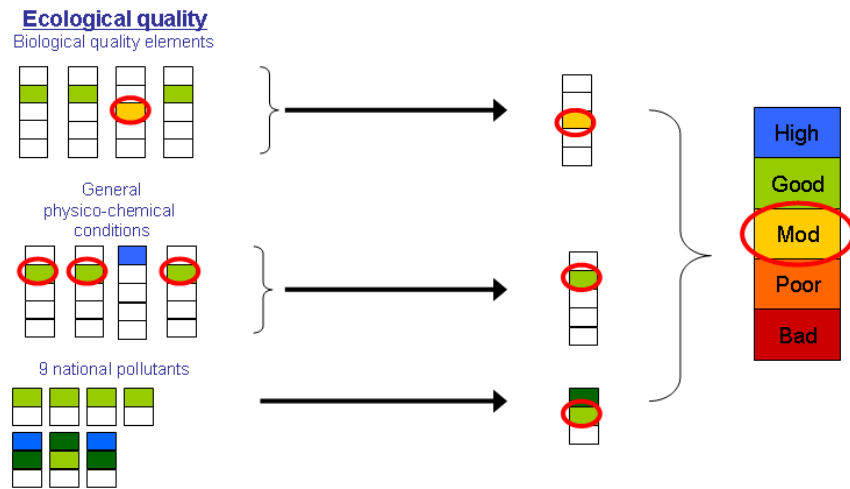


Figure 4-4 Determining water body status

4.5.3

Alternative objectives

Although the WFD specifies that good status should be met by 2015 there are circumstances where it is possible to delay meeting good status until 2021 or 2027, or where a lesser objective will be required. These circumstances include technical feasibility, disproportional costs, or natural conditions (recovery times). In most instances it is likely that these circumstances will lead to an extended deadline (i.e. 2021 or 2027) to meet good status, rather than setting a less stringent objective. A less stringent objective can be set for specific bodies of water when they are so affected by human activity, or their natural condition is such that the achievement of these objectives would be infeasible or disproportionately expensive, subject to certain conditions being met. These conditions include that the environmental and socioeconomic needs served by such human activity cannot be achieved by other means, which are a significantly better environmental option not entailing disproportionate costs, that the highest ecological and chemical status possible is achieved, given impacts that could not reasonably have been avoided due to the nature of the human activity or pollution, and that no further deterioration occurs.

Under Article 4 (3) of the WFD it is possible to designate water bodies as artificial or heavily modified water bodies. The WFD recognises that some water bodies have been modified to provide valuable social or economic benefits, and it is recognised these water bodies are not able to achieve natural conditions, and hence should not be required to achieve good ecological status. Artificial or heavily modified water bodies therefore have an alternative objective of meeting “good ecological potential” and these are identified in the draft River Basin Management Plans.



4.5.4

River Basin Management Plans

In England and Wales, the Environment Agency is the lead authority in ensuring delivery of the WFD. The Environment Agency have prepared draft River Basin Management Plans (dRBMP), published for consultation in December 2008, which set out:

- the current status for each water body (including confidence limits);
- the objectives and targets for each water body;
- the main pressures for each water body;
- an action plan outlining what will be required, by whom, and when to meet good ecological status, and;
- justification for setting an alternative objective by 2015.

Following the consultation of the dRBMP, they will be adopted as the first RBMP in December 2009, with the aim of meeting the main environmental objectives by December 2015. RBMPs will then be periodically reviewed and updated every six years (i.e. 2021, 2027).

The Thames River Basin Management plan, within which the River Loddon catchment sits, is shown in the figure below:



Figure 4-5 Thames River Basin Management district

A summary of the classification of the Thames RBMP is shown in Figure 4-6 below, with a summary of the targets for each subsequent review of the RBMP.

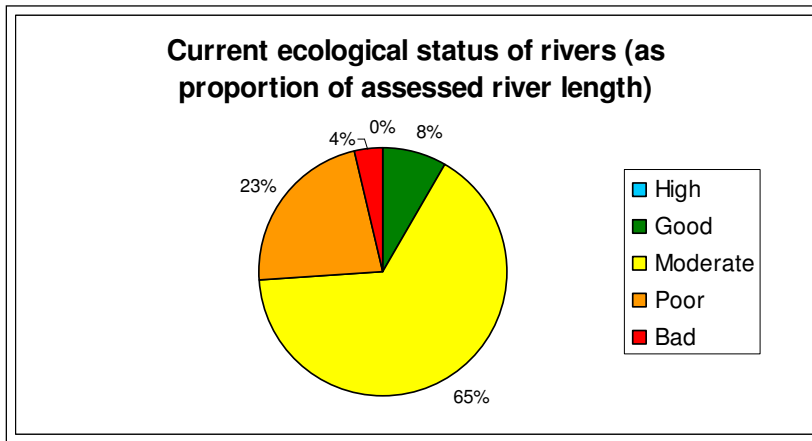


Figure 4-6 Overall ecological status of the Thames RBMP⁶

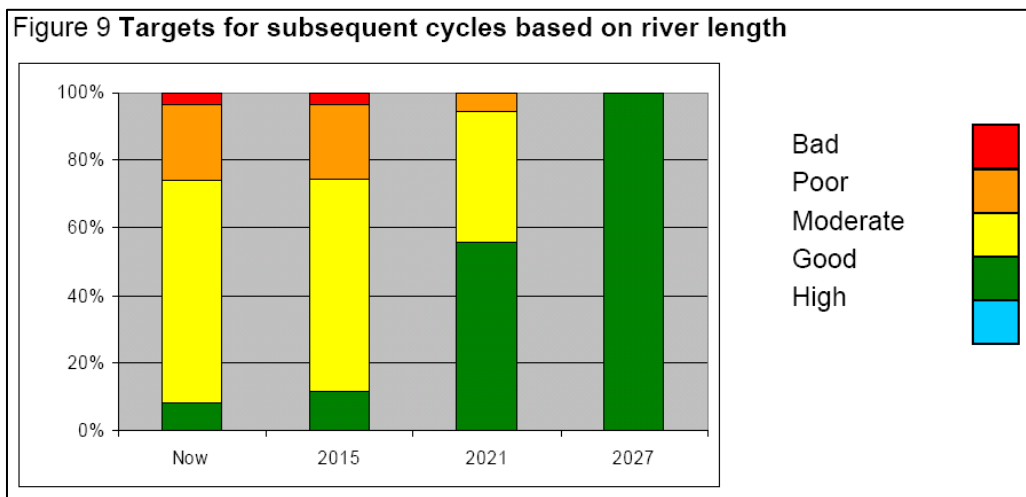


Figure 4-7 Target overall status for the Thames RBMP

4.5.5

Water Framework Directive classification

Sewage treatment works discharges will typically impact primarily on the physico-chemical classification, which includes parameters such as ammonia and phosphate, and the biological classification of a river, which includes measures such as fisheries and river invertebrates.

The following maps show the overall ecological status classification, and a map of the phosphate classification for the same region is shown. These maps serve to show that Basingstoke and Deane Borough is not atypical in the range of classification of its waterbodies across the South East region.

⁶ This information is taken from the Environment Agency consultation on the Thames River Basin Management Plan

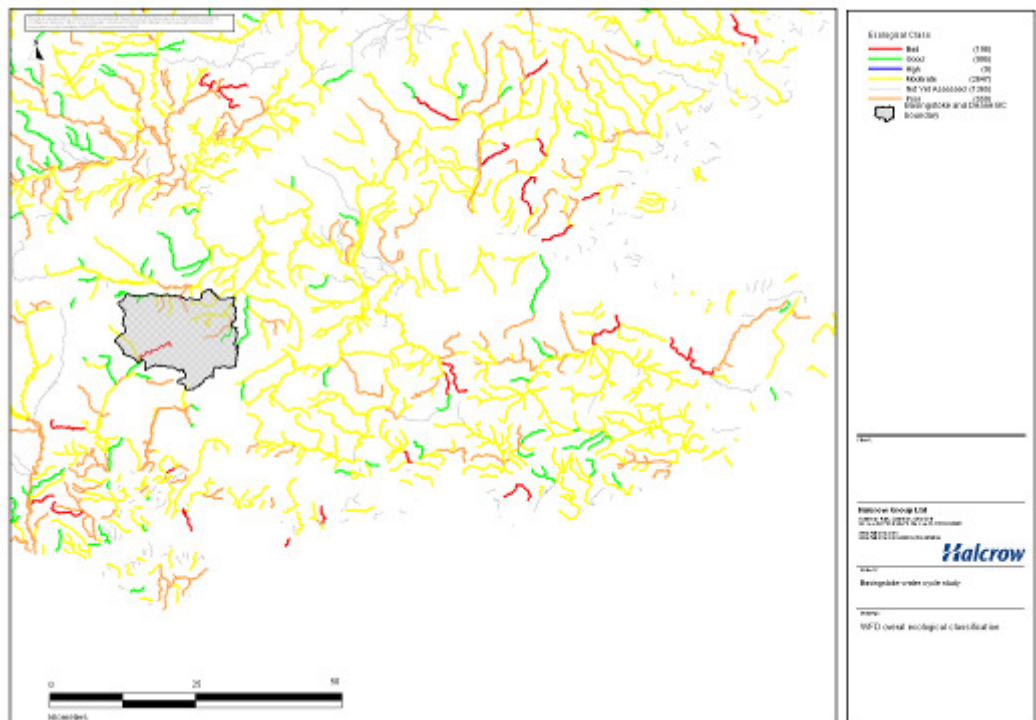


Figure 4-8 Overall ecological status classification

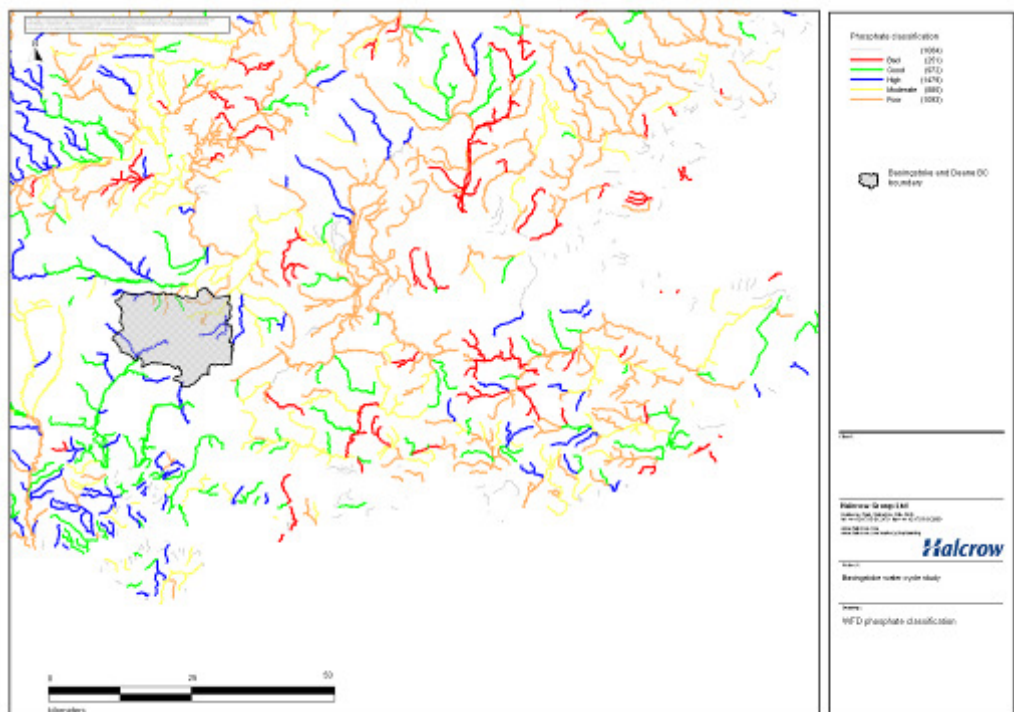


Figure 4-9 Physico-chemical phosphate classification



4.5.6

River Loddon WFD classification summary

This chapter has so far identified that the primary reason for the detailed water cycle study was to determine the effect that growth and development in and around the Basingstoke urban area may have on water quality and ecology within the River Loddon catchment, with particular reference to the links between ecology and river chemistry.

The following maps show the WFD classification results for the river catchments that drain the Basingstoke and Deane Borough.

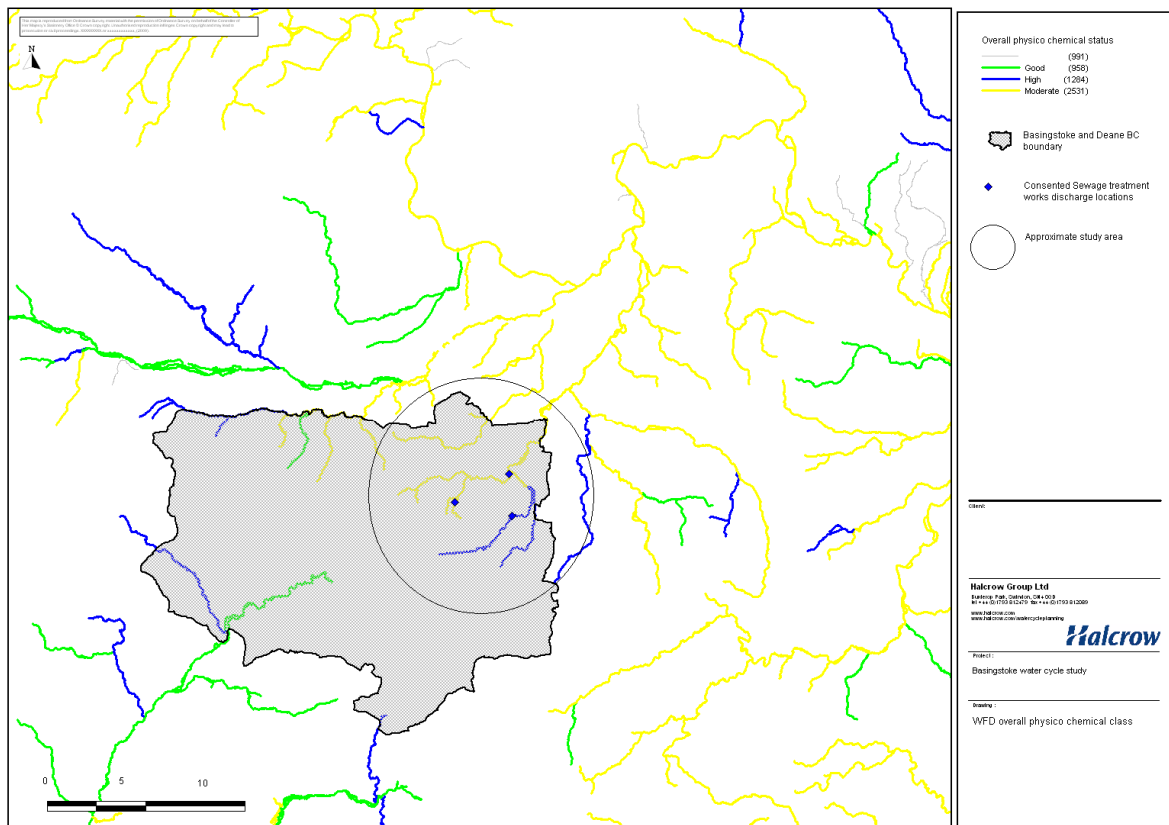


Figure 4-10 Basingstoke and Deane waterbodies overall physico-chemical status

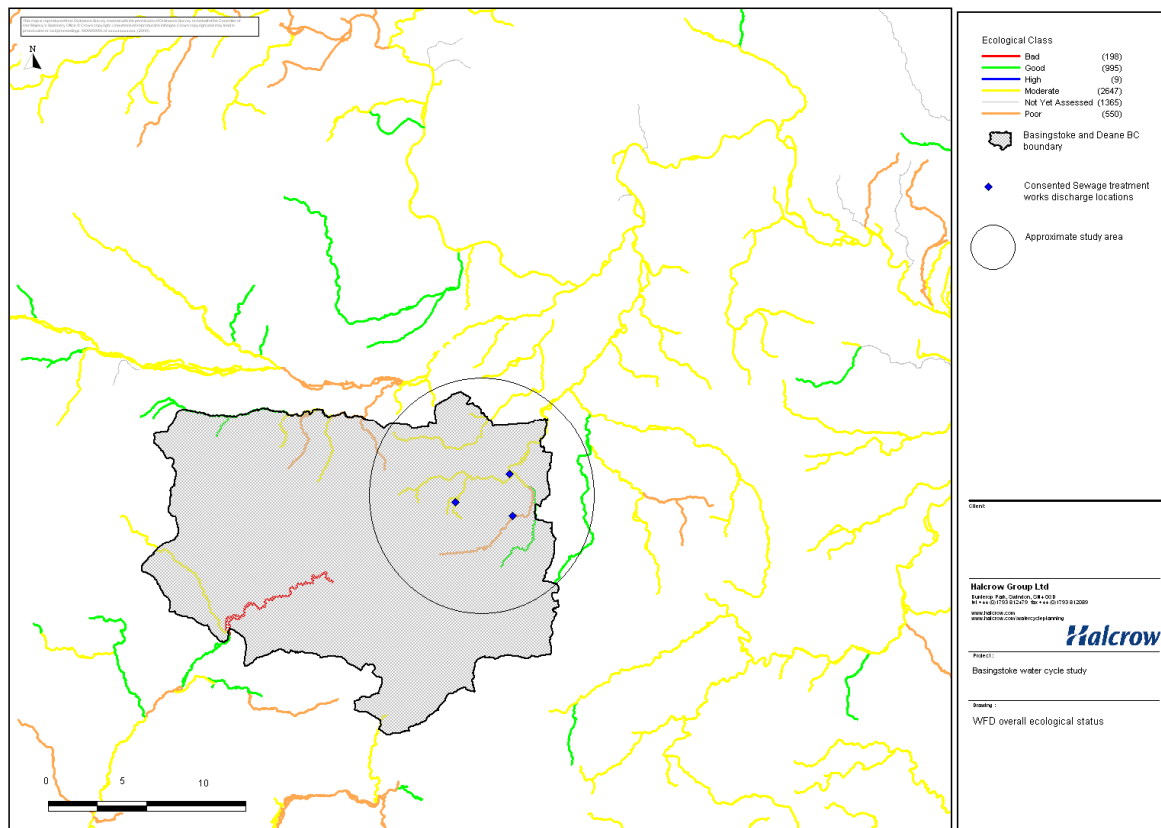


Figure 4-11 Basingstoke and Deane waterbodies overall ecological status

| River Reach | Overall physico-chemical status | Biological Status |
|--|---------------------------------|-------------------|
| Vyne Stream | ● | ● |
| Bow Brook (d/s Vyne Stream) | ● | ○ |
| Bow Brook (u/s Vyne Stream) | ● | ○ |
| Lyde | ● | ● |
| Loddon (containing Basingstoke STW) | ● | ● |
| Loddon (confluence with Lyde to confluence with Bow Brook) | ● | ○ |
| Loddon (Bow Brook confluence to Blackwater confluence) | ● | ● |
| Loddon (d/s Blackwater) | ● | ● |

| Symbol | Status |
|--------|------------------|
| ● | High |
| ● | Not High |
| ● | Good |
| ● | Moderate |
| ● | Poor |
| ● | Bad |
| ○ | Not yet assessed |
| ● | Other |

Figure 4-15 Basingstoke and Deane current WFD river classifications



| River Reach | Diatoms ⁷ | Macro-phytes | Macro-invertebrates | Fish |
|--|----------------------|--------------|---------------------|------|
| Vyne Stream | ○ | ○ | ● | ○ |
| Bow Brook (d/s Vyne Stream) | ○ | ○ | ○ | ○ |
| Bow Brook (u/s Vyne Stream) | ○ | ○ | ○ | ○ |
| Lyde | ○ | ○ | ● | ○ |
| Loddon (containing Basingstoke STW) | ○ | ○ | ● | ● |
| Loddon (confluence with Lyde to confluence with Bow Brook) | ○ | ○ | ○ | ○ |
| Loddon (Bow Brook confluence to Blackwater confluence) | ○ | ○ | ● | ● |
| Loddon (d/s Blackwater) | ○ | ○ | ● | ● |

Figure 4-16 Basingstoke and Deane WFD biological parameters

| River Reach | Dissolved Oxygen | pH | Phosphate | Ammonia |
|--|------------------|----|-----------|---------|
| Vyne Stream | ● | ● | ● | ● |
| Bow Brook (d/s Vyne Stream) | ● | ● | ● | ● |
| Bow Brook (u/s Vyne Stream) | ● | ● | ● | ● |
| Lyde | ● | ● | ● | ● |
| Loddon (containing Basingstoke STW) | ● | ● | ● | ● |
| Loddon (confluence with Lyde to confluence with Bow Brook) | ● | ● | ● | ● |
| Loddon (Bow Brook confluence to Blackwater confluence) | ● | ● | ● | ● |
| Loddon (d/s Blackwater) | ● | ● | ● | ● |

Figure 4-17 Basingstoke and Deane WFD physico-chemical parameters

⁷ Although the draft RBMP has not provided diatom classification, and hence this table shows the diatom classification as not yet assessed, we have received supplementary information from the Environment Agency that indicates the current diatom classification is poor (with an 85% probability). The Environment Agency have also stated that the poor diatom classification could be caused by the phosphate discharged in treated sewage effluent.



It can be seen from the classification maps and the tables above, that the River Loddon catchment downstream of Basingstoke and Deane urban area is not compliant with good ecological status. Based on analysis of the classification data presented, the reasons for this are:

- The waterbody immediately downstream of Basingstoke urban area only achieves a biological classification of poor because of a poor fisheries status. The remainder of the biological parameters achieves moderate status.
- The waterbody downstream of the primary sewage treatment works serving Basingstoke achieves moderate status, with phosphate being the only parameter that fails to meet good status.
- The waterbodies downstream of the two smaller sewage treatment works on the River Loddon catchment are assessed as having an overall status of poor or moderate. The physico-chemical phosphate parameter is the only monitored parameter that causes these waterbodies not to reach good status.

Based on the Water Framework Directive classification data, it appears that Basingstoke and Deane Borough is facing a similar scale of water quality and ecology issues to other areas in the South East of England. However, because the primary sewage treatment works serving Basingstoke is situated near the headwaters of the River Loddon where there is limited dilution, it already has a very stringent discharge consent, and with respect to both Ammonia and phosphate is currently operating at what the Environment Agency currently consider achievable with conventional sewage treatment works technology (described in the remainder of this report as Best Available Technology or BAT).

Even though Basingstoke sewage treatment works treats to a very high standard, the scale of the failure of the WFD phosphate target downstream is significant. The phase 1 study identified that the observed phosphate quality in the River Loddon is approximately six times higher than the WFD standard for good status, and the modelling in this study supports that conclusion.

Simplified river modelling in the phase 1 study showed that because Basingstoke sewage treatment works is operating at the limit of conventional technology, an increase in the population connected to the sewage treatment works would lead to an increase in the phosphate load being discharged into the river catchment, and therefore could potentially cause a deterioration in the physico-chemical status for phosphate. Furthermore, although the phase 1 ecological survey found no evidence of ecological degradation⁸

⁸ The phase 1 ecological survey found no evidence of ecological deterioration in the River Loddon, and found that the observed ecology and biology was of the standard expected of rivers of its type. However, it was acknowledged that survey data was sparse, and in some cases inconclusive. For this reason, a detailed ecological survey and water quality modelling exercise has been carried out.



despite the high level of phosphate in the river, there is a risk that any additional load of phosphate could cause a threshold change in the river ecology, which could lead a deterioration from the current biological status.

4.5.7 *Scope of water cycle study environmental assessment*

The detailed water cycle study was required to undertake detailed ecological survey work and detailed water quality modelling to determine:

- baseline biological status in the River Loddon catchment downstream of the Basingstoke urban area, and;
- baseline in-river processes in the River Loddon catchment, to better understand how river flow, river quality and river ecology interact.

The baseline model will allow growth scenarios to be modelled to determine:

- if there is a sustainable level of growth that will prevent any deterioration in WFD waterbody status;
- if there is a sustainable level of growth that will not prevent the River Loddon waterbodies being able to achieve good ecological status, and;
- what opportunities are available through better strategic development and infrastructure planning to help achieve good ecological status.

4.5.8 *Ecological appraisal*

In association with the development of the detailed water cycle study an ecological appraisal was commissioned to assess the potential impacts of changes in water quality and hydrology on the River Loddon catchment

A range of ecological surveys were carried out at sites along both the River Loddon and River Lyde including:

- River habitat survey (RHS, including Geo-RHS),
- river corridor survey,
- macrophyte survey,
- macroinvertebrate survey,
- woodland survey,
- fisheries habitat survey; and
- diatom survey.

To determine the current trophic state of the rivers a number of standard key ecological indicators were used including Mean Trophic Rank (MTR), Trophic Diatomic Indices (TDI) and various biotic indices including BMWP (Biological Working Party), ASPT (Average Score Per Taxon) and LIFE (Lotic-invertebrate Index for Flow Evaluation).



The results of these surveys are that eutrophication generally increases downstream within the surveyed catchment, with MTR and diatom sampling identifying nutrient enrichment downstream of Basingstoke STW. Biological water quality as indicated by macroinvertebrates was good with the exception also being immediately downstream of the STW, indicating organic pollution.

The overall MTR score is close to the mean of the top 10% of the rivers for this type (Type II River Community “rivers flowing in catchments dominated by clay”) though the results indicate that Basingstoke STW is having an impact on both diatom and invertebrates immediately downstream. Altered chemical features in the river originating from the STW appear to be increased organic loading, measured as biological oxygen demand (BOD) and chemical oxygen demand (COD).

The upper reaches of the River Loddon and River Lyde show classic chalk stream features for several kilometres before they are influenced by non chalk geology. The upper stretches of the River Lyde in particular are characteristic of an unimpacted chalk stream, with good habitat quality, low levels of modification and good aquatic indices scores. This area of the River Lyde would be at greatest risk from any development impacts.

Water quality, flow and ecological indices are good in the lower sections of the River Loddon and there is no indication that either Basingstoke, Sherfield on Loddon or Sherbourne St John STWs are having a negative impact this far downstream.

The full ecological appraisal report is included in Appendix I.

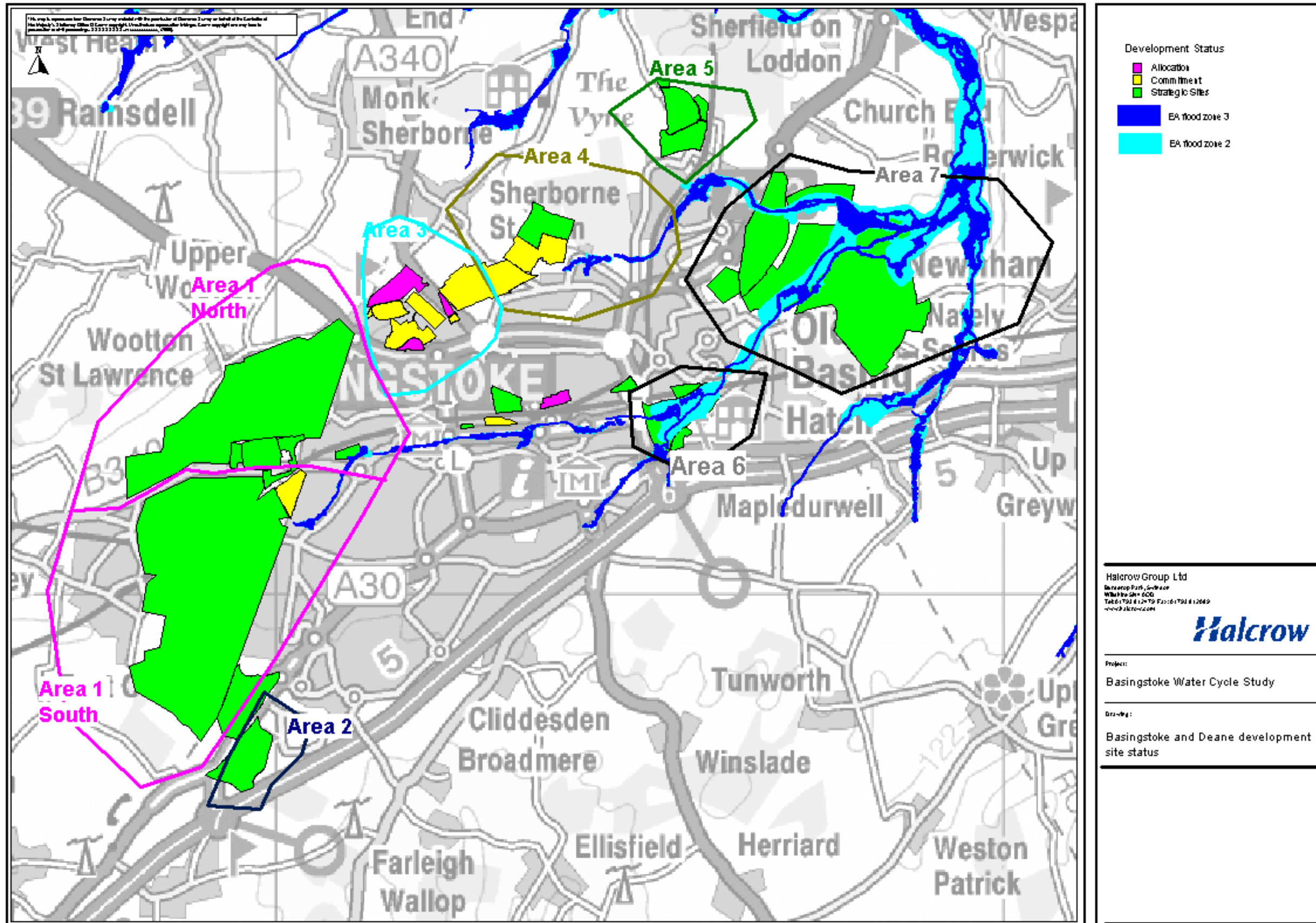


Figure 4-12





5 Water quality and wastewater treatment

5.1 *Introduction*

As part of the evidence base for the Basingstoke WCS, a detailed water quality assessment was carried out to assess the current water quality in the catchment, and to assess the potential impact of growth on water quality. The water quality assessment has been closely linked to the ecological survey carried out by Halcrow, to help build up an overarching understanding of the catchment.

5.1.1 *Regional Policy*

The final South East Plan includes the following policy on water quality, and the Basingstoke and Deane Core Strategy will need to be in general conformity with this policy.

Policy

Policy NMR2: Water Quality.

Water quality will be maintained and enhanced through avoiding adverse effects of development on the environment.

In preparing local development documents, and determining planning applications, local authorities will:

- Take account of water cycle studies, groundwater vulnerability maps, groundwater source protection zone maps and asset management plans as prepared by the Environment Agency, water and sewerage companies, and local authorities
- Ensure that the environmental water quality standards and objectives as required by European Directives are met
- Ensure that the rate and location of development does not breach either relevant 'no deterioration' objectives or environmental quality standards
- Not permit development that presents a risk of pollution or where satisfactory pollution prevention measures are not provided in areas of high groundwater vulnerability (in consultation with the Environment Agency and Natural England).

Local Authorities will work with water and sewerage companies and the Environment Agency to:

- Identify infrastructure needs, allocated areas and safeguard these for infrastructure development
- Ensure that adequate wastewater and sewerage capacity is provided to meet planned demand
- Ensure that impacts of treated sewerage discharges on groundwater, inland and marine receiving water do not breach environmental quality standards or 'no deterioration' objectives
- Ensure that plans and policies are consistent with River Basin Management Plans
- Ensure that water cycle studies are carried out, prior to development sites being given planning permission, where investigations by the Environment Agency indicate that water quality constraints exist
- Ensure that Sustainable Drainage Systems are incorporated in a manner to reduce diffuse pollution.

Local Authorities should promote land management activities to reduce agricultural pollution.



5.2

Water quality methodology

The phase 1 study identified key concerns that there may not be environmental capacity within the River Loddon system to accommodate the proposed levels of growth at Basingstoke.

The concern centred around the uncertainty that the River Loddon would be able to meet new targets to be set by the Water Framework Directive through the River Basin Management Plan (published in draft for consultation December 2008, and due to be published December 2009).

The phase 2 study has used a more detailed modelling approach, based upon catchment modelling, and has identified what standards would be required to be applied at the three sewage treatment works that discharge to the River Loddon or its tributaries downstream of the Basingstoke urban area in order to assure compliance with the chemical status required by the Directive.

The modelling has also looked at the sources of pollutants in the catchment, especially phosphorus, in order to assist in identifying the actions that need to be taken to achieve good status under the WFD.

5.3

Approach to modelling

5.3.1

Background to modelling methodology

For Basingstoke detailed WCS water quality analysis was undertaken using two modelling packages:

- STAVRoS – a rainfall-driven stochastic model, and;
- ISIS-quality – a semi-deterministic process water quality model.

STAVRoS is a water quality modelling package, which is used to assess the impact of continuous and intermittent discharges on receiving watercourse. The model is rainfall-driven, and includes an urban and rural hydrological response to rainfall. Urban runoff quality is controlled by a build-up and washoff model, whereas diffuse rural runoff is controlled by a stochastic process (based on mean and standard deviation). Discharges from Sewage Treatment Works (STW) are based on the known mean and standard deviation final effluent concentrations. STAVRoS models BOD, ammonia and orthophosphate.

ISIS-quality is an add-on package of the ISIS software. The model is driven by inputs (at flow-time and concentration-time boundaries). ISIS-quality is a full process based model, and can represent the complex interactions of pollutants in rivers, dissolved oxygen processes and the cycling of nitrogen and phosphorus. The principal pollutants considered in the ISIS-quality model for Basingstoke WCS were:



- ammoniacal nitrogen;
- total oxidised nitrogen (nitrite and nitrate);
- un-ionised ammonia
- pH;
- temperature;
- dissolved oxygen;
- total BOD;
- orthophosphate;
- adsorbed phosphorus, and;
- suspended sediments.

The models were conceptualised to represent the main rivers and STW within the catchment. The ISIS model reaches and locations of the STW are shown in Figure 5-2.

5.3.2

Flow calibration

Initially the STAVRoS model was calibrated for flows to match the observed mean and 95%ile low flows. River catchment areas were defined for each river reach in STAVRoS to generate diffuse flows to the rivers. For the ISIS model flow-time boundaries were generated based on the STAVRoS flow calibration.

Likewise, STW discharge was modelled in STAVRoS, and the time series output was extracted to the ISIS model.

5.3.3

Model water quality calibration

Upstream water quality boundaries in both models were based on observed data, where available. However, there are no existing Environment Agency sampling points at the upstream boundaries of Vyne Stream or Bow Brook and upstream quality was therefore assumed by back calculating from the downstream sample point.

Mass balance calculations of observed data indicated that 'known' sources of pollution (i.e. upstream boundaries or STW) could not account for all of the observed load in the river.. Therefore, river water quality was calibrated against observed data, and mass balance achieved by calibrating diffuse runoff. Once STAVRoS had been calibrated the upstream quality boundaries were extracted to the ISIS model. Within ISIS, process rates



were adjusted within recommended limits⁹ to calibrate the model for all the pollutants included.

For full details of the model calibration please see the model calibration report in Appendix II.

5.4 **Baseline water quality**

The baseline results were obtained by running the calibrated model for a three year time period, 2004-2006. The baseline results suggest water quality in the Loddon catchment is generally good, and for the most part complies with river standards and WFD targets. All rivers currently comply with the River Quality Objective for BOD, ammonia and unionised ammonia. Dissolved oxygen in all reaches complies with the Freshwater Fish Directive standard for salmonid waters (>9mg/l as a 50%ile). Under the proposed WFD standards the Loddon, Vyne Stream and Bow Brook would achieve either 'high' or 'good' chemical status for BOD and ammonia.

However, currently the Loddon (downstream of Basingstoke), Vyne Stream (downstream of Sherborne STW) and Bow Brook (downstream of confluence with Vyne) would fail to meet 'good' ecological status for orthophosphate. Final effluent orthophosphate from all three STW play a significant role in increasing orthophosphate in the Loddon catchment. There is clear evidence that discharge from Basingstoke STW directly influences downstream orthophosphate in the Loddon. Similarly Sherborne (4.3mg/l annual average) and Sherfield (5.3mg/l annual average) have a significant impact on orthophosphate in Vyne Stream, Bow Brook and the Loddon.

Evidence from observed data suggests orthophosphate in the Loddon has been improving since 2006, and this has principally been due to reduced loads from Basingstoke STW, as shown in Figure 5-1

⁹ George, L., *et al.*, (1985). Rates, Constants and Kinetics Formulations in surface water quality modelling (2nd edition), Environmental Research Laboratory, U.S. Environmental Protection Agency

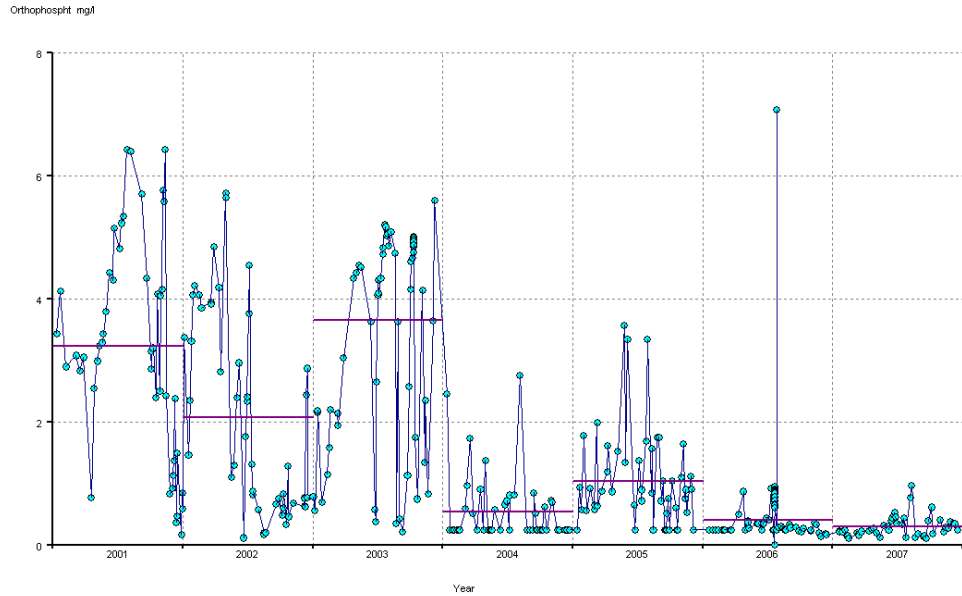


Figure 5-1 Observed orthophosphate from Basingstoke STW 2001-2007

Table 5-1 below shows modelled compliance (assessed over the baseline years) with river quality objectives, WFD targets, and freshwater fish directive targets.

The WFD classification for the Loddon downstream of Basingstoke STW to its confluence with the Lyde is poor. This stretch has been classified for ‘poor’ based on fisheries information and not water quality; however it is clear that phosphate levels in the stretch of the river downstream of the treatment works would be classified as poor for phosphate based on the Environment Agency’s routine water quality monitoring.

Table 5-1 Assessment of classification of individual sample points with WFD standards¹⁰

| River reach | BOD | | Ammonia | | Un-ionised Amm | Phosphate | Dissolved Oxygen* |
|--------------------------|------|-----------------------------|---------|-----------------------------|----------------|-----------------------------|-------------------|
| | RQO? | Current WFD classification? | RQO? | Current WFD classification? | RQO? | Current WFD classification? | FFD? |
| Loddon @ Pyots Bridge | Yes | High | Yes | High | Yes | High | Yes |
| Loddon @ Keepers Cottage | Yes | High | Yes | High | Yes | Poor | Yes |
| Loddon @ Long Bridge | Yes | High | Yes | High | Yes | Moderate | Yes |
| Loddon mid-SSSI | Yes | | Yes | High | Yes | Moderate | Yes |
| Loddon @ | Yes | High | Yes | High | Yes | Moderate | Yes |

¹⁰ The Environment Agency report WFD classification by waterbody, and not by individual sample point. The observations of individual sample points are pooled using a statistical method to derive a classification for the waterbody. We have not been able to ascertain this statistical methodology, therefore have reported classification by individual sample points



| | | | | | | | |
|-------------------------|-----|------|-----|------|-----|----------|-----|
| Blackwater | | | | | | | |
| Bow Brook u/s Sherfield | Yes | High | Yes | High | Yes | Moderate | Yes |
| Bow Brook d/s Sherfield | | | | Good | Yes | Poor | Yes |
| Lyde @ Deanlands Farm | Yes | High | Yes | High | Yes | High | Yes |
| Vyne d/s Sherborne | Yes | Good | Yes | High | Yes | Poor | Yes |

*use observed data for DO as ISIS model under-predicts, which affects predicted compliance to salmonid standard for FFD

Suspended sediment loads were high on the Vyne Stream and Bow Brook, and this indicates a highly turbid river. The source of the suspended sediment is likely to be a combination of load from the STWs and diffuse runoff. In the River Loddon suspended sediment increases downstream, and this is consistent with the ecological survey results, which suggested increased turbidity in the latter reaches of the Loddon. The ISIS model simulated the adsorption of orthophosphate to suspended sediment. The greatest concentration of adsorbed phosphorus was therefore in the reaches with the highest suspended sediment (Vyne and Bow Brook).

Legend

- STW
- WFD - Overall Classification
 - Poor
 - Good
 - Moderate

Client: Basingstoke and Deane

Halcrow Group Ltd
Basingstoke, Hampshire
UK • +44 (0)1256 312475
www.halcrow.com

Project: Basingstoke Water Cycle Strategy

WFD classification

Client: E Smith **Date:** 05/03/2019

Drawn by: **Date:** **Checked by:** **Date:**

FIGURE - X

Drawing Code: AS

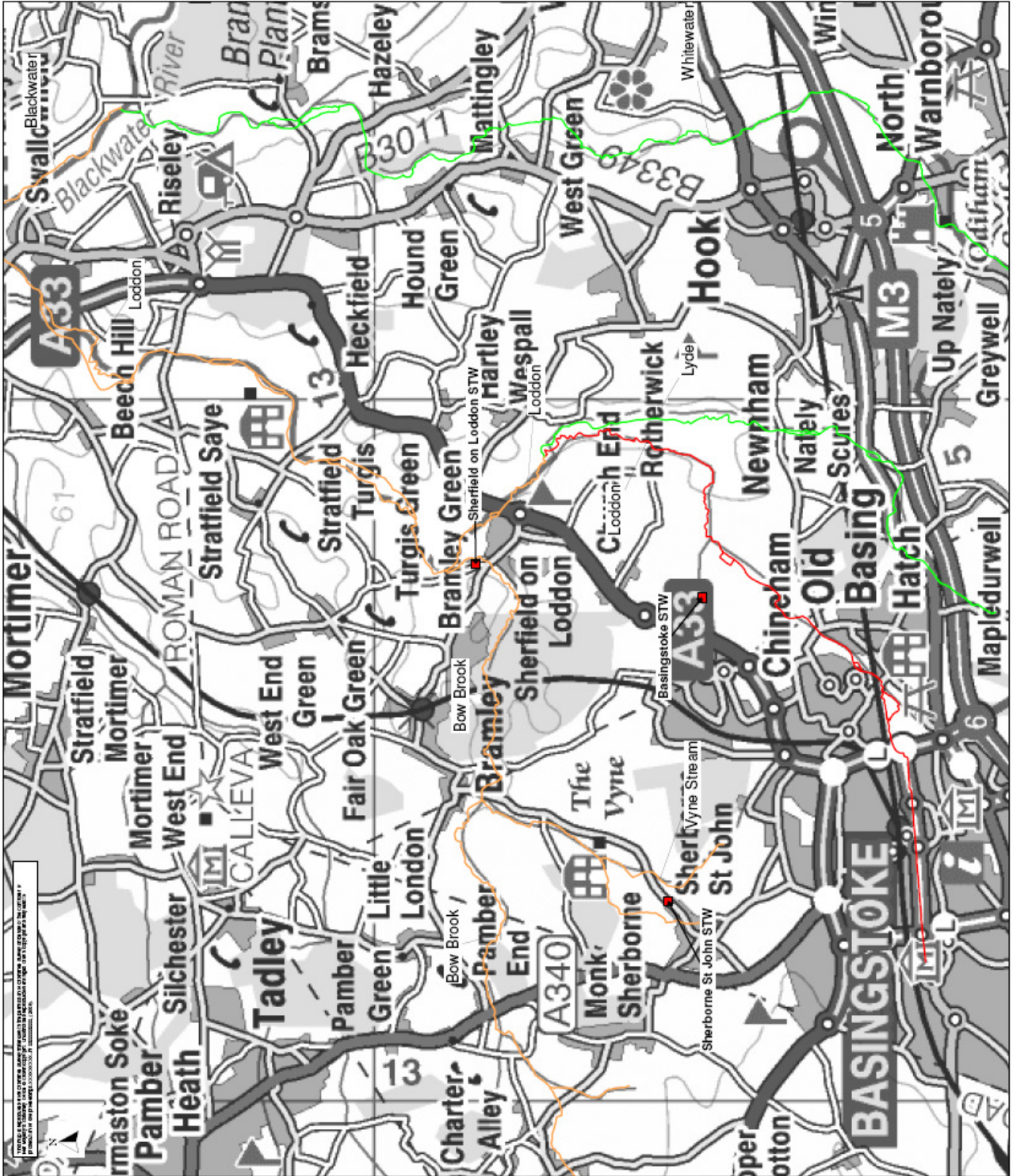


Figure 5-2 Water framework directive overall ecological status



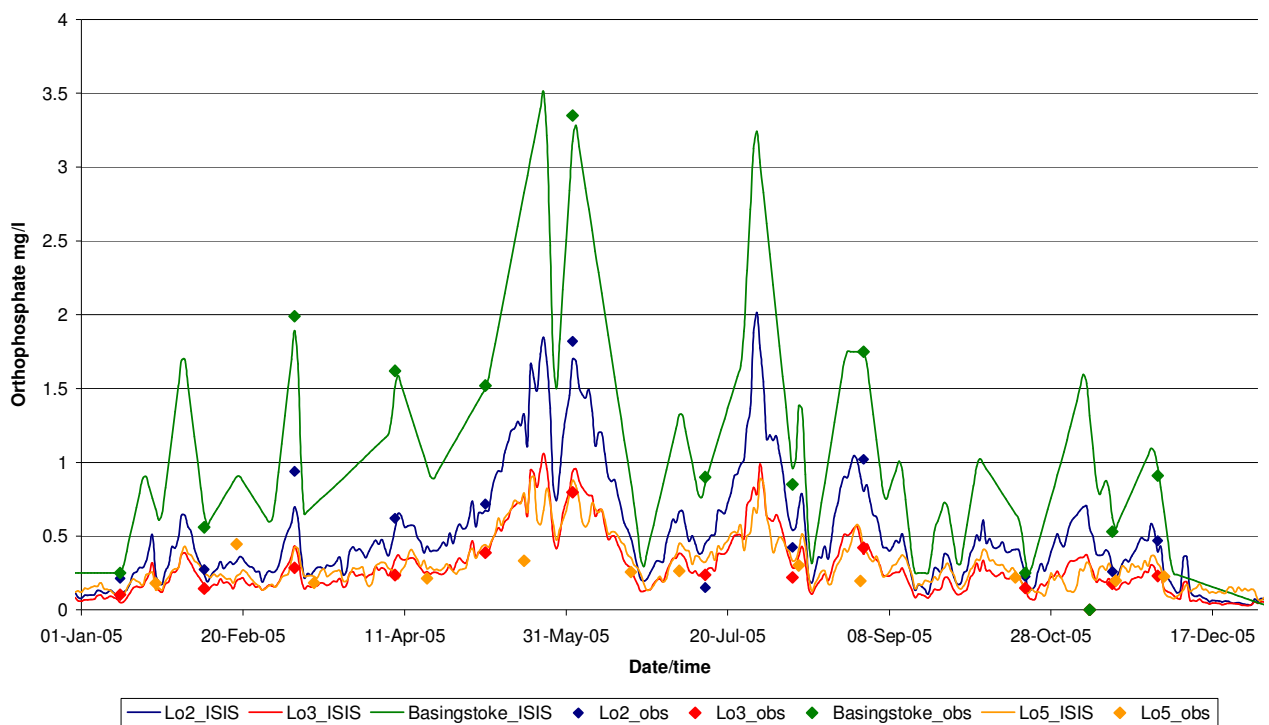
5.4.1

Influence of Basingstoke STW on River Loddon

The modelling and observed data indicated the potential significance of final effluent on downstream water quality. Figure 5-3 illustrates how trends in final effluent of orthophosphate from Basingstoke STW appear to be replicated in trends on downstream water quality in the Loddon, as far as the Loddon at Blackwater.

Linear regression analysis was conducted to compare the relationship between Basingstoke STW final effluent and downstream water quality for BOD, ammonia, TON, and orthophosphate. The regression analysis was carried out at three locations; Loddon immediately downstream of Basingstoke (Loddon 2), Loddon immediately upstream of the confluence with the Lyde (Loddon 3), and Loddon at Blackwater (Loddon 5). There were insufficient observed data to compare Basingstoke STW and the Loddon at Blackwater, and this analysis was extrapolated from ISIS modelling results. Furthermore, it was not possible to carry out regression analysis for the observed BOD data, because the majority of samples were less than values; again the regression was only conducted based on the modelling results.

Figure 5-3 Comparison of continuous modelled quality and observed STW and river orthophosphate data



The regression analysis for observed data indicated a strong positive relationship for ammonia and orthophosphate at both Loddon 2 and Loddon 3. For TON the relationship remained fairly strong, but less so than for ammonia or orthophosphate. The regression analysis based on the modelling results should be used with an element of



caution, but they also indicate the strong positive relationship between Basingstoke STW final effluent and river quality in the Loddon 2 and Loddon 3. The extrapolated results for Loddon 5 suggest that even at this point of the River Loddon the BOD and orthophosphate are strongly influenced by Basingstoke STW final effluent.

Table 5-2 Regression analysis showing relationship between Basingstoke STW observed effluent quality and observed river quality¹¹.

| Variable | Observed | | ISIS modelling | | |
|-----------------------|----------|---------|----------------|---------|---------|
| | Loddon2 | Loddon3 | Loddon2 | Loddon3 | Loddon5 |
| BOD | - | - | 0.94 | 0.82 | 0.62 |
| Ammonia | 0.96 | 0.9 | 0.94 | 0.73 | 0.35 |
| Orthophosphate | 0.92 | 0.81 | 0.92 | 0.92 | 0.8 |
| Oxidised N | 0.66 | 0.41 | 0.64 | 0.67 | 0.5 |

This analysis illustrates the impact of Basingstoke STW on downstream water quality. These findings from the ISIS-quality modelling are consistent with the findings of the ecological survey, which found aquatic macro invertebrate communities sensitive to organic and particulate inputs and diatom communities indicative of an increase in nutrient enrichment. Both the modelling assessment and the observed data indicate the influence of the STW on the Loddon, as far downstream as the Loddon at Blackwater.

Figure 5-4 demonstrates the phosphate loads in the Loddon catchment, attributed by source (either point source or ‘other’ source¹²). This indicates that the STW in the catchment are the dominant source of phosphate loads in the rivers.

¹¹ The statistical significance of each linear regression was analysed using Analysis of Variance (ANOVA), and all of the regressions were found to be significant with a greater than 95% probability.

¹² In other locations and other modelling studies, the Environment Agency have identified that sampling bias can lead to a difference between the modelled impact from a STW and the actual impact. This could lead to the estimated proportion of load attributable to point sources being incorrect. We do not believe that this would have a large impact on the modelling results, because the detailed river modelling includes time of concentration, and because of the very strong correlation between observed and modelled river quality when assessed on a continuous basis.

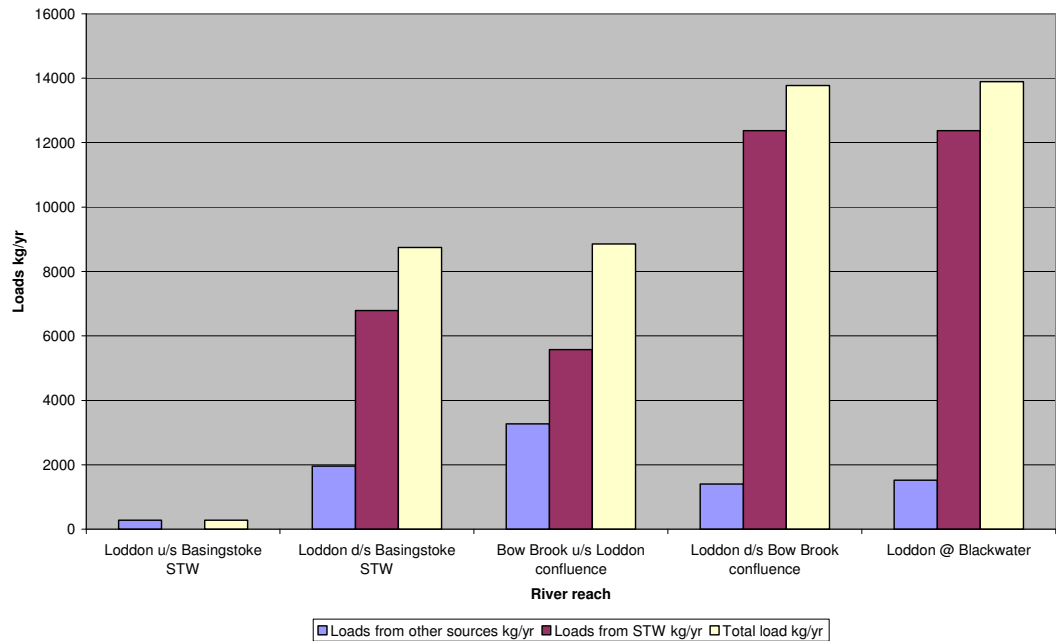


Figure 5-4 Graph highlighting the breakdown of orthophosphate load by source in different reaches of the model

5.4.2

Influence of Sherfield-on-Loddon and Sherborne St John STW

Sherborne St John STW discharges to the Vyne Stream, and has a consented DWF of 1430 m³/d (0.016 m³/s). Its consented discharge is 8mg/l BOD, 10mg/l ammonia in winter (5mg/l in summer). There is no consented quality limit for phosphate, but the current orthophosphate discharge is 4.3mg/l (annual average). Analysis of water quality immediately upstream and downstream of the works indicates that the STW is causing significant deterioration of orthophosphate in the Vyne Stream, which is directly attributable to the final effluent. The deterioration is sufficient to cause a failure against the proposed WFD standards. For other pollutants analysed the STW did cause deterioration in downstream quality but the Vyne Stream would still comply with both its RQO and proposed WFD standards.

Sherfield-on-Loddon has a consented discharge of 30mg/l for BOD, 4mg/l for ammonia. There is no consented quality limit for phosphate, but the current orthophosphate discharge is 5.4mg/l. Analysis of water quality upstream and downstream of the STW indicates deterioration for all pollutants modelled, with the most noticeable deterioration for ammonia and orthophosphate. Downstream of the STW ammonia remains compliant with the RQO standards, but would fail the proposed WFD standard for 'high' ecological status for lowland and high alkaline rivers. Orthophosphate would also fail the WFD standards at this location, and this is a combination of high effluent concentrations from both Sherfield and Sherborne STWs.



The observed data for suspended sediment (SS) illustrates high concentrations in both the Vyne Stream and Bow Brook. The observed suspended sediment in final effluent is much lower than the observed water quality data, which indicates that the high loads are due diffuse runoff from the catchments, or possibly caused by diatom growth as a response to high nutrient levels. High SS from Bow Brook and Vyne Stream appear to be a factor in the increased SS loads in the Loddon, and modelling results show an increase in SS immediately downstream of the confluence with the Bow Brook. The ecological surveys found higher suspended solids and lower water clarity in the river Loddon downstream of the confluence with Bow Brook which is consistent with this assessment. Sources of SS have not been able to be identified on the ground in this study, but the results suggest that any integrated catchment solutions will need to consider SS from diffuse sources.

Furthermore, there is evidence that BOD, orthophosphate and ammonia concentrations at the downstream end of Bow Brook do influence river quality in the River Loddon as it enters the Loddon (see Table 5-3 below). This is consistent with findings from the ecological survey whereby Mean Trophic Rank on the Loddon was lower downstream of Bow Brook, which indicates a greater proportion of plant taxa with higher tolerance to nutrient enrichment (either in numbers or their cover values). Caution must be exercised in making comparisons, however, as the prevailing site conditions (particularly water turbidity) means that confidence levels relating to the MTR in the downstream reaches of the Loddon are lower.

Table 5-3 Comparison of modelled pollutant concentration in the River Loddon upstream and downstream of the confluence with the Bow Brook

| Variable | Loddon u/s confluence with Bow Brook (mg/l) | Loddon d/s confluence with Bow Brook (mg/l) |
|---------------------------|---|---|
| BOD (90%ile) | 1.77 | 1.93 |
| Ammonia (90%ile) | 0.10 | 0.14 |
| Orthophosphate (mean) | 0.17 | 0.24 |
| Total Oxidised N (90%ile) | 11.72 | 11.18 |

5.4.3

Summary

In summary the baseline water quality results indicate:

- baseline water quality meets current FFD and RQO standards, and will meet 'high' or 'good' ecological status for all chemical standards except Orthophosphate
- baseline water quality fails to meet 'high' or 'good' ecological status for orthophosphate under WFD for the majority of reaches, and the only individual



sample points that achieve good ecological status for orthophosphate are those points upstream of the sewage treatment works discharges;

- Basingstoke STW plays a significant role in determining water quality downstream of the discharge, and this is particularly evident for ammonia and orthophosphate;
- Sherfield-on-Loddon and Sherborne St John STW cause deterioration of water quality in Bow Brook and Vyne Stream, respectively;
- there is a deterioration in BOD, ammonia, and orthophosphate in the River Loddon due to elevated concentrations arriving from Bow Brook;
- suspended sediment increases in the River Loddon downstream, and some of this is directly attributable to sediment load from Bow Brook (the SS load from Bow Brook appears to be due to diffuse runoff, not from the STW);
- the water quality results are consistent with the findings of the ecological survey; in particular the deterioration of water quality downstream of Basingstoke STW is consistent with the aquatic macro invertebrate and diatom surveys. Increase in suspended solids downstream of the STW in the River Loddon is consistent with increased turbidity in the SSSI, although it has not been possible to establish a causal relationship.

5.5

Options testing

5.5.1

Development scenarios

The Secretary of States' indication set out in the Proposed Changes to the draft South East Plan, now adopted, was that Basingstoke and Deane's annual housing allocation would be 945 dwellings/annum. This, subject to testing and confirmation by the Water Cycle Study, would mean that the level of housing growth in Basingstoke and Deane will be 18,900 new dwellings between 2006 and 2026. Water quality assessments were carried out to understand the likely impact of this additional growth. The water quality results were also used to predict changes in ecology. The additional foul flow from all new development was assumed to be sent to Basingstoke STW.

Further analysis was also undertaken to compare the difference between the council's formal position of 14,800 dwellings (740 dwellings/annum), and the Panel of Inspectors' South East Plan figure of 17,900 (895 dwellings/annum).

Table 5-4 indicates the estimated population and number of dwellings that are served by Basingstoke STW. The existing estimated population was taken from the InfoWorks CS model of the catchment, and current estimated number of dwelling was calculated by assuming an occupancy rate of 2.2, which is consistent with the WRMP.



Table 5-4 Comparison of estimated population and number of dwellings to Basingstoke STW under different growth scenarios

| Scenario | Estimated population | Estimate dwellings | Notes |
|---------------------|----------------------|--------------------|--|
| Existing population | 96225 | 43750 | Population estimate taken from InfoWorks model, assumed occupancy of 2.2 |
| 740 dwellings/annum | 128881 | 58550 | |
| 895 dwellings/annum | 135377 | 61650 | |
| 945 dwelling/annum | 137930 | 62650 | |

5.5.2

Impact of growth on water quality

The predicted additional discharge from Basingstoke STW for each of the growth scenarios was modelled in ISIS. The results are shown in Figure 5-5 to Figure 5-10.

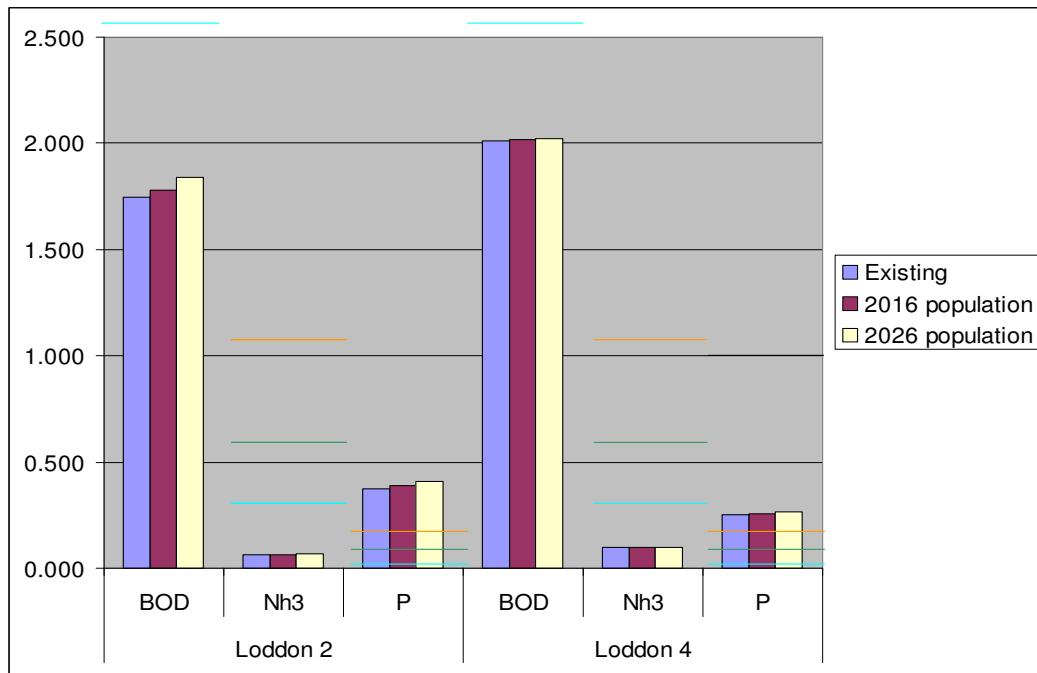


Figure 5-5 Impact of population growth on River Loddon, assuming no tightening of STW quality consent (blue line = high WFD status, green line = good WFD status, orange line = moderate WFD status)

A 'do nothing' scenario was initially modelled. This scenario assumed the highest forecast increase in the number of dwellings (18,900), with Basingstoke STW discharging at its current consented quality, that is, at Best Available Technology. This scenario is effectively business as usual, and assumes that no active intervention is made to achieve Good Ecological Status.



The modelling results show that the 'do nothing' scenario will not lead to a deterioration in physicochemical or ecological status on either the Vyne Stream or the Bow Brook. This is to be expected because no growth has been allocated to these STWs. The 'do nothing' option will also not lead to a deterioration of physicochemical class in any modelled stretch of the River Loddon, for any of the chemical parameters.

There is a risk that there may be a deterioration in ecological status in the River Loddon caused by the small modelled increases in phosphate from the additional effluent causing a deterioration in observed biological status. However, this risk has been assessed to be minor based on the modelled increase in phosphate loads, although it is not possible to fully quantify this risk. The risk may be mitigated slightly if the population growth is limited to 14,800 dwellings in total or 740 dwellings per year. However, there is no significant difference in modelled river quality between the two different population scenarios. The figures below illustrate that there will be marginal deterioration in numerical water quality with growth, and there will be no deterioration in chemical class.

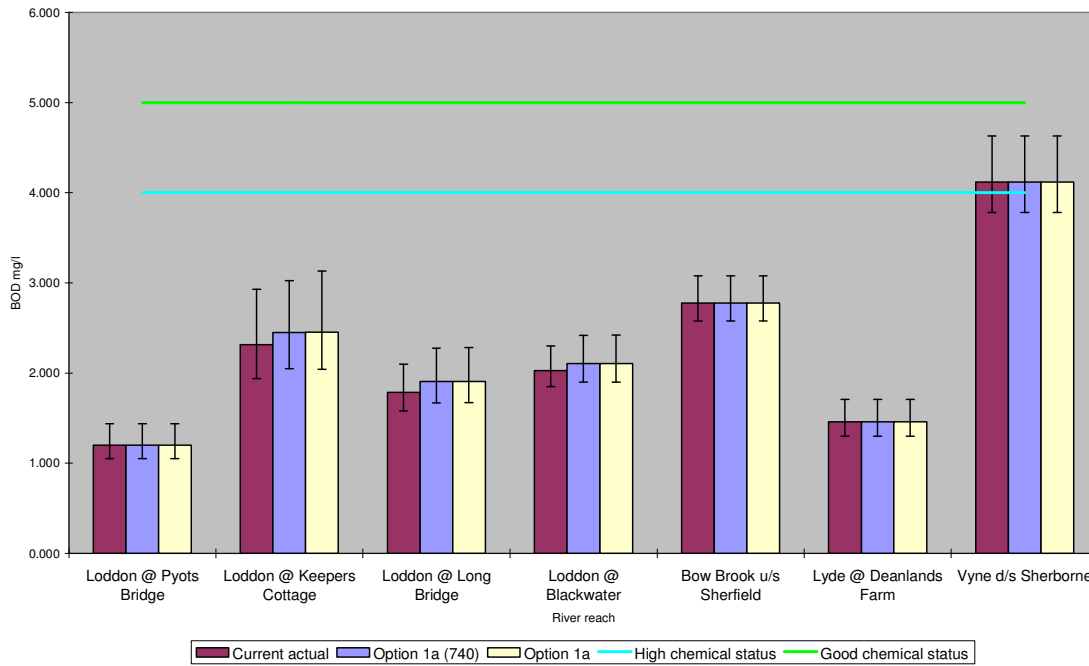


Figure 5-6 Change in modelled BOD concentration by river reach and population scenario¹³

¹³ The error bars shown in these figures represent 95% confidence limits derived from the modelled mean and SD assuming 36 samples over a three year monitoring period

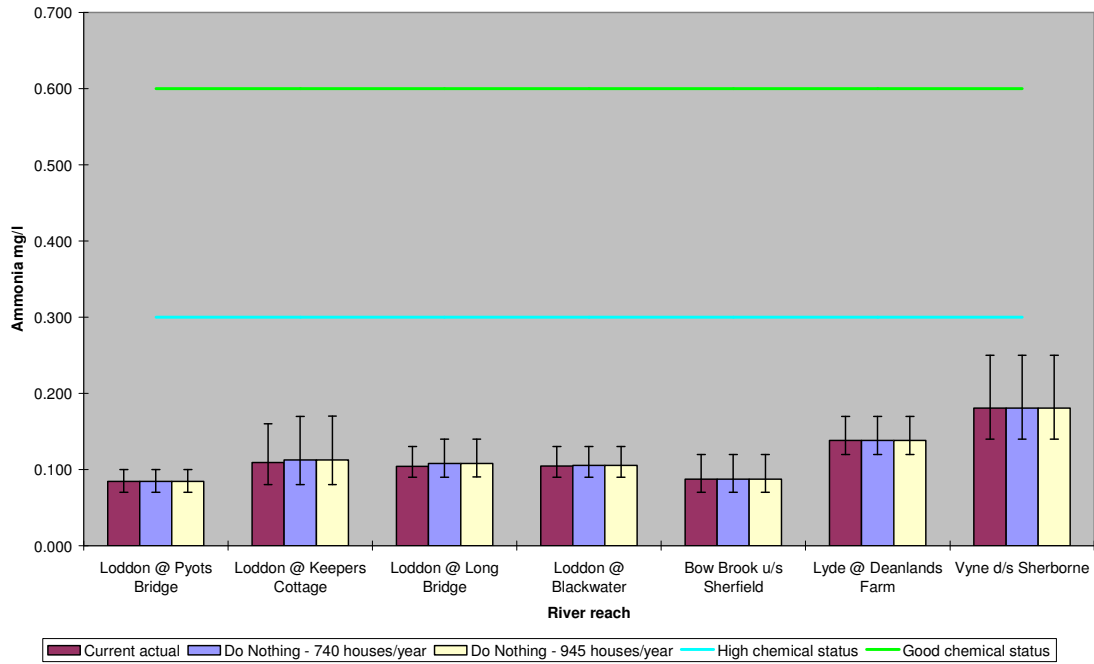


Figure 5-7 Change in modelled Ammonia concentration by river reach and population scenario

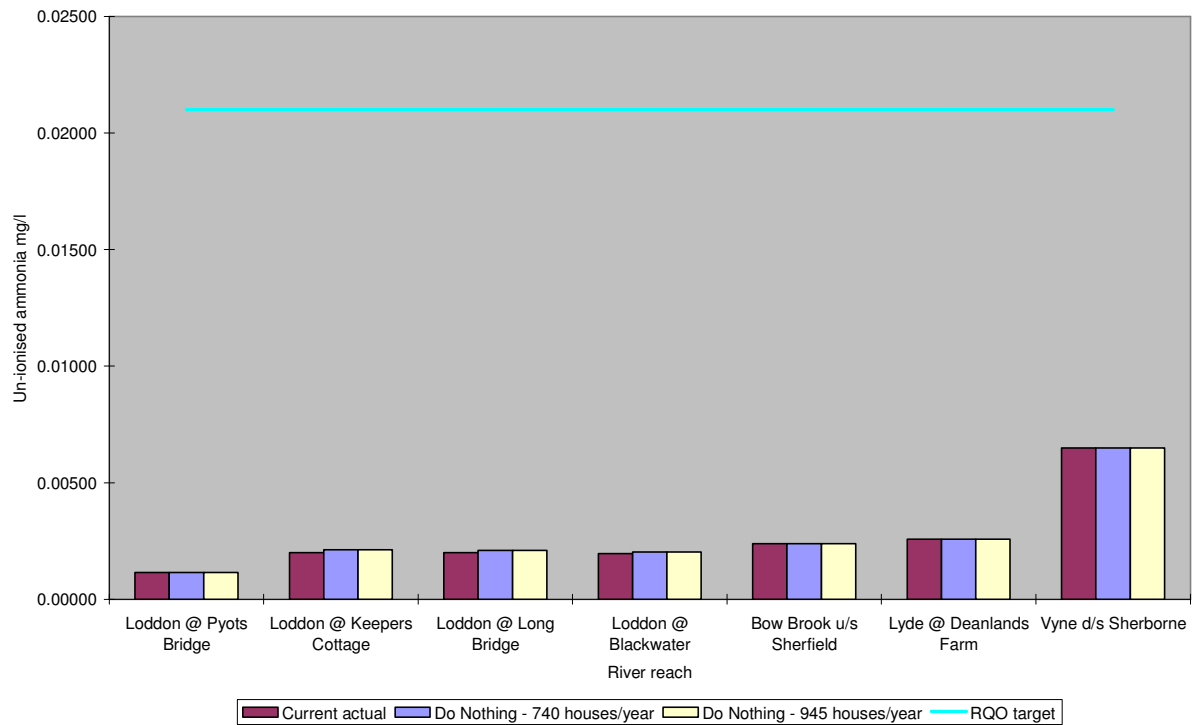


Figure 5-8 Change in modelled un-ionised Ammonia concentration by river reach and population scenario

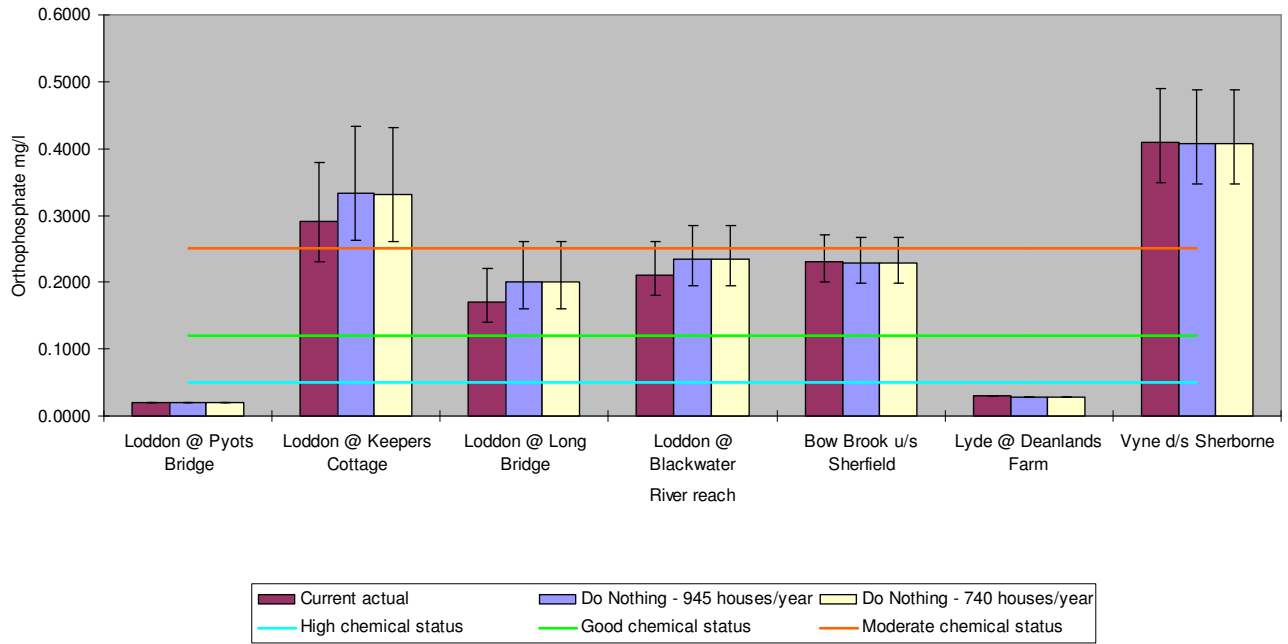


Figure 5-9 Change in modelled Orthophosphate concentration by river reach and population scenario

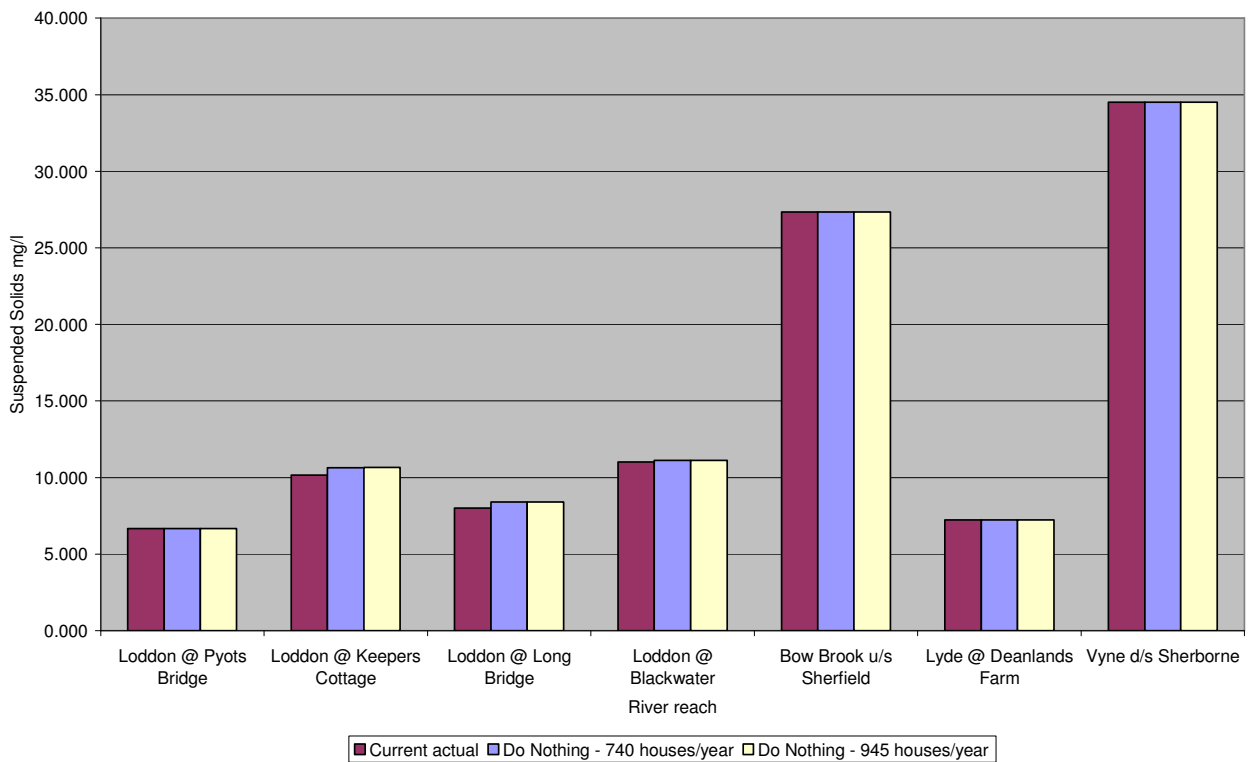


Figure 5-10 Change in modelled total suspended solids concentration by river reach and population scenario



5.5.3

Impact on Loddon SSSI downstream of confluence with Bow Brook

The SSSI is likely to be most sensitive to changes in orthophosphate and suspended solids, which could potentially have a detrimental impact on the plant community. Natural England has suggested that high turbidity would probably affect the Loddon pondweed, particularly if it is a chronic problem. Nutrient-rich waters may actually favour the pondweed, but nutrient enrichment is likely to have a detrimental effect on other macrophytes present.

The modelling suggests that there will be a marginal deterioration in orthophosphate and suspended solids due to growth. Uncertainty still remains surrounding the relationship between the effluent discharges and the turbidity in the SSSI. Natural England have advised that the turbidity could be due to diatoms, and these in turn could be related to the trophic status, and be adversely impacted by any increase in orthophosphate load. Although the marginal nature of the deterioration means that the risk of physical ecological deterioration as a result of additional effluent discharge is low, it is not possible to rule out an impact. Therefore a monitoring programme is recommended to further understand how turbidity and diatom vary in relation to environmental variables. Chapter 9 proposes a Core Strategy policy to implement a monitoring framework to resolve this uncertainty.

5.5.4

Options to meet water framework directive requirements

The modelling in this chapter has shown that the impact of additional treated sewage effluent¹⁴ from the additional development scenarios modelled is unlikely to cause a deterioration of current status in the River Loddon. However, doing nothing will not achieve 'good status' in the River Loddon and its tributaries as required under the WFD.

The critical cause of failure of good status as already mentioned is orthophosphate, and with up to 92% of the load of phosphate in the River Loddon deriving from treated sewage effluent, it was not possible to achieve good status by managing or removing other sources of phosphate. Therefore the study looked at the following options to improve water quality to good status

1. direct all growth to Basingstoke STW , and set quality consents at all STW including Sherfield and Sherborne STW to meet WFD chemical status of good by 2027, and;
2. direct all additional growth to Basingstoke STW, with quality consents set to meet WFD chemical; status of good by 2027, close down Sherfield-on-Loddon and Sherborne St John with flow from these STW directed to Basingstoke STW

¹⁴ All modelling has used continuous simulation and we have represented diurnal flows at the STW, with flows reaching FFT and subsequent storm discharges. Furthermore this includes modelling of dry weather events and low flow during the summer.



3. identify what the baseflow in the River Loddon would need to increase by (for example by reducing abstraction).

The results for modelling scenarios 1 and 2 (Table 5.5 below) show that it is not possible to meet good ecological status for phosphate in the River Loddon with current available sewage treatment technology. The results also show that the different population scenarios assessed do not affect the consent changes that would be required.

Where a consent change is required that is within current available treatment technology, the consent values are in **bold BLUE text**, and where a consent change is required that is beyond current available treatment technology, the consent value is marked in *Italicised RED text*.

Under option one the BOD, ammonia and phosphate consents would need to be tightened at Sherfield and Sherborne to achieve good ecological status. At Basingstoke STW the BOD and ammonia consent would not need to be tightened, but phosphate consent would need to be set to 0.13 or 0.14 mg/l. The required phosphate consents at all three STW to achieve good ecological status for phosphate is beyond currently accepted Best Available Technology¹⁵.

Under option 2, where both Sherfield and Sherborne STW are closed down and their flow redirected to Basingstoke, both Vyne Stream and Bow Brook would achieve 'good' ecological status for phosphate. However, this assessment has only focused on BOD, ammonia and phosphate and does not take into account the hydromorphology of the Vyne Stream. If this option is progressed a detailed study would need to be undertaken encompassing all flow and water quality parameters.

The results of the additional baseflow modelling (option 3) show that the baseflow in the River Loddon would need to be increased by approximately 170Ml/day, effectively increasing the flow at the point of STW discharge by 400%, and doubling the flow in the River Loddon at the Blackwater confluence. This option has not been discussed further because of the severe flood risk and ecological disturbance that would result from such changes.

¹⁵ The Environment Agency currently consider that 1mg/l orthophosphate as an annual average is the lowest value that conventional sewage treatment works technology can reliably achieve. Although some STWs can outperform this, as Basingstoke STW has for some years, further investment in treatment techniques that have not been tried and tested would be required to reliably achieve quality below this level. The equivalent limit for BOD and ammonia is 5mg/l and 1 mg/l as a 95% percentile standard.



| Scenario | STW name | Current consent | | | WFD consent for 14,800 population growth | | | WFD consent for 18,900 population growth | | |
|------------|---------------------|-----------------|------------------|------------------|--|------------------|------------------|--|------------------|------------------|
| | | BOD (95%ile) | Ammonia (95%ile) | Phosphate (mean) | BOD (95%ile) | Ammonia (95%ile) | Phosphate (mean) | BOD (95%ile) | Ammonia (95%ile) | Phosphate (mean) |
| Do Nothing | Sherfield-on-Loddon | 30 | 4 | 7.5 | 30 | 4 | 7.5 | 30 | 4 | 7.5 |
| | Sherborne St John | 8 | 7.5 | 6 | 8 | 7.5 | 6 | 8 | 7.5 | 6 |
| | Basingstoke | 10 | 1 | 1 | 10 | 1 | 1 | 10 | 1 | 1 |
| Option 1 | Sherfield-on-Loddon | 30 | 4 | 7.5 | 18 | 3 | 0.2 | 18 | 3 | 0.2 |
| | Sherborne St John | 8 | 7.5 | 6 | 7 | 4 | 0.3 | 7 | 4 | 0.3 |
| | Basingstoke | 10 | 1 | 1 | 10 | 1 | 0.13 | 10 | 1 | 0.13 |
| Option 2 | Sherfield-on-Loddon | 30 | 4 | 7.5 | STW assumed to be closed down and flow directed to Basingstoke STW | | | | | |
| | Sherborne St John | 8 | 7.5 | 6 | | | | | | |
| | | 10 | 1 | 1 | | | | | | |

Table 5-5 Modelled indicative STW consents needed to achieve WFD good ecological status





WFD implications of scenarios assessed

The table below indicates how the options modelled will impact on compliance with the Water Framework Directive chemical and ecological status. If a 'do nothing' scenario is adopted the river Loddon, Bow Brook and Vyne Stream would all fail to achieve good ecological or chemical status. Under option 1 and 2 the rivers can achieve good chemical and ecological status by tightening the consents at the three STWs examined. For phosphate the consents would need to be tightened beyond current accepted Best Available Technology.

Table 5-6 Assessment of the impact of additional treated effluent on WFD classification within the study area

| Option | STW name | WFD deterioration of class? | | Achieve good status by 2027? | |
|------------|---------------------|-----------------------------|----------|------------------------------|----------|
| | | Ecology | Chemical | Ecology | Chemical |
| Do nothing | Sherfield-on-Loddon | No | No | No | No |
| | Sherborne-St-John | No | No | No | No |
| | Basingstoke | Unlikely | No | No | No |
| Option 1 | Sherfield-on-Loddon | No | No | Yes | Yes |
| | Sherborne-St-John | No | No | Yes | Yes |
| | Basingstoke | No | No | Yes | Yes |
| Option 2 | Sherfield-on-Loddon | No | No | Yes | Yes |
| | Sherborne-St-John | No | No | Yes | Yes |
| | Basingstoke | No | No | Yes | Yes |

In summary the water quality modelling indicates;

- growth in the catchment at the levels assessed would be highly unlikely to cause a deterioration in WFD physicochemical classification at individual sample points;
- growth in the catchment would cause a marginal numerical deterioration in physicochemical water quality in the river Loddon, but this deterioration is within sampling error margins and therefore not significant.
- closing Sherfield-on-Loddon and Sherborne-St-John STWs and re-directing their flow to Basingstoke STW would result in both Bow Brook and Vyne Stream achieving good ecological status, but would not achieve any improvement in the River Loddon;
- Vyne Stream and Bow Brook can achieve good ecological status if the consents at Sherfield and Sherborne are tightened – for phosphate this would require a consent beyond current BAT, and;



- the river Loddon is already in good ecological status for BOD and ammonia. To achieve good status for phosphate would require the STW to treat to standards tighter than BAT, and significantly better than that achieved within conventional technology within the UK. The consent would need to be tightened from the current 1mg/l to 0.13mg/l as an annual average.

5.5.5 Impact of growth on river flows

The modelling has indicated either no change or a small increase in mean flow in the river Loddon with the development scenarios. Development of up to 945 houses per year (with climate change) will cause an increase in mean flow throughout the river Loddon, with the exception of the river reach downstream of the urban area (up to Pyots Bridge).

The sensitivity of the plant community to flow was assessed using Mean Flow Rank (MFR). MFR shows an overall expected trend of decreasing levels as one moves downstream in the Loddon. The sites surveyed did not indicate particularly high flow sensitivity, with the exception of Pyots Bridge which had a relatively high MFR score. This indicates this section of the river may be sensitive to reduction in flow velocity. The modelling suggests river flows at Pyots Bridge will decrease marginally with climate change, which may be a cause for concern.

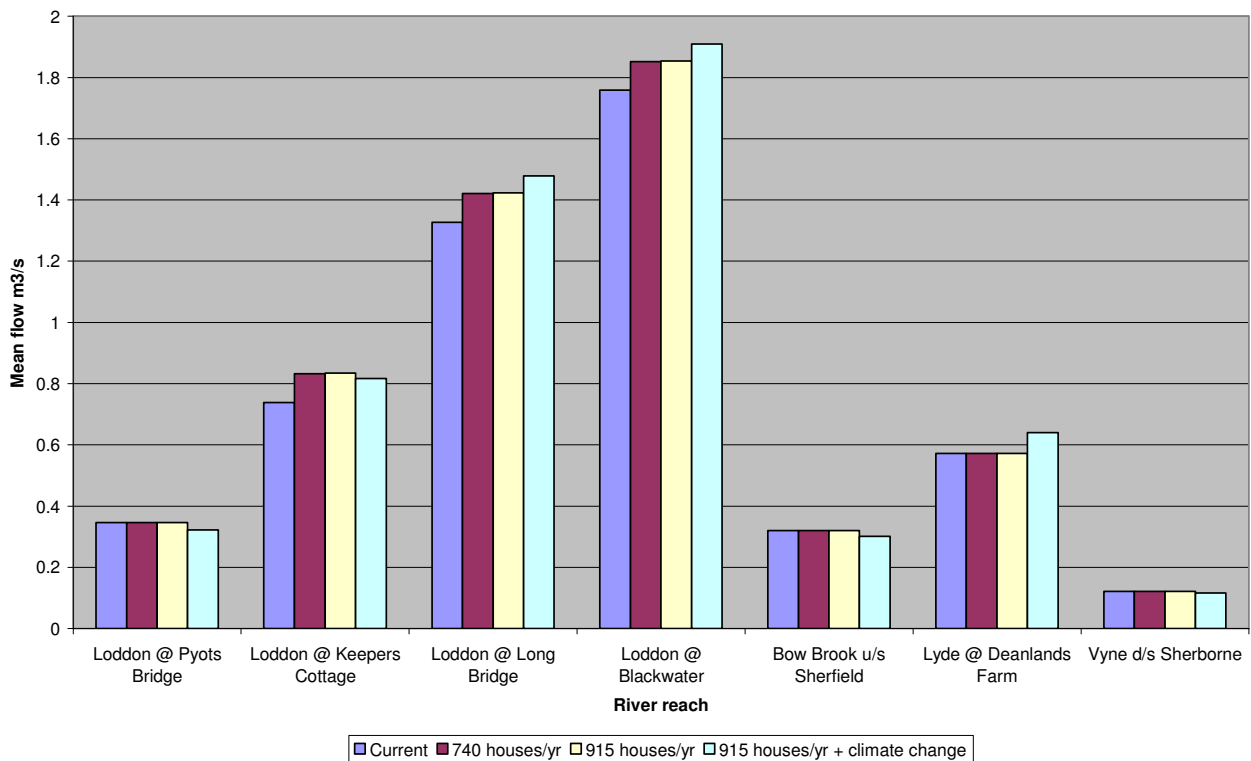


Figure 5-11 Modelled change in mean river flow



Lotic-invertebrate Index for Flow Evaluation (LIFE) scores were assessed during the aquatic macro invertebrate surveys which links changes in macro invertebrate communities to prevailing flow conditions. None of the LIFE scores recorded were considered particularly low, which is likely to be a reflection of the maintained baseflow inputs from groundwater sources into the rivers. Future flow scenarios should not affect flow-sensitive macro invertebrates.

Any impacts due to increased flow are more likely to affect salmonid fisheries rather than cyprinid fisheries. A reduction in habitat diversity is the greatest risk, particularly spawning and juvenile habitats. However the predicted increases in flows are unlikely to affect salmonid fisheries, especially if the habitat enhancements recommended in the Fisheries Habitat Survey report are undertaken.

5.6

Climate change analysis

To assess the combined impact of development and the impact of predicted changes in rainfall, river flows and temperatures due to climate change the ISIS model was run for a joint climate change and development scenario. Average seasonal rainfall was adjusted based on factors from UKCIP02 for a high emissions scenario for the 2080s, and an allowance was made for predicted changes in rainfall intensity during the summer. Seasonal water temperatures were increased to reflect predicted increases in air temperatures with climate change, based on UKCIP02.

Climate change is likely to lead to an increase in peak flows in the urban area due to more intensive rainfall. In particular summer rainfall is predicted to remain similar to current rainfall on average, but rainfall is predicted to occur in more intense rainfall events. The potential impacts of more intense rainfall are two-fold:

1. potential for greater number of spills from combined sewer overflows, storm overflows at sewage treatment works, and increased risk of pollution from foul flooding events, and;
2. greater buildup of pollutants within the catchment during longer antecedent dry periods (in the summer) and therefore higher washoff from the catchment during intense rainfall events.

Increases in overflows from combined sewers or storm tanks at the STW could lead to a local deterioration in water quality and ecology due to increased turbidity from silt carried via storm drains, and nutrient enrichment from the overflows. In addition, increased sediment loads could be added to the river during intense rainfall events from the rural catchment, which could further increase turbidity in the river. This could cause deterioration in suspended solids in the river during or after intense rainfall events.



Although there are no known or consented combined sewer overflows (CSOs) or dual manholes in the Basingstoke drainage network, there is existing evidence of poor water quality affecting the ecology within the urban area. A lower MTR was found within the urban area, indicative of nutrient enrichment. Furthermore, there is evidence of localised influences on aquatic macro invertebrates with the lowest Average Score per Taxon recorded immediately downstream of the Basingstoke urban area.

There is also evidence of sewage pollution in the urban area of Basingstoke, particularly in the river Loddon through Eastrop Park, where sewage fungus was observed during the ecological survey. This is consistent with misconnections and, or CSOs in the largely culverted surface water drainage system upstream.

Hard surfacing and intense rainfall can also cause a reduction in aquifer recharge, although this can be managed through the development process with the provision of infrastructure to encourage infiltration (e.g. sustainable drainage systems). This is subject to a groundwater risk assessment (see sections 6.3.3 and 6.3.4).

The way in which urban drainage in new developments is managed is discussed in Chapter 8. However, good design of new drainage systems for Greenfield development can prevent these problems occurring, and redesign of drainage systems for brownfield development sites can improve the current situation. Therefore good design of SuDS is essential, and must be managed through the planning process.

The objective of water quality modelling to assess the impact of climate change was to assess the predicted changes in river quality and river processes. The modelling is able to demonstrate the changes in river processes due to increased temperatures and changes in rainfall (and hence river flows). The results from the water quality modelling, shown in Table 5-7 below indicate:

- Ammoniacal nitrogen will decrease throughout the catchment, as decay and nitrification rates will increase with increases in average temperature.
- Nitrites and nitrates will increase, but this is not significant because increases in temperature do not cause rapid changes in nitrification rates. Furthermore the optimal temperature for nitrification is 30-35°C and river temperatures in the catchment will remain well below this with climate change.
- Un-ionised ammonia is a function of temperature and pH. Therefore with climate change levels of un-ionised ammonia are predicted to significantly increase throughout the catchment. However model outputs still indicate un-ionised ammonia will comply with both the RQO and Freshwater Fisheries Directive (FFD) standards.



Table 5-7 Percentage change in pollutant concentration for climate change IPCC 2080 high emissions scenario and the high 2026 growth scenario

| Pollutant | Loddon @ Pyots Bridge | Loddon @ Keepers Cottage | Loddon @ Long Bridge | Loddon @ Blackwater | Bow Brook u/s Sherfield | Lyde @ Deanlands Farm | Vyne d/s Sherborne |
|---------------------|-----------------------|--------------------------|----------------------|---------------------|-------------------------|-----------------------|--------------------|
| BOD | -0.11% | 0.30% | -0.98% | -0.05% | -0.28% | 0.27% | -0.07% |
| Ammoniacal Nitrogen | -5.82% | -2.93% | -2.96% | -11.16% | -6.30% | -2.79% | -1.05% |
| Phosphate | -0.01% | -3.08% | -8.58% | -4.95% | 2.97% | 0.14% | 3.44% |
| Temperature | 20.20% | 20.20% | 20.20% | 20.20% | 20.20% | 20.20% | 20.20% |
| Dissolved Oxygen | -0.22% | -2.10% | 0.15% | -0.31% | -0.76% | 0.04% | -0.45% |
| Nitrite | 6.78% | 7.07% | 3.86% | 1.52% | -0.39% | -0.78% | 1.11% |
| Nitrate | 0.00% | 2.58% | -0.69% | -0.09% | 0.73% | 0.01% | 0.76% |
| Unionised ammonia | 25.73% | 27.29% | 27.03% | 24.46% | 24.09% | 28.88% | 26.95% |

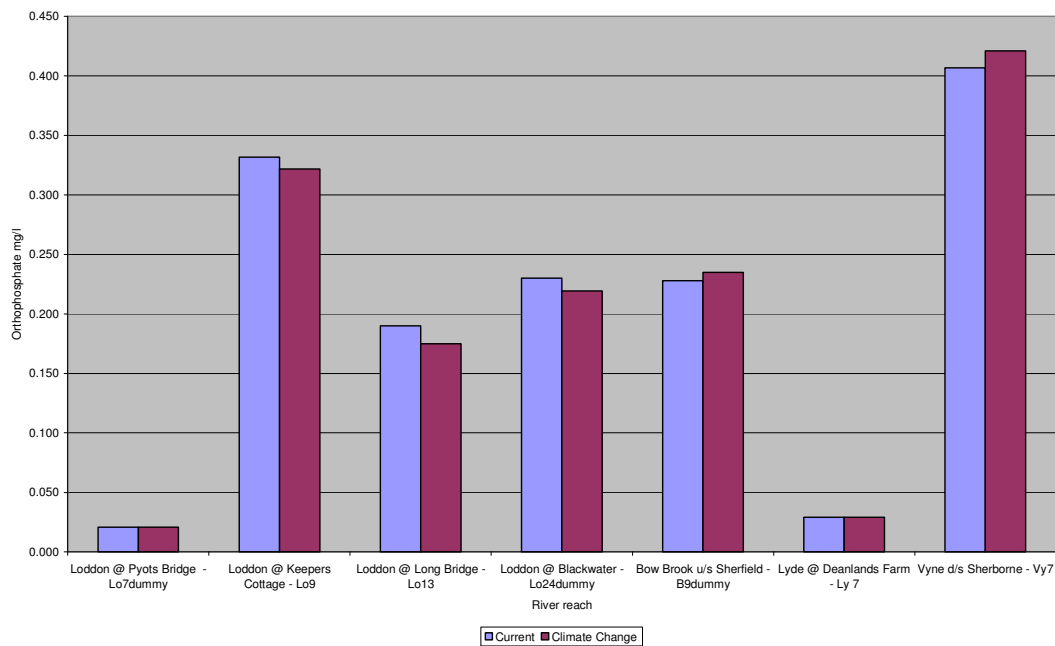


Figure 5-12 Modelled annual average orthophosphate concentration change for 2080 climate change growth and 2026 population scenario

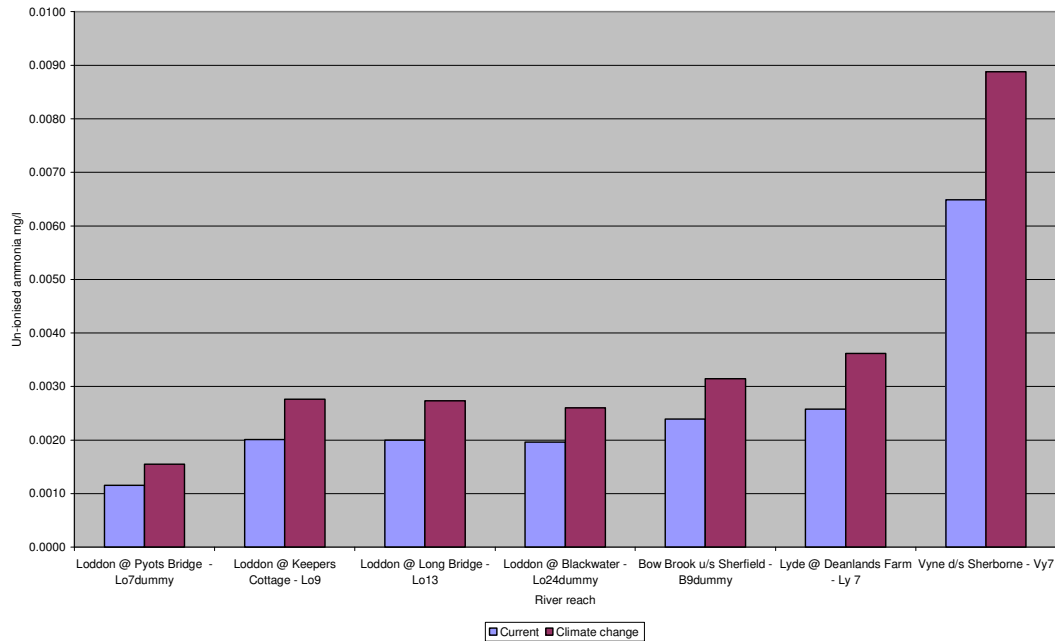


Figure 5-13 Modelled annual average un-ionised ammonia concentration change for 2080 climate change growth and 2026 population scenario

5.7

Analysis of the impact of drought conditions

The ISIS model represents temperature and temporally varying river flows. As a result it is possible to model the impact of dry periods on water quality in the catchment. To assess the impact of dry periods two summer periods were chosen for comparison:

- Summer (June, July, August) 2004 – total summer rainfall was 220mm, against the 2001-2006 average summer rainfall of 140mm, and average air temperatures were 16.5°C.
- Summer 2006 – total summer rainfall was only 80mm, and the average air temperature was 17.5°C. This was considered to represent a typical dry summer.

As illustrated in Figure 5-14 the dry summer resulted in significantly reduced river flows in the catchment, compared to a wetter summer.

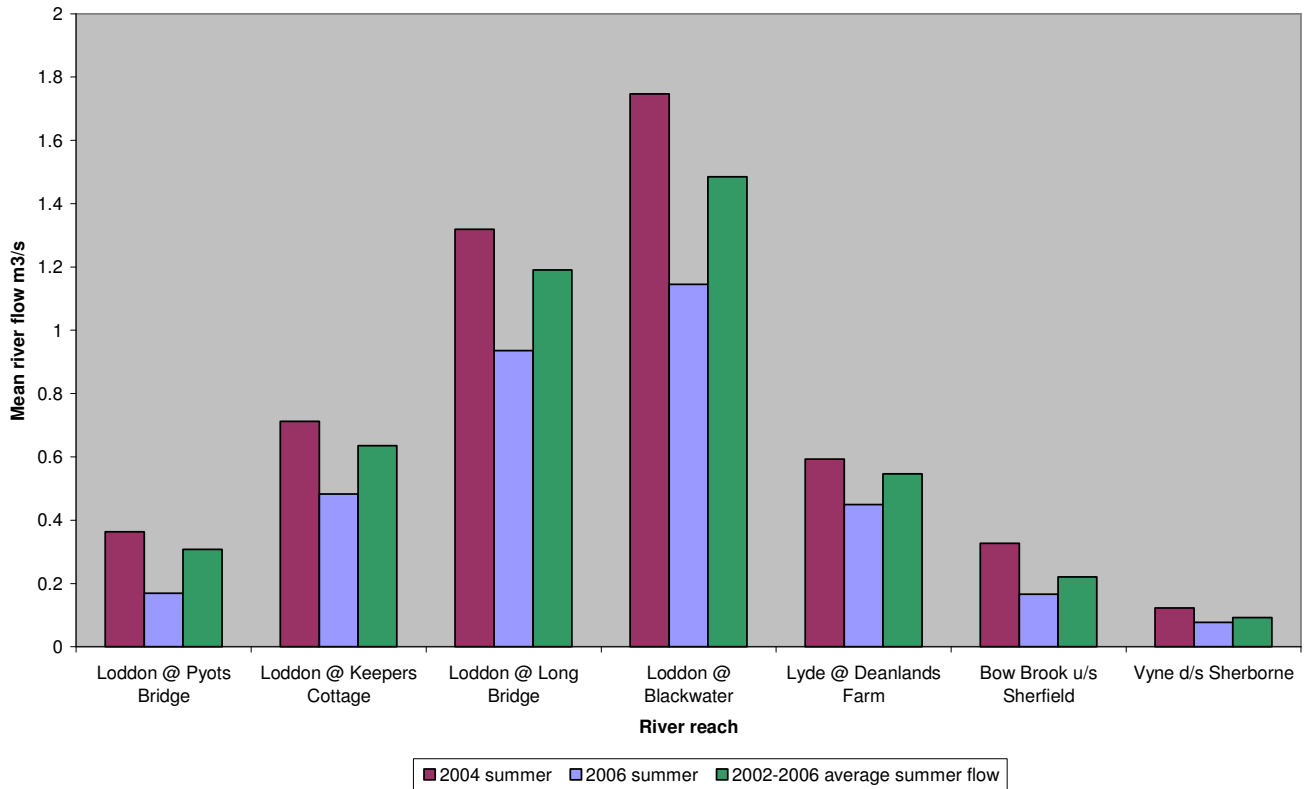


Figure 5-14 Variation in mean seasonal river flow

Due to reduced summer river flows in 2006 there was significantly less dilutive capacity in the river to dilute the final effluent from Basingstoke, Sherfield, and Sherborne STW. Therefore during 2006 the relative contribution of pollutant loads from the STW to the total river load increased, and hence there was a noticeable deterioration in water quality during summer 2006, compared to a wetter summer period such as 2004.

Figure 5-14 illustrates the summer phosphate concentrations in the catchment for 2004-2006, 2004 only and 2006 only. The results indicate the potential deterioration in water quality during a dry, hotter summer, when compared to the 2004-2006 summer average.

The results indicate the modelled phosphate concentration as an average against the WFD standards for the annual average phosphate concentration. This shows that dry summer conditions may cause a temporary deterioration with the seasonal average being higher than the annual average target. There is still significant uncertainty regarding the likely impact of climate change, and the assumptions made in modelling climate change water quality are open to challenge. However, the modelling shows that climate change may have an impact on river water quality which could exacerbate any impacts caused by growth. The climate change modelling supports the need for ongoing ecological and water quality monitoring, and the requirement to ensure that planning policy has a



mechanism for ensuring intervention in development plans where the risk of deterioration increases.

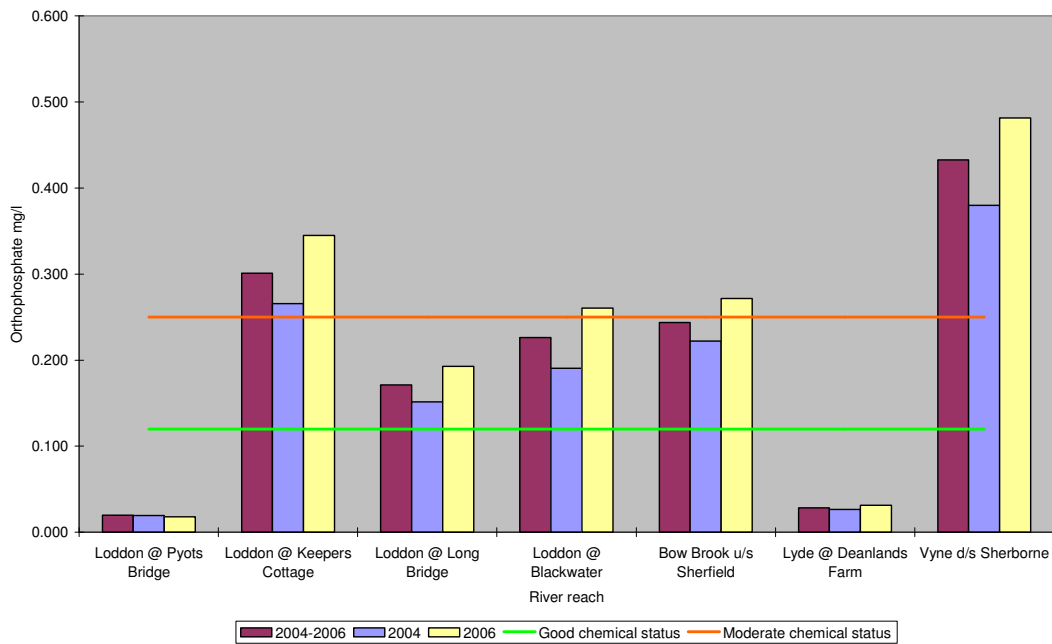


Figure 5-15 Variation in mean seasonal orthophosphate

5.8

Sewage treatment infrastructure

In order to allow informed planning decisions to be made with respect to location and extent of housing development in Basingstoke & Deane BC area, we have looked at consented sewage treatment capacity in the following settlements. These settlements were selected following discussions with Basingstoke and Deane BC and to ensure consistency with the areas assessed in detail as part of the Strategic Flood Risk Assessment.

- Basingstoke urban extent
- Tadley
- Bramley
- Overton
- Sherfield on Loddon
- Whitchurch



Table 5-8 below identifies what STWs these settlements drain to, and Figure 5-16 shows the location of these STWs.

Table 5-8 Sewage treatment works catchments

| Settlement | Sewage treatment works |
|----------------------------|--------------------------------|
| Basingstoke | Basingstoke STW |
| Tadley | Silchester STW |
| Bramley | Sherfield on Loddon STW |
| Overton | Overton STW |
| Whitchurch | Whitchurch STW |
| Sherfield on Loddon | Sherfield on Loddon STW |



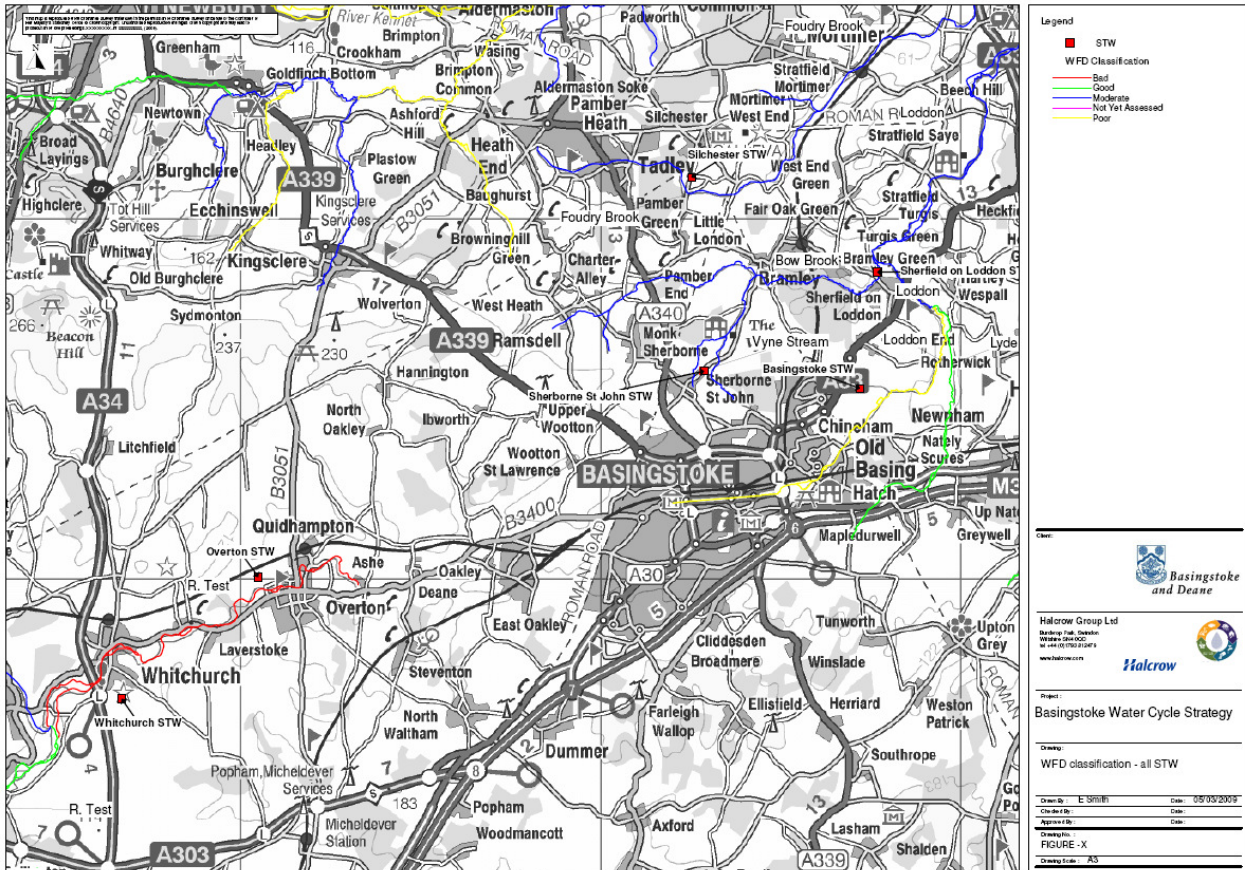


Figure 5-16 Location of sewage treatment works considered

Sewage treatment works consents

The STWs are consented either based on the maximum flow to be discharged in any day, or based on the dry weather flow¹⁶.

Most of the chemical consent parameters are values that must be achieved in 95% of the samples that are take during routine monitoring by the Environment Agency. The phosphate consent is an annual average, and compliance against this consent is assessed at the end of a monitoring year.

The table below identifies the current equivalent population connected to each of the sewage treatment works covering the settlements being assessed.

¹⁶ Dry weather flow: the flow treated at a sewage treatment works during a dry period. Typically dry weather flow conditions occur about 10% of the time.



Table 5-9 Sewage treatment works consent information

| Catchment | Water company | Current population equivalent | Discharge quality consent | | | |
|-------------------------------|---------------|-------------------------------|--------------------------------|---|----------------------------|---|
| | | | Suspended solids (mg/l 95%ile) | Biochemical oxygen demand (mg/l 95%ile) | Ammonia (as N mg/l 95%ile) | Orthophosphate (annual average as P mg/l) |
| Basingstoke | Thames | 98000 | 10 | 10 | 1 | 1 |
| Silchester | Thames | 17000 | 25 | 7 | 5 | 2 |
| Bramley & Sherfield on Loddon | Thames | 5330 | 45 | 30 | 4 | NA |
| Overton | Southern | 4150 | | | | |
| Whitchurch | Southern | 4500 | | | | |
| Sherborne | Thames | 2150 | 15 | 8 | 7.5 | NA |

The capacity at these STWs has been assessed by looking at the performance of the works against the flow consent. When a sewage treatment works reaches its flow consent, the water company responsible will need to seek a variation to the consent to allow the additional flow to be treated and discharged. At such a point, the Environment Agency may require the quality consent to be tightened to prevent any water quality deterioration in the downstream watercourse. Typically, sewage treatment works are designed to the same design horizon as the consent. Therefore, the consented capacity is good indicator of when infrastructure capacity at the sewage treatment works may become limiting.

Table 5-10 shows that the STWs that serve Tadley, Bramley and Sherfield on Loddon have capacity within their consent for the development scenarios tested. Whitchurch and Overton however would be approaching, or be breaching their flow consent if the population increase tested was to come forward.

Table 5-10 Consented capacity at treatment works assessed

| Location | Development scenario | | Watercourse | | STW | Flow/volume (m3/d) | | | | | Consent type | |
|---------------------|------------------------------|------------------------------|-----------------|--------------------|---------------------|--------------------|-------------|-------------|--------------|--------------|--------------|---------------------|
| | Number of dwellings assessed | Domestic population increase | Receiving water | WFD overall status | | Additional DWF | Current DWF | Current MAX | forecast DWF | forecast MAX | | Flow/volume consent |
| Overton | 500 | 1250 | River Test | Good | Overton | 276 | 887 | | 1163 | | 1160 | DWF |
| Tadley | 2406 | 6015 | Fouldry Brook | Moderate | Silchester | 1329 | | 10620 | | 13644 | 24000 | MAX |
| Bramley | 250 | 625 | Bow Brook | Moderate | Sherfield on Loddon | 284 | | 2787 | | 3416 | 5262 | MAX |
| Sherfield on Loddon | 279 | 697.5 | | | | | | | | | | |
| Whitchurch | 500 | 1250 | River test | Good | Whitchurch | 276 | 2046 | | 2322 | | 2336 | DWF |

This is a simplified assessment, and although Sherfield on Loddon and Silchester STW appear to have capacity, any development that impacts on the Sherfield on Loddon STW will have a further detrimental impact on the Bow Brook and downstream River Loddon, than the impact already discussed in section 5.4.

In addition, the testing scenarios equate to growth of greater than 20% at both Sherfield on Loddon and Silchester. Although there is believed to be consented capacity at these STWs, it doesn't necessarily follow that the sewage treatment works actually has physical



capacity, or that the sewerage network has capacity to drain the development and convey the sewage to the respective STW (see chapter 8 for further discussion of network capacity).

Although these issues alone should not affect strategic decision making, it is important that the water companies are consulted as early as possible of developments that may impact on small STWs and small sewerage networks. Chapter 9 proposes policy recommendations to ensure that this happens as part of the planning process.

Basingstoke STW

Thames Water have advised that there is sufficient capacity at the sewage treatment works to effectively treat all the growth planned up to 2016, which approximately is when the works reaches its consented capacity, as shown in Figure 5-17.

Thames Water have also advised that they have assessed the requirement to provide capacity to serve growth until 2021 as part of the recent assessment of capacity, and that between £10m and £20m is required to be spent on infrastructure to ensure that the STW can treat all growth until 2021. The delivery of this infrastructure has been split into two phases and Thames Water are planning this infrastructure to be funded through their asset management plan. Phase 1 of the improvements are planned to be delivered between 2010 and 2015, subject to agreement by their financial regulator in the final determination of their business plan. Phase 2 is planned for delivery between 2015 – 2020 as part of PR19.

In addition to the £10-20m Thames Water has identified as sewage treatment improvements need to support growth to 2021, Thames Water has planned for approximately an additional up to £10m sewage and sludge treatment infrastructure upgrades to be delivered between 2010 and 2015 to improve serviceability at the works. This figure does not relate to growth and is related to maintenance of the existing treatment works infrastructure.

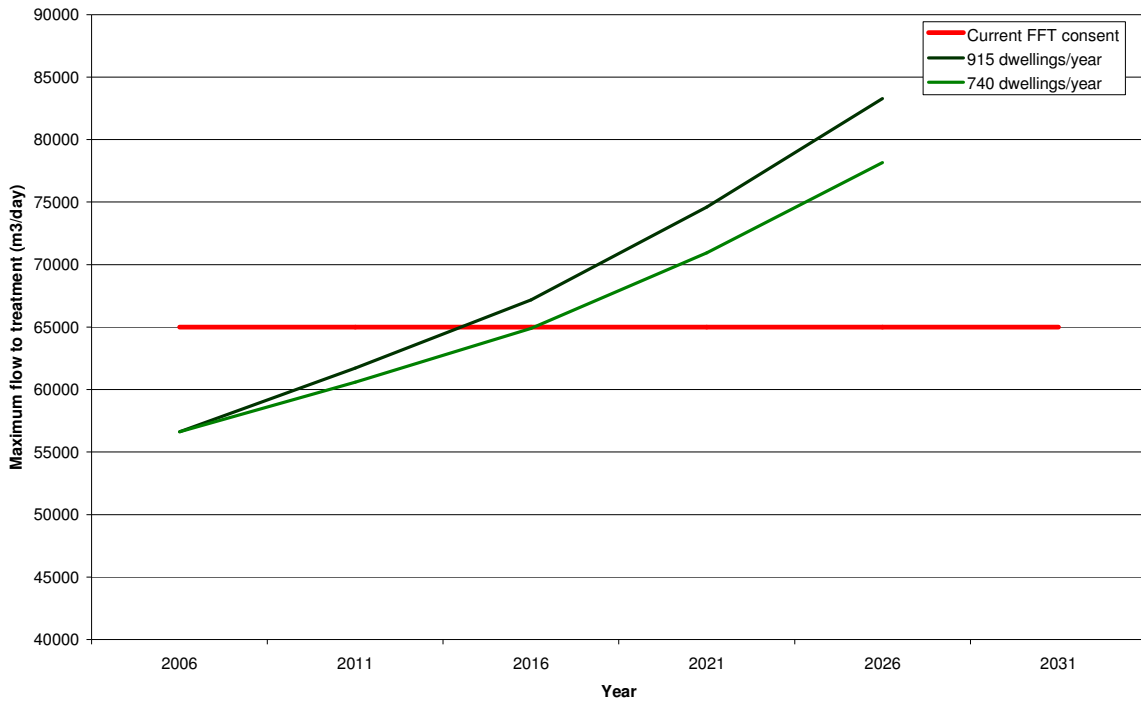


Figure 5-17 Consented capacity at Basingstoke STW

5.8.1

Infrastructure required to meet Water Framework Directive requirements

As discussed in section 3.4.3, achieving good ecological status in the River Loddon can only be achieved with a significant reduction of the phosphate discharged from Basingstoke, Sherfield on Loddon and Sherborne St John sewage treatment works. The consent standards that would need to be applied are beyond what is considered current available technology for sewage treatment, although the processes are already applied to achieve very tight standards for drinking water.

In order to allow an initial assessment of proportionate cost, we have assumed that potable water treatment such as reverse osmosis or ultra filtration could be applied to treated sewage effluent to achieve the very tight standards. These values, along with an initial estimate of operational cost and carbon emissions are shown in Table 5-11 below. The construction of new infrastructure has an embedded carbon cost, as well as a physical construction cost. Similarly operating the infrastructure has an actual cost based on the energy and staff required to operate it, and a carbon cost associated with the operation. The table estimates both the actual physical costs of constructing the



infrastructure and operating it, and the associated carbon cost. The Carbon Cost is based on the Shadow Price of Carbon¹⁷.

It must be emphasised that these costs have been calculated by Halcrow and are not endorsed by Thames Water. A full pilot of applying this treatment technology to wastewater would be required before a water company accepted such an onerous consent, and these pilots have not yet been undertaken. Thames Water's opinion is that the capital cost estimate identified below may be an underestimate of up to 100%. In addition, the addition of such technology has a large physical footprint, and the land availability to provide such technology would need to be assessed on a site by site basis. As the report has already mentioned, failure of the WFD phosphate physicochemical standards is widespread in the Thames River Basin, and any action to apply novel sewage treatment techniques will need to be assessed as part of the wider River Basin Management Plan, to ensure that any investment is correctly targeted to the most cost effective catchments. Until such a River Basin wide assessment has been undertaken, this study consider that it would be inappropriate to propose Basingstoke STW for such a pilot.

Because of the uncertainty in costs, it is not possible to differentiate between option 1 (applying a tight consent at all three sewage treatment works) and option 2 (closing Sherfield on Loddon and Sherborne St John STW and pumping to Basingstoke STW). There will be significant operational costs and new wastewater conveyance and pumping infrastructure required to transfer flows from Sherfield on Loddon and Sherborne St John STWs that are difficult to determine without detailed site specific analysis. In addition, these costs will need to be understood within a regional WFD compliance framework, and can only be part of a regional prioritise programme of measures to achieve good ecological status through the River Basin Management Planning process.

Table 5-11 Initial assessment of costs to achieve tight phosphate standards

| Capital infrastructure | | | Operational costs | | |
|------------------------|---|---|-------------------------|---|---|
| Capital cost | Carbon equivalent impact of infrastructure (tonne sCO2) | Carbon cost of capital infrastructure (based on shadow price of carbon) | Annual operational cost | Carbon equivalent of operations (tonnes/CO2/yr) | Annual carbon cost of operation (based on shadow price of carbon) |
| £25-35m | 7405 | £200k | £400k - 600k | 37738 | £1.1m |

¹⁷ For more information on carbon pricing and the shadow price of carbon, please visit <http://www.defra.gov.uk/environment/climatechange/research/carboncost/>



5.9

Conclusions

The detailed assessment of water quality and the implications of the WFD in light of planned growth indicates that there is an existing challenge to meet good ecological status under the WFD for the physico-chemical parameter for orthophosphate and the biological classification for diatoms. The modelling indicates that growth *per se* is unlikely to cause a failure of the WFD standards, and the modelling suggests that growth will not cause deterioration in chemical class at any of the sampling points assessed. Furthermore marginal changes in water quality due to growth are unlikely to cause deterioration of the biology of the river, although such deterioration cannot be ruled out. As with all modelling assessments there is an element of uncertainty in the model predictions, and it is vital that an ecological and water quality modelling regime is established as part of the development process to ensure that any deterioration in chemistry of biology of the river would be noticed.

Thames Water have currently planned to provide the necessary infrastructure at Basingstoke STW to meet growth up to 2021, and to maintain the current consent. For growth beyond 2021, a policy decision needs to be made in the RBMP with respect to consent standards to ensure good ecological status is achieved by 2027. Our analysis shows that it might be possible to secure compliance with good ecological status by using novel technology in combination with closing two smaller STWs, but there is a financial implication and a large carbon and energy implication in so doing. Although the high standards of treatment are believed to be achievable with treatment techniques applied for potable water, such as reverse osmosis, further research and development along with pilot application of the techniques would be required before application on a works the size of Basingstoke could take place.

In light of the fact that Basingstoke STW accounts for approximately 90% of phosphate load in the river Loddon there are no catchment measures (e.g. controlling agricultural runoff loads) which could be used to secure compliance with the WFD, although catchment management activities could potentially offset the additional phosphate associated with growth and reduce the residual risk of a deterioration in WFD classification.





6 Water resources and water supply

6.1

Introduction

This Phase 2 Water Cycle Study (WCS) has investigated water efficiency scenarios, including neutrality¹⁸, and has involved undertaking demand scenario analysis to assess the impacts on water demand of water efficiency initiatives such as metering and the implementation of the Code for Sustainable Homes. Impacts upon water resources and abstractions associated with the Water Framework Directive (WFD) have been identified. The section has also been reviewed against the latest water company draft WRMP (June 2008) and other relevant documents.

6.2

Data and References

The data used for this section of the WCS has been sourced from the following locations:

- <http://www.statistics.gov.uk>
- Strategic Direction Statement 2007 (South East Water Ltd)
- Draft Water Resources Management Plan 2008 (South East Water Ltd)
- Data provided by South East Water Ltd
- The Environment Agency's Representation on South East Water's draft Water resource Management Plan (Environment Agency, 2008).
- The Loddon Catchment Abstraction Management Strategy (Environment Agency, 2003)
- Areas of water stress: final classification (Environment Agency)
- The Draft Regional Spatial Strategy for the South East 2006-2026, South East Regional Assembly, 2006.
- Future Water: The Government's water strategy for England', Department for Environment Food and Rural Affairs, 2008
- Code for Sustainable Homes – A Step Change in Sustainable Home Building Practice. Crown Copyright, 2006

6.3

Water Company Overview

The public water supply to the east of Basingstoke and Deane district is provided by South East Water (SEW) and the public water supply to the west is provided by Southern Water Services (SWS). South East Water supplies the area as part of its resource zone 4 (RZ4) and Southern Water Services supplies it as part of the Hampshire Kingsclere resource zone. The SWS Hants Kingsclere resource zone is in Hampshire. The majority

¹⁸ Water neutral in this instance refers to the scenario in which, over the entire study area the total demand for water does not increase with new development.



of its area is covered by the west of Basingstoke and Deane district. Figure 6-1, taken from the phase 1 WCS shows the location of the water resource zones.

Basingstoke is located in the east of the study area where the majority of the development associated with growth over the planning period is to be concentrated and thus only data from SEW has been considered in this section. South East Water supplies around two million customers within Kent, Sussex, Surrey, Berkshire and Hampshire. Over 70% of the water delivered comes from just over 150 boreholes and wells, with the remainder from six river intakes and surface water reservoirs. We have made an assumption that the status quo will be maintained and South East Water will remain responsible for the provision of water resources for the development areas within the study area. It is however possible for other companies to supply the water to the development sites via inset appointments¹⁹.

6.3.1

Existing Water supply

The existing potable water supply network for Basingstoke is operated and maintained by South East Water Ltd (SEW). Basingstoke is located within their Water Resource Zone (WRZ) 4. The River Loddon which flows through Basingstoke has its source to the south and is supplied by the chalk aquifer. 50% of water abstracted in the catchment is for Public Water Supply and all these abstractions are from groundwater sources in the Chalk and Lower Greensand aquifers. There are 10 sources which supply water to WRZ4 and these are shown in Table 6-1 below.

¹⁹ The inset appointment process is the route by which one company replaces the incumbent as the appointed water and/or sewerage company for a specified area. The replacement appointed water company will have all of the same duties and responsibilities as the previous statutory water company for the specified area. (www.ofwat.gov.uk)



Table 6-1 Sources of water in WRZ4.

| Source | Dry Year Deployable output (ML/d) | Annual Licensed Quantity (ML/d) |
|---|-----------------------------------|---------------------------------|
| Beenham's Heath, Hurley & Toutley Group | 30.5 | 38.9 |
| Boxhalls' Lane and Tongham Group | 16.2 | 18.9 |
| Bray (Group) | 54 | 63.4 |
| College Avenue | 18.5 | 22.7 |
| Cookham | 18.68 | 18.7 |
| Greywell | 6.82 | 6.8 |
| Itchell | 3.45 | 5.6 |
| Lasham | 15.73 | 15.00 |
| West Ham & Cliddesden (Group) | 19.62 | 21.10 |
| Woodgarston | 6 | 6.80 |



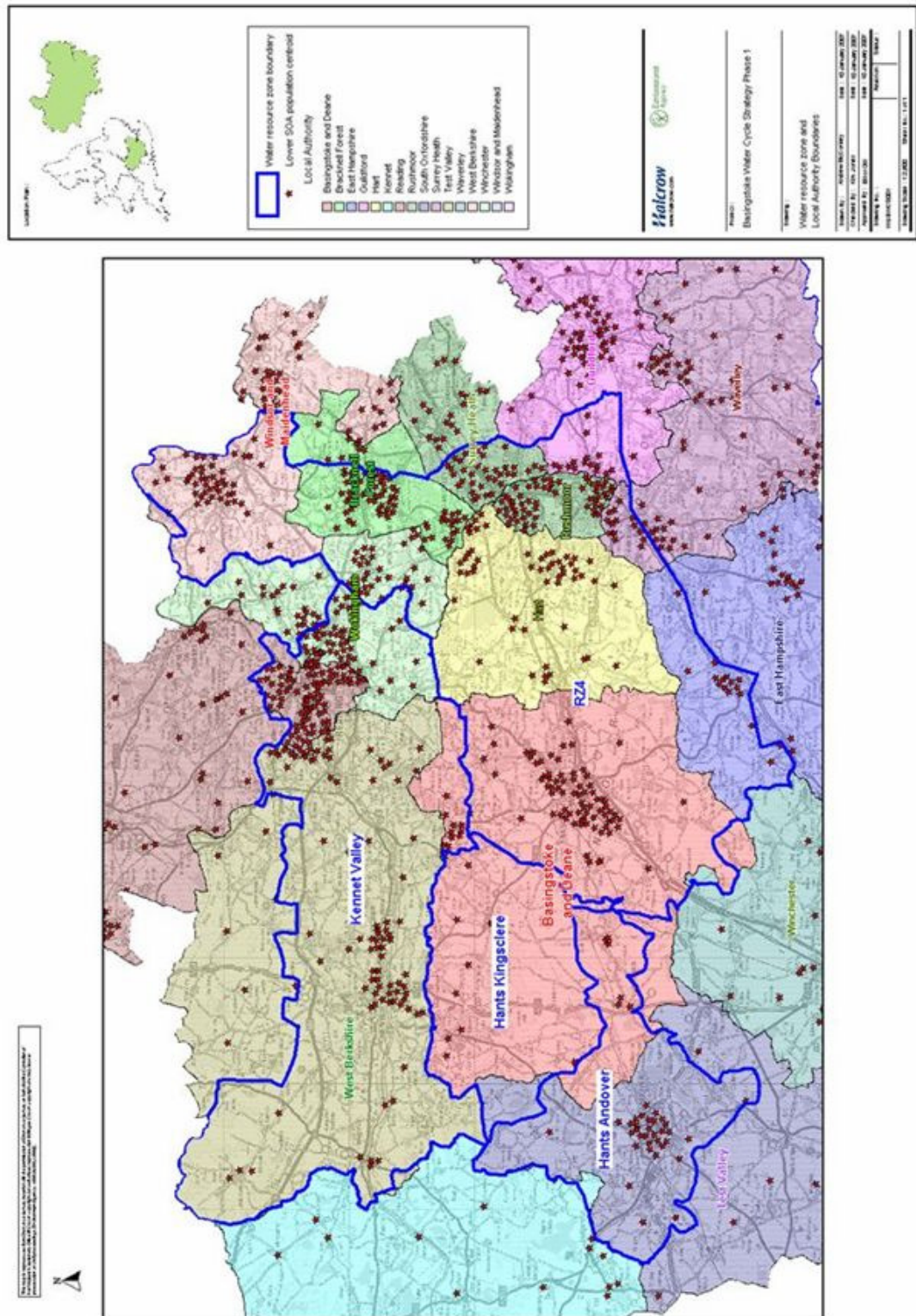


Figure 6-1 Water resource zones serving Basingstoke and Deane Borough



6.4

Environment Agency Water Resource Management

The Environment Agency manages water resources at a local level through Catchment Abstraction Management Strategies (CAMS), which are prepared on a 6 yearly cycle.

Within the CAMS, the Environment Agency’s assessment of the availability of water resources is based on a classification system which states the perceived resource availability status, indicating:

- the relative balance between the environmental requirements for water and how much is licensed for abstraction;
- whether water is available for further abstraction, and;
- areas where abstraction needs to be reduced.

The categories of resource availability status are shown in Table 6-2 below. The classification is based on an assessment of a river system’s ecological sensitivity to abstraction-related flow reduction.

| Indicative Resource Availability Status | Licence Availability |
|---|--|
| Water available | Water is likely to be available at all flows including low flows. Restrictions may apply. |
| No water available | No water is available for further licensing at low flows. Water may be available at high flows with appropriate restrictions. |
| Over-licensed | Current actual abstraction is such that no water is available at low flows. If existing licences were used to their full allocation they could cause unacceptable environmental damage at low flows. Water may be available at high flows with appropriate restrictions. |
| Over-abstracted | Existing abstraction is causing unacceptable damage to the environment at low flows. Water may still be available at high flows with appropriate restrictions. |

Table 6-2 CAMS resource availability status categories

This classification can be used to help assess the potential for additional water resource abstraction opportunities.

The water which supplies the Basingstoke study area comes from groundwater sources associated with the Loddon catchment and covered by the River Loddon CAMS. The catchment and the water available within it has been discussed in Phase 1 of the WCS (Halcrow, 2007) and can be summarised as follows:

- The chalk aquifer that feeds the Loddon, Lyde and Whitewater has been classified as “no water available”.



Figure 6-2 shows the Environment Agency's assessment of relative water stress throughout England, and it can be seen that water resources in the Basingstoke area and the whole of the surrounding area are under serious water stress. The effects of climate change are likely to further reduce supply and could also actually increase demand²⁰.

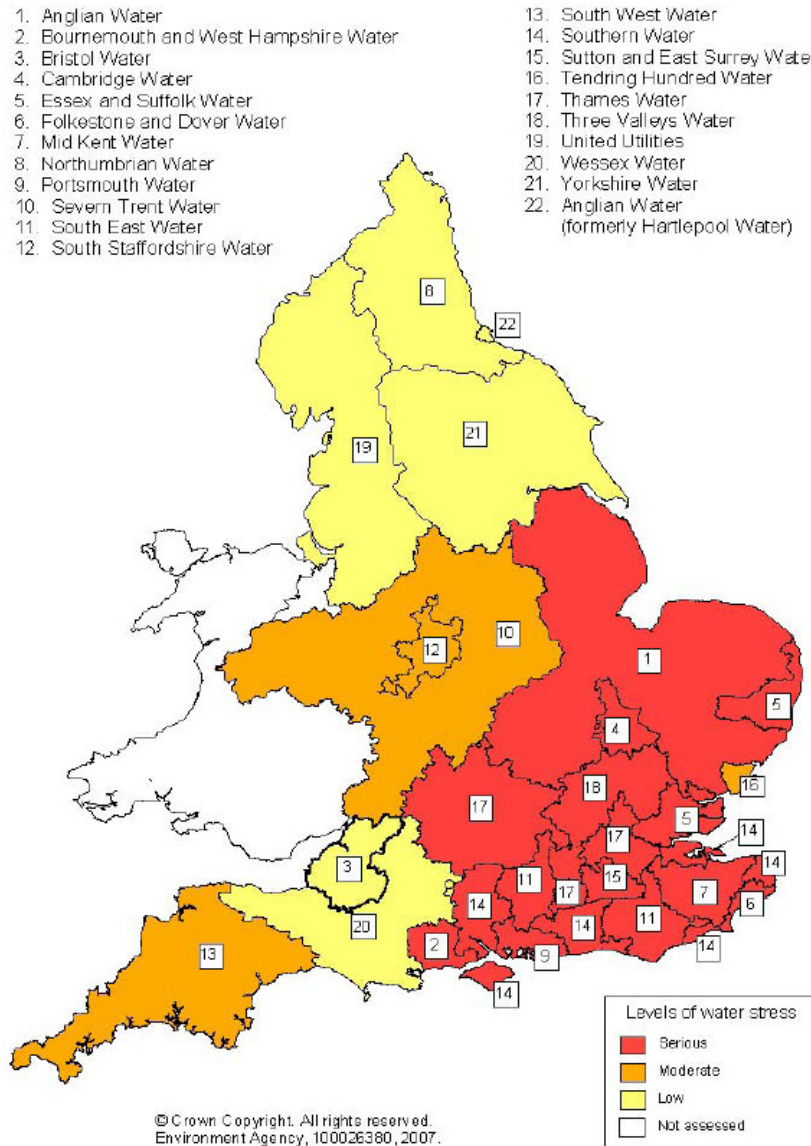


Figure 6-2: Map of Areas of Relative Water Stress (source: Areas of Water Stress, Final Classification; Environment Agency)

²⁰ This map was produced to inform a national debate on water metering policy. It must be noted that the classifications identified in this regional map are entirely that; regional. Within a region which is water stressed, there may be areas of less stress and vice versa. Therefore local considerations must override this assessment. However, it does provide a useful indication of the relative level of water stress in different regions of England



6.5

Water Company Planning

As the appointed water company, South East Water has a responsibility to provide sufficient quantity and quality of water to meet the needs of its customers, whilst also minimising their impacts on the environment. This responsibility applies to new customers and population growth as well as changing demands within the existing customer base must therefore be comprehensively planned for.

All water companies have a duty to produce water resources plans covering the next 25 years. These plans set out how companies intend to provide sufficient water to meet their customers' needs. Although not previously compulsory, companies have prepared 25 year water resource management plans on a voluntary basis, and shared these with the Government and regulators, since 1999. On 1 April 2007 these plans became compulsory under changes to the Water Industry Act 1991, and this year for the first time they were also subject to public consultation before they were finalised.

Information regarding the strategic water resources for the study area has been obtained from SEW's draft Water Resources Management Plan (WRMP) 2008. The final documents were submitted in Spring 2009 and it should be noted that the strategies and conclusions may vary from the draft to the final submission. SEW typically undertake a yearly review of their water resource plans as part of the June Return process. As this WCS coincides with the preparation of SEW's new WRMP, the information used for the WCS is the most comprehensive and up-to-date possible. This also means; however, that the information remains subject to change pending the statutory sign-off processes.

Whilst strategic plans for meeting future demand over a 25 year period are set out in the WRMP, detailed design of schemes is not undertaken until works have been granted funding by Ofwat.

Any improvements to the water services infrastructure needs to be programmed into a water company's capital programme, which runs in five year Asset Management Plan (AMP) cycles. We are currently in the AMP4 period (2005-2010) and water companies are in the process of preparing for its next submission to Ofwat, to determine its allowable capital expenditure for AMP5 (2010-2015). Figure 6-3 illustrates the AMP planning cycle to 2015. This funding cycle and its associated constraints can have implications for the phasing of development, and it is important that water companies are involved in the planning process to ensure that infrastructure can be provided in time.

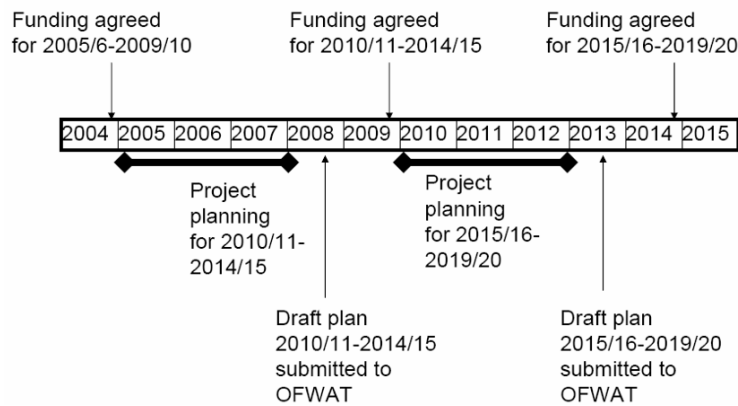


Figure 6-3 Water company capital funding cycle

6.6 South East Water Resource Strategy

6.6.1 Company Strategic Overview

In producing the draft WRMP09 South East Water have looked at the current supply-demand balance and the future supply-demand balance. The table below gives some baseline information of the current situation in WRZ4. The data provided in the draft WRMP is subject to an audit by the Environment Agency. The Environment Agency issued their comments on South East Water’s draft WRMP09 in August 2008 and requested that South East Water revise and review certain parts of the plan, particularly in relation to deployable output, demand forecasts and preferred options. Therefore it must be realised that the data given and recommendations based upon the data provided in the draft WRMP is subject to change.

Based on this information within WRZ4 22% of the household population is metered with 27% of household properties being metered. This figure is lower than the meter penetration for the SEW supply region as a whole of 35%. The figures also show that within the SEW WRZ4 supply area, in 2006/07, household consumption accounted for 54% of demand, non-household consumption 23.5%.

South East Water have identified that WRZ4 has a surplus in supply for the dry year demand scenario for the majority of the planning period and a deficit does not occur until 2033. However a deficit occurs for the peak week demand scenario by 2016. SEW are proposing to transfer existing surplus in WRZ5 to WRZ4 via the existing inter-resource zone transfer between the zones. WRZ5 continues to provide part support until 2035. SEW state that further resource development is still necessary and propose to increase output from the groundwater scheme at Bray from 9ML/d on average to 18ML/d during peak summer periods by 2021. In the last year of the planning period, 2034, SEW propose to increase the company’s existing groundwater source at Lasham which currently delivers 1.25ML/d on average and increase this to 5ML/d during peak summer periods. Although no deficit would occur initially the healthy surplus in WRZ4 is allowed to reduce over time. However resource development is required due to the following reasons:



- climate change (increase demand (pcc) from existing population);
- sustainability reductions (potential loss of existing sources of supply reducing the Deployable Output);
- proposed growth within the WRZ (increasing demand from new population), and;
- societal and cultural changes (linked to occupancy rates).

Most of these factors are inter-linked and cannot be considered or addressed in isolation.

| Parameter | Units | Value |
|--|-------|---------|
| Unmeasured household population | | 458,420 |
| Measured household population | | 134,281 |
| Unmeasured household Properties | | 170,355 |
| Measured household Properties | | 64,042 |
| Unmeasured household consumption (pcc) | l/h/d | 175.57 |
| Measured household consumption (pcc) | l/h/d | 151.89 |
| Total Leakage | MI/d | 32.00 |
| Deployable Output | MI/d | 187.30 |
| Supply-demand balance | MI/d | 33.69 |

Table 6-3 Information from South East Water draft WRMP09 during Average Annual Dry Year

South East Water has identified within its draft WRMP that the impacts of climate change on supply and demand is one of the most important and challenging uncertainties to be considered in the long term. South East Water has used climate change factors and



methods from the Environment Agency guidance and UKWIR²¹ to incorporate climate change into their WRMP.

The assumptions made by South East Water within its draft WRMP09 are also closely aligned with recommendations provided by UK Climate Impact Programme (UK CIP). The combined effect of increased rainfall in the winter months and reduction of rain in the summer months, with higher temperatures will act to decrease the winter recharge season. For WRZ4 this equates to the average baseline deployable output (excluding transfers) to decrease from 197.3 Ml/d in 2010 to 176.4 Ml/d by 2035.

The draft WRMP09 includes an allowance for climate change in the per capita consumption forecasts which recognises the possible changes in behaviour linked to climate change, namely increases in the frequency of bathing and showering, water use for gardens and ownership of washing machines. Historically the average pcc has risen at a rate close to 1% per year. The company's historical monitoring data show that this rate also applies to the SEW supply area and still applies today, although at a lower rate. South East Water's updated analyses of pcc data suggested it would be reasonable to apply a lower pcc growth rate of 0.5% pa for future forecasting of demand, however this may be difficult to support across the whole 25 year planning horizon. Further microcomponent analysis and forecasting has been undertaken by SEW, that takes account of future water efficiency policy, impacts of metering, and the code for sustainable new homes which results in a lower pcc growth rate of 0.3% pa for all property types and this growth rate has been ambitiously adopted in the draft WRMP08. The draft WRMP09 shows a decrease each year in measured and unmeasured pcc from 2006 to 2013-2014 after which pcc continues to increase each year to 2035.

Within the SEW supply area several sustainability reductions which will effectively remove or reduce some sources of water are being investigated, including on the Greywell Fen/Whitewater. Without an alternative this reduces the amount of water entering the system and thus the Deployable Output (DO). However the company have assumed, upon instruction by the Environment Agency, that there is no impact upon deployable output from any sustainability reductions.

Significant growth is anticipated within the Basingstoke area of the WRZ4. An increase in population leads to an increase in the amount of water which South East Water need to supply. The assumptions made by South East Water in relation to new population and property numbers are stated below. South East Water have also allowed for a decrease in occupancy rates of measured households which will increase demand as fewer people live in more properties.

²¹South East Water has used UKWIR Methodology for the derivation of precipitation and potential evaporation conversion factors as recommended in the Guidelines. (*Effects of Climate Change on River Flows and Groundwater Recharge: Guidelines for Resource Assessment and UKWIR06 Scenarios*, UKWIR, Report 06/CL/04/8,2007)



Within the draft WRMP08 South East Water have made a number of assumptions for their baseline data and for calculations over the planning period for their baseline demand forecast. These include the following:

- Within WRZ4 population increase varies each year over the planning period from 1000 to 5000 per year.
- Within WRZ4 the number of properties increases each year to include an additional 35,027 by 2021/21 and 60,278 by 2035.
- Within WRZ4 occupancy rates are expected to decrease from 2.10 in 2006/07 to 2.07 in 2020/21 to 2.03 in 2031/32.
- New properties will use close to 130l/h/d.
- The deployable output (DO) for the WRZ4 is currently 187.30 ML/d. This is expected to decrease to 178.76 by 220/21 and to 177.13 by 2030/31.
- Impacts of climate change are included in SEW's calculation of deployable output and forecast demand.
- The population served within WRZ4 will increase by up to 14 per cent or some 80,683 people between 2006 and 2030/31.
- Assumed measured household consumption will rise within WRZ4 to 159.53 l/h/d by 2030/31.
- Increase in the number of metered customers in the South East Water region from the current level to 90 per cent by 2020.
- Commercial demand (non-household) within WRZ4 is expected to decrease slightly over the planning period. The base year total non household usage for the SEW supply area of 131 ML/d accounts for 24% of total demand.
- Leakage in WRZ4 is expected to remain constant over the planning period at 32.0 ML/d.

Future Water Resource Strategy

Within their draft WRMP09 South East Water have considered options for ensuring there is enough water to supply demand until 2035 for both the dry year and critical period year. No deficit is predicted for the dry year however the draft WRMP09 has considered options to address the in-balance for the deficit during the critical period and proposes a preferred option.

SEW adopts a twin track approach for water resource management via both demand management and water resource development. This means demand management programmes of leakage reduction, metering and water efficiency are considered alongside water resource scheme options. It is noted that many aspects of demand management relies on customer behaviour, and whilst SEW can influence these habits, it is ultimately outside of their control to enforce them. It is therefore essential to the success of demand reduction measures that other bodies also promote the importance of being water smart. This includes local authorities (through both planning policy and public



education), the Environment Agency, and local press. When this does occur achievements can be made in reducing water demand.

Demand Management

SEW adopts a twin track approach for water resource management via both demand management and water resource development. A number of demand management proposals have been selected including:

- targeted customer metering;
- targeted leakage control;
- pressure reduction;
- domestic water audits, and;
- encouraging water efficient devices.

SEW currently meter approximately 37% of household properties which is above the national average and this is expected to increase to 41% by the end of AMP4. Leakage has been reduced by 30% over the last 10 years and SEW are currently operating at just below the economic level of leakage. Increasing the number of households on a meter and the progressive management of leakage form the two key parts of the strategy for water resources.

Metering is a viable demand management option in WRZ4. South East Water are proposing a ten-year progressive programme of targeted compulsory metering starting in 2010. This aims to result in an overall individual household meter penetration of around 90% by 2020. This will be achieved through existing policy to meter all new properties, offer free meter installation to those that wish to opt for a meter, and a number of smaller local initiatives focused on metering properties on change of occupier. South East Water has also undertaken trials in seasonal tariffs and retrofitting new homes, although this has not been undertaken in WRZ4.

South East Water also have a water efficiency programme which includes wider communication such as distributing water efficiency literature to customers, promotions of cistern displacement devices and subsidising sales of water butts, providing free or subsidised customer supply pipe repairs or replacements, an education programme targeting schools and higher education institutions, and partnership activities to continue to effectively promote the water efficiency message.

In conclusion, SEW' strategic infrastructure and resource strategic planning within the Water Resource Zone 4 will support the proposed growth within the study area until 2034 during the dry year scenario and till 2016 for the critical period scenario. It should be noted that iterative reassessment of this will be undertaken as standard in water company planning, to incorporate latest changes to the social, environmental, and legislative aspects of water resource availability.



The gap in the critical period scenario identified in the draft WRMP post 2016 is of concern and needs further assessment when the final plan is published.

6.7 ***Demand Management***

National Policy

The Government's new water strategy for England, *Future Water* was published February 2008. *Future Water* outlines a strategic and integrated approach to the sustainable management of our water resources to 2030, for the public water supply as well as for the provision of healthy ecosystems and the services they provide.

The Vision by 2030 includes the following measures:

- Reduced per capita consumption of water through cost effective measures, to an average of 130 litres per person per day (l/p/d) by 2030 or possibly even 120 litres per person per day depending on new technological developments and innovation
- Amend the Building Regulations to include a requirement for a minimum standard of water efficiency in new homes. The requirement will be in the form of a calculated whole building performance standard set at 125 litres per day (l/p/d).
- In areas of serious water stress it is believed that near universal metering will be needed by 2030.

In response to the Strategy the Environment Agency have stated that in water stressed areas, such as Basingstoke the introduction of universal metering needs to be undertaken earlier. The Environment Agency would like to see the majority of households in areas where water is scarce to be metered by 2015 with the remainder in water scarce areas being metered by 2020. The Environment Agency also wish to promote the metering of all new properties, including flats.

6.7.1 ***Code for Sustainable Homes (CSH)***

The Code for Sustainable Homes introduces a step-change in sustainable development and forms a basis for future developments to the Building Regulations. As of May, 2008 the Government has made it mandatory that all new homes have a rating against the Code for Sustainable Homes. The Code measures the sustainability of a new home against nine categories of sustainable design, rating the 'whole home' as a complete package. The Code uses a 1 to 6 star rating system to communicate the overall sustainability performance of a new home. The Code sets minimum standards for energy and water use at each level.

The relevant sections in relation to the Water Cycle Strategy are:

- Water Efficiency;



- Surface Water Run-off; and
- Energy / CO₂ (relating to heating water).

A minimum requirement for each of the nine categories is necessary to achieve the base rating of Level 1. Beyond this, threshold values must be attained for both 'Water' and 'Energy' to achieve higher code levels. Hence to achieve Code Level 3, as required by Basingstoke and Deane's Design and Sustainability SPD, the requirements for both carbon and water efficiency must be achieved in addition to the minimum points system requirement. Points may be awarded in the other sustainability categories for initiatives and measures implemented beyond the base level requirement for Code Level 1.

Table 6.4 defines the Carbon and Water Efficiency requirements for each Code Level rating. This assumes the basic entry requirements are met for the other six categories.

| Achieving a sustainability rating | | | | | |
|-----------------------------------|--|----------------|--------------------------------------|----------------|------------------------|
| Minimum Standards | | | | | |
| Code Level | Energy | | Water | | Other Points' Required |
| | Standard (Percentage better than Part L' 2006) | Points Awarded | Standard (litres per person per day) | Points Awarded | |
| 1(★) | 10 | 1.2 | 120 | 1.5 | 33.3 |
| 2(★★) | 18 | 3.5 | 120 | 1.5 | 43.0 |
| 3(★★★) | 25 | 5.8 | 105 | 4.5 | 46.7 |
| 4(★★★★) | 44 | 9.4 | 105 | 4.5 | 54.1 |
| 5(★★★★★) | 100 ² | 16.4 | 80 | 7.5 | 60.1 |
| 6(★★★★★★) | A zero carbon home ³ | 17.6 | 80 | 7.5 | 64.9 |

Notes

1. Building Regulations: Approved Document L (2006) – 'Conservation of Fuel and Power.'
2. Zero emissions in relation to Building Regulations issues (i.e. zero emissions from heating, hot water, ventilation and lighting).
3. A completely zero carbon home (i.e. zero net emissions of carbon dioxide (CO₂) from all energy use in the home).
4. All points in this document are rounded to one decimal place.

Table 6-4 Code Level requirements for energy and water efficiency

(Source: Code for Sustainable Homes – A Step Change in Sustainable Home Building Practice. Crown Copyright, 2006.) .

All new social housing already has to be built to CSH level 3, and the Water Act 2003 places a requirement on planning authorities to take steps wherever practicable to encourage the conservation of water. It should be noted that to attain Code Level 3, a home must satisfy the criteria for carbon AND water efficiency. The reduction in use of



heated water can therefore contribute towards achieving higher targets for both carbon and water efficiency.

The Environment Agency recommends that measures are adopted to allow the efficient use of water in all new homes with water efficiency set at 105 litres per head per day (i.e. level 3/4 for water within Code for Sustainable Homes) or better.

Regional Policy

Under the Water Act 2003, (part 3 sections 81 & 83), relevant authorities must, where appropriate, take steps to encourage the conservation of water'. The final South East Plan includes the following policy on water resources, and the Basingstoke and Deane Core Strategy will need to be in general conformity with this policy.

Policy

Policy NMR1: Sustainable Water resources, groundwater and river water quality management.

Water supply, ground water and river water quality will be maintained and enhanced through avoiding adverse effects of development on the water environment. A twin-track approach of demand management and water resource development will be pursued, together with development of sewerage and waste water treatment infrastructure. In preparing Local Development Documents, and determining planning applications, local authorities should:

- Ensure compatibility with River Basin Management Plans and take account of other plans and strategies including water and sewerage company asset management plans, the Environment Agency's Regional Water Resources Strategy, Catchment Abstraction Management Strategies, groundwater vulnerability maps and groundwater source protection zone maps
- Ensure that the rate and location of development does not lead to unacceptable deterioration of water quality and is in step with current and planned provision of adequate water supply, sewerage and waste water treatment infrastructure capacity
- Require development that would use significant quantities of water to incorporate measures to achieve high levels of water efficiency, and reflect current best practice including BREEAM "very good" and increasingly "excellent" standards and, where appropriate, sustainable drainage solutions where these are consistent with protection of groundwater quality
- Work with water and sewerage companies and the Environment Agency to identify infrastructure needs, allocate areas and safeguard these for infrastructure development
- Encourage winter water storage reservoirs and other sustainable farming practices which reduce summer abstraction, diffuse pollution and runoff, increase flood storage capacity and benefit wildlife and recreation

It goes on to acknowledge that a twin-track approach to water management is required. This is to be achieved through increased demand management (including increased water efficiency, leakage management and the increased use of metering). Secondly, sustainable new water resources and wastewater treatment infrastructure need to be planned and



provided in step with the development they serve. New development must also have substantially increased levels of water efficiency.

Basingstoke & Deane Borough Council Policy

As described, Basingstoke and Deane BC requires a minimum Code level three to be achieved for all new developments with greater than 10 dwellings, and a BREAM very good standard for any non-residential developments of greater than 1,000m². Code level 3 has a mandatory requirement for new dwellings to be designed to a maximum of 105 litres per head per day (l/hd/d), and provides incentives to further reduce demand to less than 80l/hd/d.

6.8

Future Demand Scenario Testing

All the analysis within the draft WRMP08 undergoes a rigorous testing and review process with Defra, Ofwat and the Environment Agency, as well as public consultation. The assumptions made by SEW have been stated above and the baseline case provided by SEW has been accepted for use within the future demand scenario testing undertaken for the WCS.

The Office of National Statistics (ONS) publishes mid-year population estimates for local authority areas on an annual basis. The most recent data is for June 2006 and was published in August 2007. These have been used to estimate the current resource zone populations.

For the local authority areas that only partially lie within a resource zone, the proportion of the district current population has been estimated using the ONS lower-layer super output area (LSOA) population data. The LSOA data, which is consistent with the ONS published district population totals, allows a population-based determination of the proportion of a district that lies within a specific water resource zone; this is more accurate than the commonly used method of deriving a population estimate based on the relative geographical areas. The most recent LSOA data, for 2006, has been used to assess the proportions of the 2006 local authority area populations within a resource zone; the same proportions are then assumed to apply to the more recent 2007 mid-year estimate population data.

The forecast populations used by SEW are based on government information from census data (2001) the RSS, past trends and forecasts of population and household numbers. The current population of the WRZ is identified by SEW as 606,525. Data from the Office of National Statistics (ONS) records the population of WRZ4 as 638,669. There is more than 5% difference between these figures and therefore the population figures from the ONS are considered to be of greater accuracy and thus have been used in the demand scenario testing. The population of the water cycle study area within SEW's WRZ4 has been calculated from the ONS data to be 118,612 in 2007.



The water company has a statutory requirement to supply water to a specific level of service. The way that it is regulated means that it cannot rely on promises by developers or local authorities to manage demand. Hence, the per capita consumption scenarios used by SEW in its demand assessment does not look at more aspirational demand management scenarios that can only be achieved with strong planning policies. This study has therefore considered demand management scenarios that go beyond SEWs plans, and looks at those scenarios proposed by the Environment Agency and Basingstoke and Deane Borough Council.

The demand management scenarios considered below use the most recent figures from the June Return figures for a 'Dry Year' as a baseline for assessment of more ambitious consumption reduction scenarios.

The demand management scenarios below shows how various demand management strategies can affect the requirement for additional water resources in the study area, and what would need to be done to achieve this in the existing urban area and the new development sites.

- We have calculated the current total potable water demand for the WCS area by factoring the current total domestic population in the water resource zone to the domestic population in the WCS area. This factor was used to apportion all demand values, including non use (e.g. leakage) and non household demand.
- We have assumed that leakage is constant during the plan period. SEW also assume in their draft WRMP09 that total leakage is constant at 32 ML/d. Whilst total leakage in l/pr/d in WRZ4 as a whole will decrease over the planning period due to an increasing number of properties.
- We have assumed that water consumption for existing metered and unmetered properties remains constant during the plan period. This differs from SEW assumption in the draft WRMP09 that pcc for metered properties increases each year and for unmetered properties decreases then increases due to increasing demand related to gardens and showering, which is a factor of climate change.
- We have assumed that non-household demand remains the same during the plan period. SEW have assumed that unmeasured household consumption increases slightly over the planning period and that measured non-household consumption decreases slightly each year.
- We have used the 2006/07 baseline occupancy rate for new properties provided in the SEW draft WRMP09. We have assumed this rate of 2.12 remains constant throughout the planning period. We have assumed the occupancy rate in the existing housing remains constant throughout the planning period. The impact of this does not affect comparison of scenarios. SEW draft WRMP09 assumes that the occupancy rate increases in the first few years and then decreases and in unmeasured households increases up to 2030 and then decreases.
- We have used forecast dwelling numbers provided in the RSS up to 2026. These may differ from the values in the draft WRMP09. As mentioned earlier, the draft



WRMP undergoes a rigorous testing and review process with Defra, Ofwat and the Environment Agency, as well as public consultation. One of the key areas for scrutiny in this process is the forecast dwelling and population assumptions; therefore we are not undertaking any additional review of the accuracy of SEW's forecast population or dwelling numbers.

Water resource testing scenarios

The list of scenarios below provides detail of the components of each scenario tested. These are summarised in Table 6.5. The outcomes of these demand management scenarios are shown in Table 6-6 and Figure 6-4 below.

Scenario 1: Business as usual

This scenario looks at how potable demand would increase should the existing current per capita consumption (pcc) rates be maintained in the new development areas, assuming that all new properties are metered. The pcc for existing homes (metered and unmetered) also remains constant throughout the planning period. This scenario has been used as the basis against which all other scenarios have been derived.

Scenario 2: Compulsory metering by 2015

The Environment Agency has proposed that compulsory water metering is adopted for water stressed areas by 2016. In this scenario we have assumed that 95% of the existing population will be metered by 2015. The pcc for all metered homes (including new dwellings) remains at 151.89 l/h/d and unmetered homes at 175.57 l/h/d as per the draft WRP09.

6.8.1

Scenario 3: Code for sustainable homes 2 (from 07-16) and CSH4 (from 2017) and compulsory metering

This scenario looks at how implementation of CSH water efficiency targets reduces the overall increase in demand. All new homes built between 2007/08 to 2015/16 will be required to achieve CSH level 2 (120 l/h/d) and that all new homes built after 2017 will be required to achieve CSH Level 4 (105 l/h/d). In this scenario we have assumed that 95% of the existing population will be metered by 2015 in line with Environment Agency proposals. The pcc for all metered homes remains at 151.89l/h/d and unmetered homes at 175.57l/h/d as per the draft WRP09.

Scenario 4: Code for sustainable homes (staggered increase) and compulsory metering

This scenario looks at how implementation of various CSH water efficiency targets over time reduces the overall increase in demand. All new homes built between 2007/08 to 2010/11 will be required to achieve CSH level 2 (120 l/h/d) and that all new homes built between 2011/12 to 2015/16 will be required to achieve CSH level 4 (105 l/h/d), after 2017 all new homes built will be required to achieve CSH Level 6 (80 l/h/d). In this



scenario we have assumed that 95% of the existing population will be metered by 2015 in line with Environment Agency proposals. The pcc for all metered homes remains at 151.89l/h/d and unmetered homes at 175.57l/h/d as per the draft WRP09.

Scenario 5: Code for sustainable homes (staggered increase)

This scenario looks at how implementation of various CSH water efficiency targets alone over time reduces the overall increase in demand. All new homes built between 2007/08 to 2010/11 will be required to achieve CSH level 2 (120 l/h/d) and that all new homes built between 2011/12 to 2015/16 will be required to achieve CSH level 4 (105 l/h/d), after 2017 all new homes built will be required to achieve CSH Level 6 (80 l/h/d). In this scenario we have assumed that the pcc for all metered homes remains at 151.89l/h/d and unmetered homes at 175.57l/h/d as per the draft WRP09 and that meter penetration remains at 2006/07 levels (i.e. EA preferred policy for compulsory metering by 2016 is not implemented).

Scenario 6: Future Water

This scenario looks at how implementation of the measures proposed in the governments Future Water Strategy will impact upon demand by 2030. The measures for water stressed areas which have been used in the scenario include a reduction in pcc of existing population to 120 l/h/d by 2030. As an incremental yearly decrease over 23 years this equates to a reduction of approximately 1.386l/h/d per year. New homes shall achieve a pcc of 125 l/h/d by 2030. Over the 23 year period this equates to a yearly decrease (from existing property metered pcc) of 1.169 l/h/d. The strategy also proposes for water stressed areas that near universal metering is required by 2030. This has been taken to be 95% of existing properties (all new properties will be metered). Over the 23 year period this equates to an additional 786 properties per year being metered, with a corresponding decrease in unmetered properties.

Scenario 7: Compulsory metering by 2015 & reduction of existing pcc

This scenario looks at how a reduction in pcc of existing properties over time reduces the overall increase in demand. In this scenario we have assumed that 95% of the existing population will be metered by 2015 in line with Environment Agency proposals. In addition the pcc for all metered homes (including new dwellings) decreases by 2 l/h/d per year over the planning period. This target is very ambitious and considered the best case scenario leading to the greatest reduction in demand.

6.8.2

Scenario 8: Reduction of existing pcc

This scenario looks at how a reduction in pcc of existing and new properties over time reduces the overall increase in demand. This scenario is similar to scenario 6 but does not allow for the Environment Agency proposals on metering. In this scenario the pcc for all metered homes (including new dwellings) decreases by 2 l/h/d per year over the planning period.



Scenario 9: Water neutrality within WCS study area

This scenario aims to achieve water neutrality which using the measures below could be achieved by 2012/13. All new homes built between 2008/09 to 2009/10 will be required to achieve CSH level 2 (120 l/h/d) and that all new homes built between 2010/11 to 2011/12 will be required to achieve CSH level 4 (105 l/h/d), after 2012/13 all new homes built will be required to achieve CSH Level 6 (80 l/h/d). In addition a reduction in the current pcc of existing properties is required of 2.5 l/h/d per year from 2007/08 to 2012/13 and then a reduction of 1.5 l/h/d per year from 2013/14 onwards. In this scenario we have assumed that 95% of the existing population will be metered by 2015 in line with Environment Agency proposals. The pcc of unmetered properties remains constant at 175.75l/h/d as per the draft WRMP09.

Table 6-6 and Figure 6-4 below show the results of the scenario analysis



| Scenario | EA Metering (95% of existing popn by 2016) | Other metering | CSH 2 | CSH4 | CSH6 | Reduction in existing pcc | Other measures |
|----------|--|--|--------------------------------|-------------------------------|-------------------------------|--|---|
| 1 | No | All new properties metered. | No | No | No | No | No |
| 2 | Yes | All new properties metered. | No | No | No | No | No |
| 3 | Yes | All new properties metered. | New properties 07/08 to 15/16. | New properties after 2017. | No | No | No |
| 4 | Yes | All new properties metered | New properties 07/08 to 10/11. | New properties 11/12 to 15/16 | New properties after 2017. | No | No |
| 5 | No | All new properties metered | New properties 07/08 to 10/11. | New properties 11/12 to 15/16 | New properties after 2017. | No | No |
| 6 | No | 95% metering of existing popn by 2030. | No | No | No | Reduction to 120l/h/d by 2030 of existing popn. | Pcc of 120l/h/d by 2030 for new properties. |
| 7 | Yes | All new properties metered | No | No | No | 2 l/h/d per year from 2007/08 onwards. | No |
| 8 | No | All new properties metered | No | No | No | 2 l/h/d per year from 2007/08 onwards. | No |
| 9 | Yes | All new properties metered | New properties 08/09 to 09/10. | New properties 10/11 to 11/12 | New properties after 2012/13. | 2.5 l/h/d per year 2008/09 to 2012/13. 1.5 l/h/d from 2013/14 onwards. | No |

Table 6-5 Description of water resources scenarios assessed



| | Demand | | | | Potable Water Treatment | | Wastewater treatment | | Total treatment | |
|------------|-------------------------------|-----------------------|-----------------------|-----------------------|--------------------------------|-----------------------------|--------------------------------|-----------------------------|--------------------------------|------------------------------------|
| | Current Demand 2006/07 (ML/d) | 2015/16 demand (ML/d) | 2020/21 demand (ML/d) | 2030/31 demand (ML/d) | Daily energy requirement (MWh) | Carbon emissions (Kg CO2/d) | Daily energy requirement (KWh) | Carbon emissions (Kg CO2/d) | Daily energy requirement (MWh) | Carbon emissions (x 1000 Kg CO2/d) |
| Scenario 1 | 18.58 | 21.7 | 23.13 | 26 | 3.5 | 726 | 3.2 | 678 | 6.7 | 1403 |
| Scenario 2 | 18.58 | 21.27 | 22.71 | 25.58 | 3.3 | 685 | 3.1 | 639 | 6.3 | 1324 |
| Scenario 3 | 18.58 | 20.62 | 21.61 | 23.59 | 2.3 | 490 | 2.2 | 458 | 4.5 | 948 |
| Scenario 4 | 18.58 | 20.45 | 21.21 | 22.72 | 1.9 | 405 | 1.8 | 378 | 3.7 | 783 |
| Scenario 5 | 18.58 | 20.88 | 21.64 | 23.15 | 2.1 | 447 | 2.0 | 417 | 4.1 | 864 |
| Scenario 6 | 18.58 | 17.15 | 16.27 | 14.56 | -1.9 | -393 | -1.8 | -367 | -3.6 | -760 |
| Scenario 7 | 18.58 | 19.04 | 19.12 | 19 | 0.2 | 41 | 0.2 | 38 | 0.4 | 79 |
| Scenario 8 | 18.58 | 19.8 | 20.06 | 20.3 | 0.8 | 168 | 0.8 | 157 | 1.6 | 325 |
| Scenario 9 | 18.58 | 18.34 | 18.26 | 18.08 | -0.2 | -49 | -0.2 | -46 | -0.5 | -95 |

Table 6-6 Associated sustainability figures associated with scenario analysis

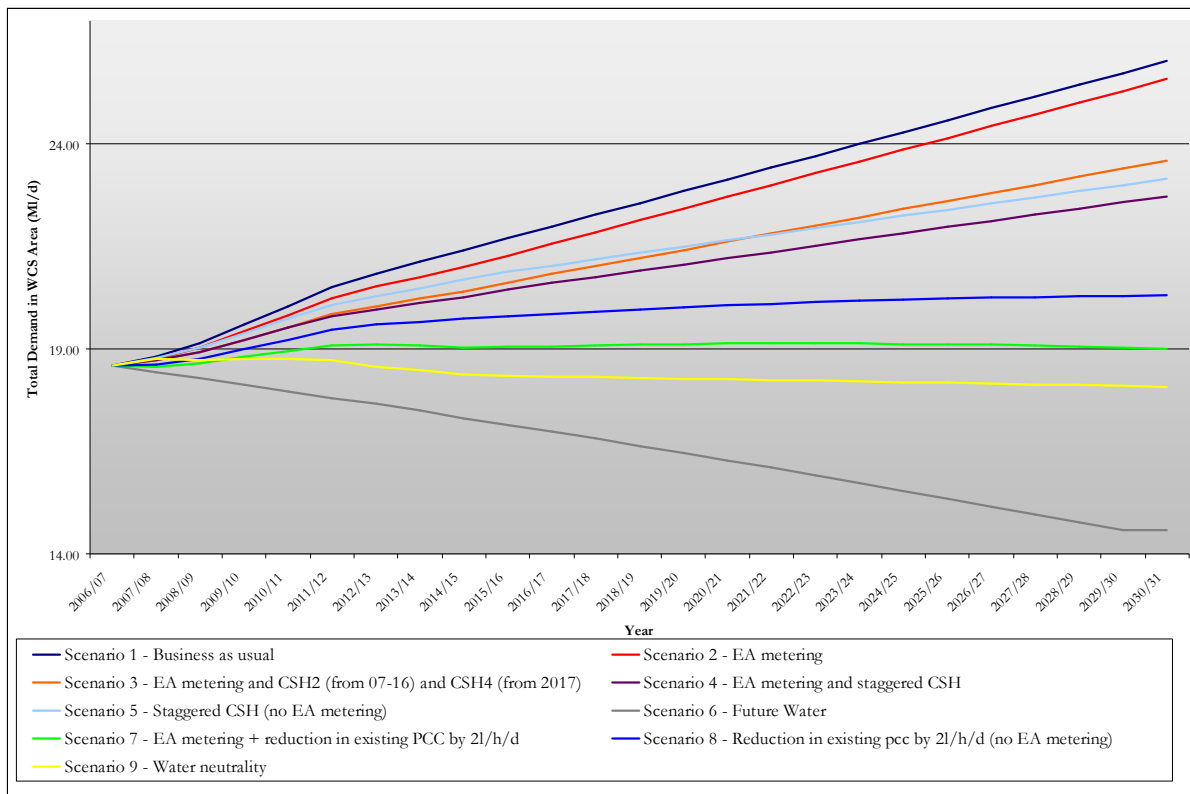


Figure 6-4 Potable water demand based on scenario analysis



Current potable water demand in the WCS in 2006/07 was 18.58ML/d. The business as usual case (scenario 1) based upon constant pcc rates shows that if no demand management measures were implemented, an additional 4.55ML/d of potable water will be required in the study area by 2021. This is approximately equivalent to almost two Olympic size swimming pools on a daily basis, or an increase in household demand of 24.5% between now and 2021. By 2030 demand rises to an additional 7.42ML/d or an increase in household demand of 40% between now and 2030. This is the worst-case scenario.

By implementing the Environment Agency's proposals on 95% meter penetration of the existing population by 2016 (scenario 2), the demand is reduced to an additional 4.13ML/d of potable water being required by 2021 or an increase of 22% compared to that under scenario 1. However this target for meter penetration is considered very ambitious in a relatively short period of time and there are likely to be practical, political, legislative, economic and social barriers to its implementation.

The implementation of the various levels of the CSH over various timescales has been tested alongside the Environment Agency's proposals on metering (scenarios 3, 4 and 5). By comparing the difference between scenario 2 and 3 it is possible to see that the introduction of the CSH level 2 for new homes built from 2007/08 to 2016/17 with CSH Level 4 from 2017 onwards reduces the additional demand by another 1.1ML/d by 2021. With more stringent implementation of the CSH as shown in Scenario 4 the additional demand by 2020/21 is reduced by 1.5 ML/d compared to that in scenario 2. Scenario 5 which looks at the implementation of the CSH in the same way as scenario 4 but without the proposals for EA metering shows that with CSH alone the additional demand compared to the BAU scenario (1) is reduced by 1.49ML/d.

If the government's strategy for managing water demand (Future Water) is implemented successfully this would see a demand of 6.8ML/d lower than the business as usual scenario (scenario 1) by 2021, which also equates to a reduction in demand of 14% from today's potable water demand. This scenario over time achieves a greater reduction in demand than the implementation of the EA metering and the CSH (scenarios 2, 3, 4 and 5).

The analysis also shows that the greatest reduction in water demand can be achieved by reducing demand in the existing population. This is because the existing population account for a larger proportion of the total population than the population from new development. Therefore although measures such as CSH, targeted at new developments have a positive impact upon total demand they should be used in conjunction with proposals for the existing population in order to achieve maximum reductions in total demand. Scenarios 7 and 8 consider a reduction in the pcc of 2.0 l/h/d per year of the existing population and for new properties. Scenario 7 also has the additional measure of



the Environment Agency's proposals on metering. Comparing these scenarios with those above it can be seen that the increase in demand is not as steep over the period than the other scenarios. It also shows that the reduction in pcc of existing population can have a dramatic affect. Scenario 7 which includes a reduction in pcc as well as Environment Agency metering proposals is the third best-case scenario, second to Future Water and water neutrality. However it must be accepted that a reduction in 2l/h.d per year cannot be sustained over the long-term and will be constrained by technology at some point.

Water neutrality (scenario 9) can be achieved by 2012/13 by implementing a variety of measures. This includes the Environment Agency's proposals on compulsory metering of 95% of existing properties by 2016, the implementation of the CSH (as described above) and a reduction in the existing pcc of the existing population. This would need to be achieved through the implementation of water efficiency measures such as retrofitting, education and encouraging water efficient devices.

6.9

Future implementation of demand management measures

6.9.1

Metering

The measures included in the scenarios above, in some cases, will not be practical to implement. The implementation of Environment Agency metering of 95% of existing properties by 2016 is an ambitious target and requires over 2,260 properties a year to be connected to a meter at a cost of up to £500 each. Currently 33% of customers in the South East Water area are connected to a meter which is above the national average. However, since October 2007, water companies within seriously water stressed areas have been given extended powers to increase compulsory metering. South East Water favour a universal metering strategy and have set themselves a targeted progressive metering programme, which will result in a company metering penetration level of 60% by 2015 and 90% of individual households by 2020. This is to be achieved by a compulsory metering programme implemented over a 10-year period from 2010. During 2006-07 SEW households reduce their water consumption by an average of 4% after a water meter is fitted.

SEW also propose to investigate as part of an accelerated metering programme the potential to expand Automatic Meter Reading (AMR) across the supply area as technological advances such as AMR support a more cost effective and environmentally acceptable strategy for meter reading in the future.

6.9.2

Water Consumption in new properties

A range of water consumption targets have been identified for new properties. The governments strategy has a requirement for a standard of 125 litres per day (l/p/d) for new properties which it anticipates will be achieved by ensuring that all new homes have fittings with a good standard of water efficiency. New requirements on water efficiency will be introduced into Building Regulations. South East Water feel this is achievable within the supply area.



It is recommended that the Code for Sustainable Homes is supported as much as practicably possible depending upon each individual development. The code should be specifically targeted through local planning regime at the largest developments where the benefits from development wide collection systems would be greatest. Staggering development should also be considered so the largest developments are built later within the planning period, in the hope that by which time the code may be statutory and technology will be in place to make the more stringent levels of the code more cost-efficient and feasible.

6.9.3

Water efficient devices and education

The government expects the demand for water efficient products from new housing to help drive the market and improve the efficiency of everyday water using products over time. To further facilitate these improved levels of efficiency, the Water Supply (Water Fittings) Regulations 1999 will be reviewed. These cover for example the maximum water use of toilets, urinals, washing machines etc. The review will also consider enforcement issues, advances in technical standards and water conservation, and the case for setting new performance standards for key water fittings. This will also support the CSH.

Most water companies offer water efficient devices either free of charge or at a reduced price. This can include cistern displacement devices (such as hippos, save-a-flush), water butts, trigger hose attachments, water audits and supply pipe replacement or repairs. Water efficiency campaigns can be very successful in reducing water consumption and are continuously undertaken by water companies. As part of the government's water strategy it has published a list of top water saving tips. South East Water also promotes water efficiency measures via its website.

The promotion of water efficient devices and awareness of water saving measures should continue to be encouraged. Whether this can achieve a reduction in water consumption used in the scenarios above and whether this reduction per year can be maintained is uncertain. It's likely that initially with efficiency devices and education a reduction in water consumption is feasible in the initial stages of the planning period. However to continue the decrease in water consumption beyond a certain level will be difficult as campaigns saturate the customer base and existing technologies are utilised. By this point it may be that consumption can be reduced to a level whereby measures, such as additional water resources or licences to support the increase in supply will not be required.

6.9.4

Water efficiency and energy²²

Approximately 24% of domestic energy consumption in the UK goes to heating water (DTI 2002). This excludes space heating. Showering alone accounts for approximately

²² Information in sections 7.9.4 and 7.9.5 - taken from [Planning for Water](#)



1% of total UK carbon emissions (MTP 2008). In addition, the treatment and distribution of water by water companies accounts for large amounts of energy consumption – e.g. Anglian Water is the largest single energy user in the East of England region, and recent estimates suggest that water companies consume more than 1% of the energy produced in the UK.

Energy prices are currently high and rising. In situations where more efficient hot water using fixtures and fittings, such as showers, baths and hot water taps are installed a major cost savings gained by the user will be through savings on the energy bill as well as the water bill.

The implementation of water efficiency measures not only reduce water demand and demand on water resources but produce associated savings in energy, financial costs and carbon emissions. Table 6.6 shows the daily reduction in carbon emissions resulting from implementing EA metering and staggered CSH (scenario 4) of 621kg of CO₂ /day; with a reduction in energy requirement of over 1.6MWh/day. Reductions in water demand could reduce the need for additional infrastructure, resulting in further savings.

6.9.5

The cost of water efficiency

A specification for indoor water use of 120 litres per person per day, as per Part G of the Building Regulations and Levels 1/2 of the Code can be achieved through installing a combination of standard and efficient fittings and fixtures. CLG estimate that this will not add any cost to a new home (CLG 2008).

Code Level 3/4 can be achieved by installation of efficient water using fixtures and fittings. CLG has estimated that under current supply-demand scenarios, achieving Code Level 3 specification for water consumption of 105 litres per person per day, will add £125 to the cost of a new home (CLG 2008). Developers Countryside Properties and Taylor Wimpey have estimated £400 and £280 respectively. The variation arises from different scales of business or assumptions on scales of business, dwelling type or assumptions on dwelling type and therefore style or desirability of fittings.

To achieve a specification of 80 litres per person per day required for Code Level 5/6, it is generally accepted that some form of water recycling is required. Inclusion of a rainwater or greywater recycling system is relatively costly. CLG estimate that achieving Code Level 5/6 would add £2650 to a new standard home. However, this is likely to be less per dwelling if communal water recycling systems are installed, and CLG (2008) estimate £800 for apartments.

The cost of meeting the Code will fall as demand increases. Bathroom manufacturer Grohe have estimated that, assuming bulk supply of the fittings and fixtures, the cost of meeting Code Level 3 /4 would drop to as little as £12.50 (Grohe 2008). The Governments stated intention is to kickstart the market transformation process by requiring the public housing sector to build to medium level Code specification.



However, this means that the relatively higher costs of meeting the Code during the early stages of market transformation are borne by housing associations. The National Housing Federation is lobbying for private developers to be subject to the same Code implementation timetable. At least at this stage, achieving Code Level 3/4 specification for water consumption is one of the cheapest aspects of Code implementation.

The average unit price for a metered water customer in 2008 is approximately 0.3 pence per litre including waste water charges. Average per capita consumption is about 150 litres per person per day. Assuming that actual water use in the home meets the target specification, savings on water bills can be estimated as shown in Table 6-7.

| Average PCC | Target Specification | Savings (litres per day) | Unit cost of water (pence per litre) | Savings (pounds per person per year) | Savings per household per year (assuming 2.4 people) |
|-------------|----------------------|--------------------------|--------------------------------------|--------------------------------------|--|
| 150 | 120 | 30 | 0.3 | £32.85 | £98.55 |
| 150 | 105 | 45 | 0.3 | £49.27 | £147.82 |
| 150 | 80 | 70 | 0.3 | £76.75 | £229.95 |

Table 6-7 Savings on water bills calculated from average UK metered water price and assuming specification targets are met in practice.

For water bills, the payback time for specifications meeting Part G and Code Levels 1 through 4 ranges from immediately to a few years. If water recycling systems are added, the payback time is significantly longer – in the order of 10 years for systems supplying single homes. Savings on energy bills also need to be considered and in general these will at least match, and often exceed, the savings on metered water bills. Dwellings with water recycling systems will also save energy if efficient fittings are installed, but recycling systems will use energy for pumping and water treatment.

In conclusion, payback times for specifications involving efficient fittings and fixtures are reassuringly quick – a few years at most. Payback times for specifications that include recycling systems are significantly longer. Defra’s water efficiency hierarchy illustrates this (Figure 6-5).

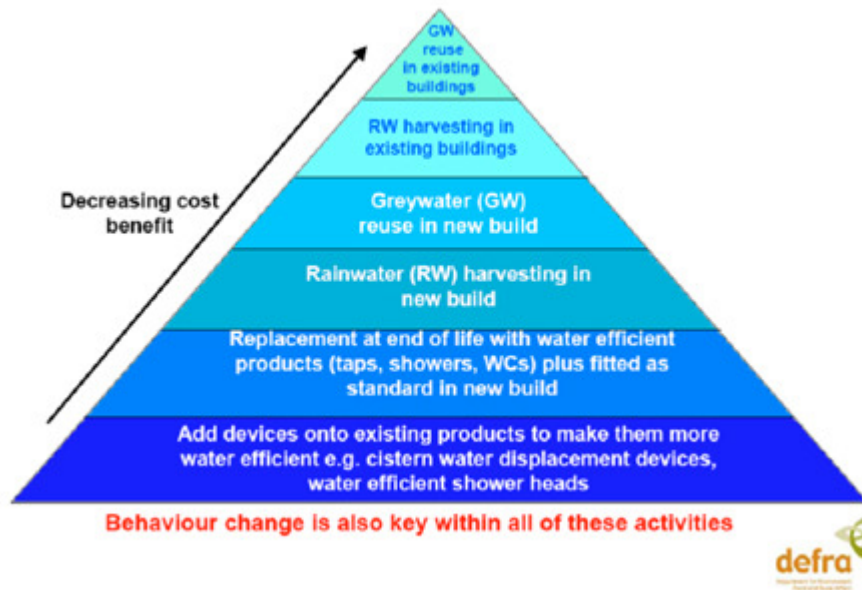


Figure 6-5 Indicative illustration of cost-benefit of water efficiency strategies (Defra)

6.10

Water Resources Summary

It is anticipated that with the twin-track approach to supply-demand management that South East Water propose in their draft WRMP09, that there will be sufficient water resources to support the predicted growth in Basingstoke during the dry year scenario until very late in the planning period. There may be reductions to existing abstraction licences used by South East Water, such as at Greywell Fen. In compliance with EA guidelines, these have not been taken into account by SEW as part of the WRMP process. However, the possibility of sustainability reductions at existing public water supply sources reinforces the need for strong demand management activities, and the need for new homes to be designed to minimise the demand for water.

The scenarios tested above have attempted to predict future demand with various demand reduction measures in place. Scenario 3 can be considered the most realistic, which shows that with Environment Agency metering proposals and the implementation of CSH Level 2 immediately and CSH4 from 2017 the additional demand by 2021 can be reduced by 1.52Ml/d from the business as usual scenario.

The demand analysis shows that a reduction in the pcc of existing properties and population is likely to have a greater impact than targeting new developments alone. It also demonstrates how increasing the proportion of the metered population can help reduce water demand. It may be possible that these measures can delay the implementation of the resource development schemes identified by South East Water, particularly for the critical period scenario. It is recommended that continued support is given to measures currently in place and that new measures and technologies are supported at a national and local level.



7 Urban drainage and flood risk

7.1

Context

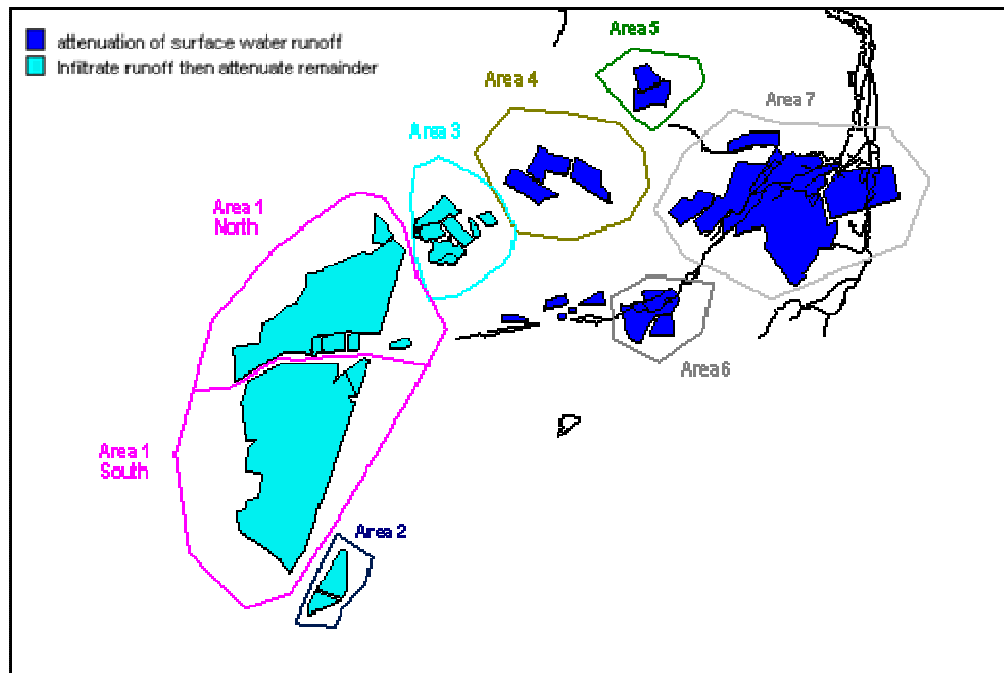
This study builds on the Strategic Flood Risk Assessment (SFRA) for Basingstoke and Deane, which considered the implications of flood risk from all sources. This section aims to aid the final selection of development sites by assessing the strategic surface water management, existing flood risk and sewage capacity associated with each development option. Although this study assesses some of the risk associated with surface water management and drainage, it is strategic in nature and can be improved with detailed local assessment and survey of individual sites. The final selection of sites will need to undergo sequential testing in compliance with PPS25 and following the recommendations of the SFRA.

Basingstoke and Deane straddles two river Catchments: the Loddon and the Test. The Environment Agency (Thames Region) has produced a Catchment Flood Management Plan (CFMP) which outlines their approach to flood risk management in the Loddon catchment. This states that flooding is generally caused by a combination of fluvial flooding and high groundwater levels. New development should be directed away from the areas of highest risk and where possible, should attempt to reduce overall flood risk. No CFMP has been produced for the Test catchment as yet but it is reasonable to assume the same policies will apply.

It should be noted that for the purposes of this assessment proposed development options with similar natural drainage characteristics have been grouped together, as shown in Figure 7-1. Developers of sites in any particular grouping should be expected to collaborate in all aspects of surface water management, including the preparation of flood risk assessments.



Figure 7-1 Surface water management groupings



7.2

Existing Flood Risk

The proposed options and areas already at risk from flooding are shown in Figure 8-2 and illustrate that development areas 6 and 7 lie within Environment Agency Flood Zone 3. As per the PPS25 practice guide the sequential test should be used to ensure development is located in the areas at lowest risk, and that development should only occur in flood zones 2 and 3 if there are no alternative suitable sites in flood zone 1. PPS25 Annex D (Tables D1, D2 and D3) identify which land uses are appropriate in which flood zone. The Basingstoke and Deane SFRA recommends that where there is uncertainty in Flood zone modelling, which is the case throughout this study area, that a precautionary approach is applied to the application of the sequential testing. Please refer to the Strategic Flood Risk Assessment for further information and discussion on how to apply the sequential and exception tests within this study area.

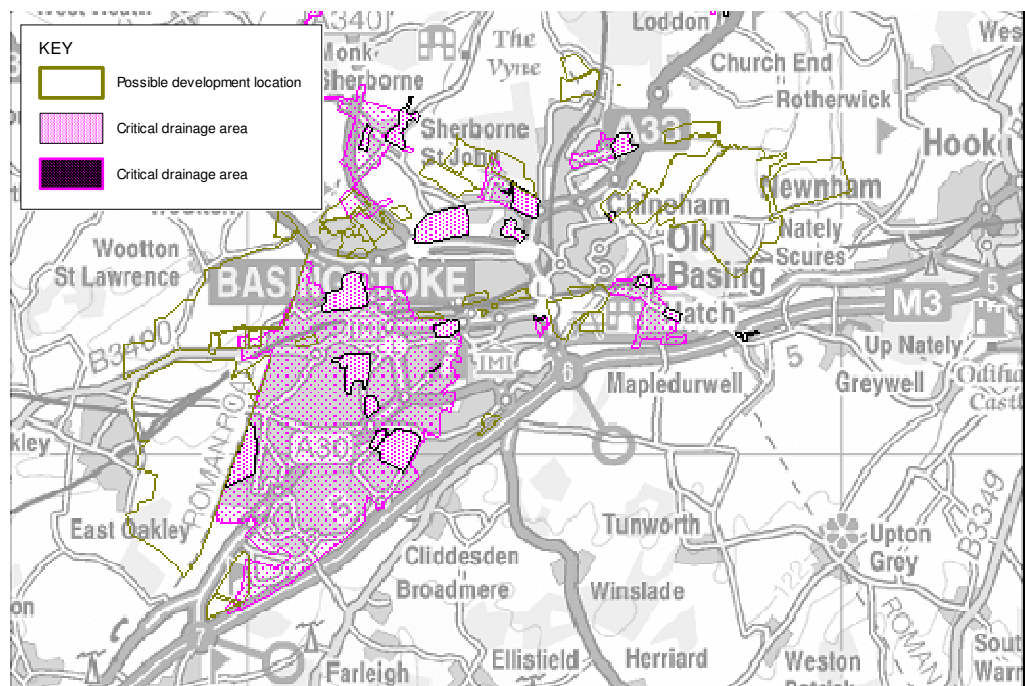
Groundwater flooding (from high groundwater levels in the Chalk aquifer) has affected low-lying areas of the Basingstoke and Deane Borough in the past. However, with the exception of Area 6, none of the proposed development sites are considered to be at risk due to their relatively high ground levels or position on impermeable strata.

Area 6 is located within the flood plain of a groundwater fed river and, ground levels, even outside the floodplain, are below those at which groundwater flooding has occurred locally in the past. This area is at high risk from both fluvial and groundwater flooding, and in accordance with PPS25 development should be located away from the areas at highest risk initially.



The SFRA identified a number of ‘critical drainage areas’ which are already susceptible to sewer flooding because the capacity of the existing drainage system is sometimes exceeded. Connection of a new development to these systems, or the upstream network, will increase flood risk unless runoff is limited to greenfield rates. This is already a requirement for new developments but it should be noted that flood risk in critical drainage areas could be reduced by reducing runoff from new developments to below the greenfield rate. As shown in Figure 7-2, except for Area 7, all the proposed options are located upstream of critical drainage areas.

Figure 7-2 Critical Drainage Areas



7.3

Surface Water Management

The purpose of a surface water management strategy for proposed development options is threefold:

- to ensure that runoff rate and volume from the development site does not exceed greenfield runoff rates and volumes up to the 1 in 100 year rainfall event, plus an allowance for climate change;
- to ensure development does not cause an increase in downstream flood risk, and;
- to ensure that there is no on-site flooding up to the 1 in 100 year rainfall event.

Through the WCS an assessment has been made of the runoff rates and volumes required from proposed development options, which allows potential land-take of mitigation



measures to be estimated. Furthermore the potential for infiltration and attenuation sustainable drainage systems (SUDS) has been assessed for each development option.

Where infiltration SUDS are proposed a groundwater risk assessment should also be carried out. SUDS can bring about both a reduction in the rate and volume of runoff, but can also contribute to improved water quality by helping to remove pollutant loads prior to discharge to the watercourse.

The WCS has also assessed the potential for proposed development options to increase downstream flood risk, for all sources of flooding. An assessment has been made of:

- foul network capacity and the potential to increase foul flooding (using critical drainage areas identified in SFRA);
- mitigation options to minimise increases in flood risk due to increase in final effluent discharge from Basingstoke STW, and;
- surface water flooding – this has been undertaken by assessing the runoff rates and volumes from the proposed development options to ensure surface water is effectively managed.

The third component of the surface water management strategy, ensuring no on-site flooding up to the 1 in 100 year rainfall event, is assessed when master planning individual development locations. Because of their large extent and position relative to the proposed development options, it is recommended that strategic drainage solutions be explored through the development of a Surface Water Management Plan (SWMP). Once the development areas have been finalised the appropriate strategic drainage solutions should be presented in a surface water drainage master-plan. Compliance with the master-plan will ensure that developers take a coordinated approach to surface water management, sanctioned by both the Environment Agency and Basingstoke and Deane BC.

7.3.1

Runoff Rates and Storage Volumes

The calculation method is described in joint Defra/Environment Agency R&D Technical Report 'Preliminary rainfall runoff management for developments' (Environment Agency, 2007). This method provides initial, conservative estimates of the increase in peak flow and volume of runoff from proposed developments. Runoff rates and storage volumes have been calculated for each grouping and the results are presented below in Table 7-1. The calculations are based on the 100 year, 6 hour storm event, as per the Defra guidance (Environment Agency, 2007).

The built-upon area of the site is referred to as the 'drainage area'. The calculations have assumed that the drainage area will be 60% impermeable, compared to 0% prior to development. This estimate of the percentage of impermeable area (PIMP) is the



maximum expected for developments compliant with PPS3, therefore the calculated storage volumes will be conservative estimates. In addition, the use of infiltration SuDS on a site would reduce the value of PIMP further.

The proportion of precipitation that becomes surface runoff (ie. which is not infiltrated or evaporated) can be expressed as the standard percentage runoff (SPR). The proposed development sites can be considered in groups, according to the runoff and infiltration characteristics of the underlying soil and geology, as described in the Strategic Flood Risk Assessment (SFRA) (Halcrow, 2008).

A housing density of 45 dwellings per hectare has been used to estimate the area within each grouping that would actually be developed: the 'Drainage Area'. The calculations have assumed that the drainage area will become 60% impermeable, compared to 0% prior to development. This estimate of the percentage of impermeable area (PIMP) is the maximum expected for developments compliant with PPS3, therefore the calculated storage volumes will be conservative estimates based on a worst case scenario. It should be noted that the use of some infiltration SuDS on a site would reduce the value of PIMP further.

For each site in Table 7-1 required storage volumes are broken down into two categories:

- attenuation storage, which is provided to reduce the *rate* of runoff to the equivalent of the pre-development rate, and;
- long term storage, which is provided to reduce the *volume* of post-development runoff to the pre-development volume. The volume must be infiltrated, or discharged to a watercourse at a rate no exceeding 2 l/s/ha.

For example, for Area 1 (North only), 31,387m³ of attenuation storage is required. Of this, at least 13,854m³ must also function as long term storage, discharging at a maximum of 2 l/s/ha (147 l/s). Discharge of the remaining 17,533 m³ must not exceed 223 l/s.



Table 7-1 – Preliminary runoff rates and storage volumes

| Area | SPR | Total Area (ha) | Drainage Area (ha) | 100 year Attenuation Storage (m ³) | Long Term Storage (m ³) | 100 year Greenfield rate (l/s) | Max. Long Term Storage Discharge Rate (l/s) | Area required for Long Term Storage assuming depth of 1m (ha) |
|--------|------|-----------------------|--------------------|--|-------------------------------------|--------------------------------|---|---|
| Area 1 | 0.02 | 335 (North only) | 73.3 | 31,387 | 13,854 | 223 | 147 | 139 |
| | | 853 (North and South) | 195.6 | 83,757 | 36,968 | 595 | 391 | 370 |
| Area 2 | 0.02 | 37 | 58.7 | 25,136 | 11,094 | 179 | 117 | 111 |
| Area 3 | 0.02 | 69.3 | 53.2 | 22,781 | 10,055 | 162 | 106 | 101 |
| Area 4 | 0.50 | 74.5 | 44.6 | 12,669 | 2,810 | 717 | 89 | 28 |
| Area 5 | 0.50 | 32.3 | 22.0 | 6,249 | 1,386 | 354 | 44 | 14 |
| Area 6 | 0.02 | 60.4 | 13.4 | 5,738 | 2,533 | 41 | 267 | 25 |
| Area 7 | 0.50 | 440 | 171.1 | 48617 | 10779 | 2402 | 342.2 | 107.8 |
| | | | 73.3 | 20824 | 4618 | 1130 | 146.6 | 46.2 |

The amount of storage required is heavily dependent upon the soil-type and geology beneath the development site. For sites with a naturally low SPR, development could significantly increase the rate and volume of surface runoff. Storage requirements will therefore be high in order to compensate. Conversely, sites with a high SPR will naturally generate a comparatively large volume of surface runoff. Less storage is therefore needed because development has a smaller effect on the existing drainage regime.

7.3.2

Infiltration drainage and groundwater protection

If soils conditions permit, any development should ensure that as much drainage as possible is infiltrated into the substrata to reduce the impact on groundwater resources and limit the volume of storage required.

However, discharges to groundwater are subject to certain restrictions put in place by the Environment Agency to protect groundwater resources. These depend on whether a site falls within (or close to) a source protection zone (SPZ). Three SPZs are defined around important groundwater sources; Zone 1, the inner zone, closest to the source, is the most sensitive. Relevant Environment Agency policy can be summarised as follows:

- Discharge of roof drainage directly to ground is permitted (and encouraged) anywhere, so long as there is no opportunity for mixing with drainage from other sources.
- Outside of Zone 1 discharge of surface water drainage from roads, car parks and amenity areas is permitted, so long as
 - (i) it is supported by a suitably detailed groundwater risk assessment;
 - (ii) appropriate aquifer protection measures are in place, and;



- (iii) there is provision for the long term maintenance and management of the system.
- Discharge of surface drainage from any significantly contaminated areas will not be permitted.
- Deep soakaways (discharging directly into the aquifer) will not be permitted unless there is no viable alternative and conditions (i) and (ii) above are satisfied.
- Within Zone 1, no new, potentially contaminated discharges will be permitted.

Once the development options have been finalised, high level groundwater risk assessments should be undertaken as part of the SWMP, for all sites where infiltration is proposed. More detailed assessments must be undertaken by developers as part of the planning application process, which will include an assessment of localised flood risk issues as part of the site-specific flood risk assessment.

7.3.3

SuDS Recommendations

Areas 1,2,3 and 6

Areas 1, 2, 3 and 6 have a very low SPR, meaning that in their natural state, precipitation is readily absorbed into the ground resulting in very low greenfield runoff rates. Consequently storage requirements are relatively high, at 428 m³/ha developed area.

The natural role for surface drainage in these areas is to recharge the Chalk aquifer, which supports flow in both the Loddon and Test catchments. This means that infiltration drainage should be effective on all sites and it is likely that storage requirements could be reduced slightly. However, it will not be possible to infiltrate all runoff from new development areas, and large storage volumes will still be needed to provide a combination of treatment prior to infiltration, and attenuation prior to discharge into the downstream catchment.

Area 6 is at high risk from fluvial and groundwater flooding and is not recommended for residential development. Because it is located within a Chalk valley, groundwater levels are likely to be near the surface much of the time. Infiltration SuDS are therefore unlikely to work efficiently when groundwater levels are high, which is when the risk of fluvial and groundwater flooding is greatest. Furthermore, infiltrated water is likely to travel rapidly into the river, increasing its flow. The area around the floodplain may however be suitable for a strategic attenuation or long term storage solution for upstream developments.

It should be noted that Area 3 lies within a SPZ1, therefore the infiltration of anything other than roof drainage will not be permitted. A possible solution would be to convey runoff to a downstream holding area where infiltration would be permitted.



Areas 4,5 and 7

Areas 4, 5 and 7 have a fairly high SPR, therefore Greenfield runoff rates are relatively high and the effectiveness of infiltration drainage will be limited. Storage requirements are relatively low, at 284 m³/ha developed area.

Areas 4 and 7 will naturally drain to the River Loddon catchment, whereas Area 5 will drain northwards to the Bow Brook, a tributary of the Loddon. Development in these areas will need attenuation storage provided on site and outside of the existing flood plain.

Although a substantial proportion of Area 7 falls within the Flood Zone 3, it has been indicated that it is only proposed to develop a maximum of around two-fifths of the site. It should therefore be possible to keep any development clear of the floodplain.

7.4

Flood risk & foul sewerage

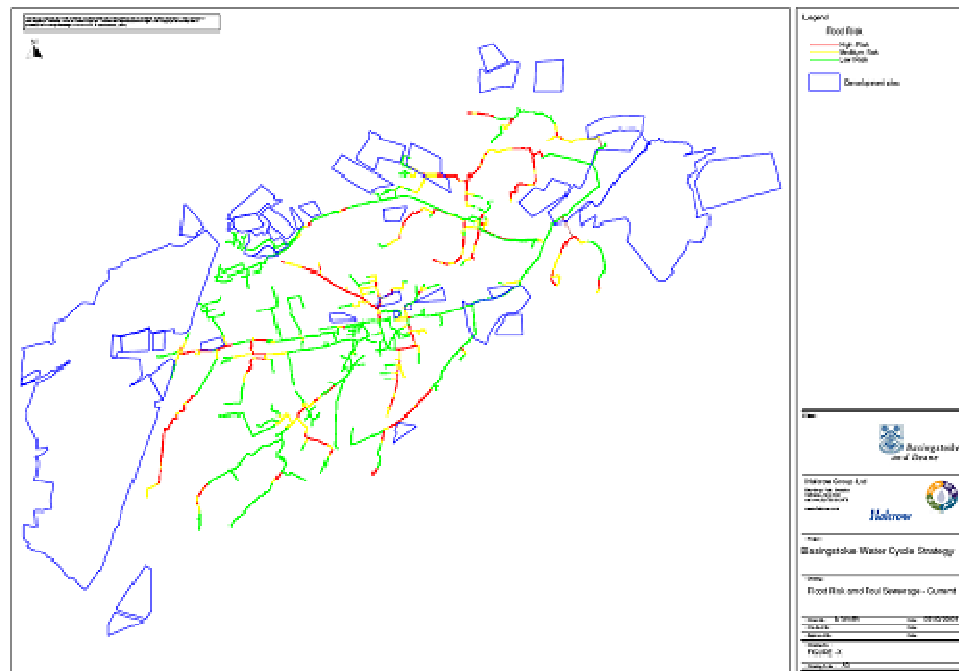
To assess the potential impact of the planned growth up to 2026 on the sewerage network in the Basingstoke catchment, an Infoworks CS model was provided by Thames Water. Using standard Thames Water model design assumptions, we looked at the current capacity of the drainage network. The modelling provides an assessment of areas of capacity and incapacity in the network, which can be used to inform the spatial distribution of development. Where there is incapacity, this should not be seen as an absolute barrier to development; capacity can be created given time and investment. However, the assessment gives an indication of the scale of infrastructure should development in specific locations come forward.

The results of the model simulations have been translated into maps to show the areas at risk of flooding. The maps have been based on the critical storm of the 60 minute 30 year summer event²³. The current foul network capacity is shown in Figure 7-3 below.

²³ The 720 minute winter event had larger volumes of flooding overall, but flooding occurred at less locations than the 60 minute summer event, which stressed the system more as a whole.



Figure 7-3 Current modelled foul network capacity for 60 minute 30year summer event



7.4.1

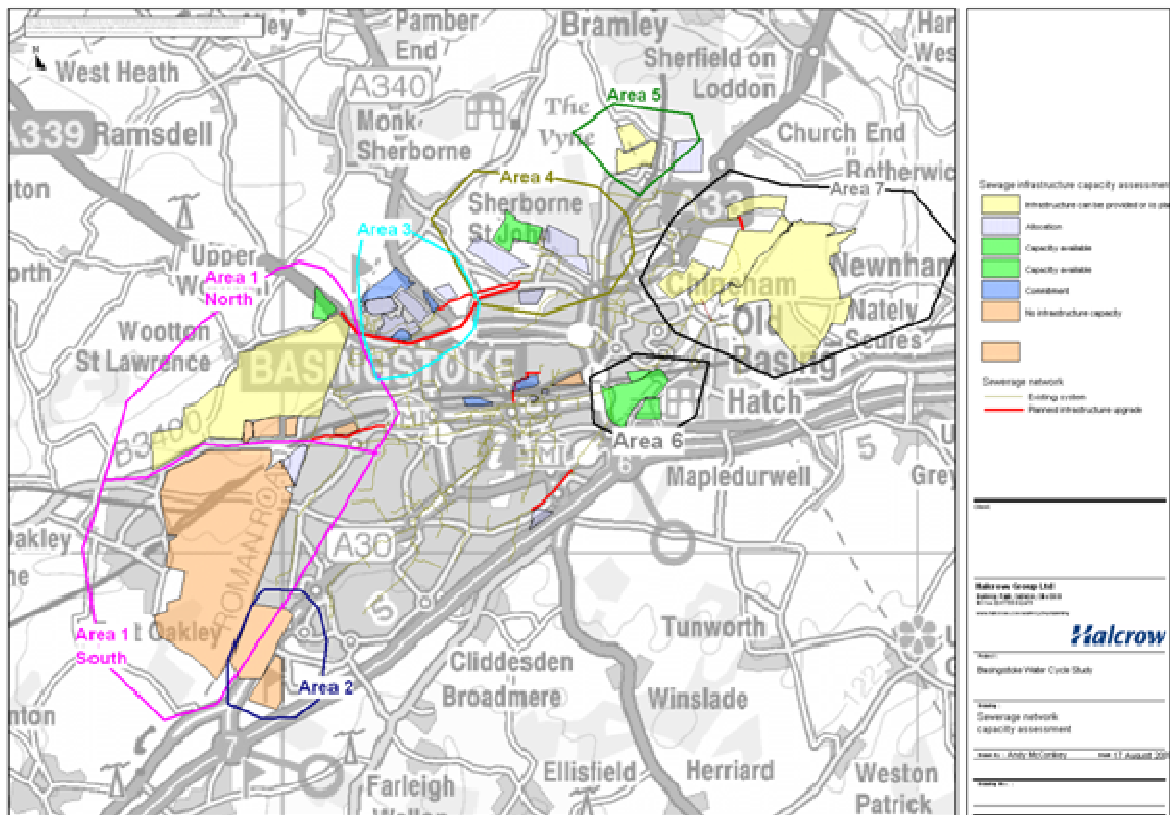
Planned sewerage improvements

Thames Water have modelled and assessed a number of foul sewerage schemes that would be required to be delivered in AMP5 to provide additional capacity for proposed new housing. These schemes are shown in Figure 7-4 below. A modelling assessment, using the Thames Water drainage model, of the allocated and committed sites, along with the strategic sites for testing has been carried out. This capacity assessment is shown in Figure 7-4. The traffic light system shows those sites where capacity is available, those where capacity is planned, those where capacity can be provided, and those where capacity is uncertain, not available or cannot be provided easily. The results can be used to provide an assessment of those development locations where development is more likely to cause an increase in foul flood risk.

Where there is no current capacity, site specific discussions will need to be held with sewerage providers. Although those areas coloured yellow or amber have been assessed as having planned infrastructure improvements, it must be stressed that Thames Water's infrastructure delivery programme is subject to change based on regional and local priorities.



Figure 7-4 Risk categorization of development sites



South West of Basingstoke – Area 2 & Area 1 south

It can be seen that any major development to the south west of Basingstoke will need major new sewerage infrastructure to convey sewage effluent to the STW, because of insufficient capacity in the existing network.

Even minor development may cause an increase in flood risk in the drainage system through Basingstoke. This could be reduced by the application of strong water demand management policies, alongside a plan to remove surface water and rainfall runoff connections at source to reduce the demand on the existing network from the existing connected population. It is noted however that there are currently no legislative mechanisms to enforce demand management measures, and source control within an existing area is notoriously difficult to achieve. As a result demand management measures would need to work alongside a strategy which could deliver the necessary certainty to allow development to occur. Should major new development be allocated in either of these locations it is almost certain that a new strategic sewer direct to Basingstoke STW would be required to ensure that development did not increase the risk of sewer flooding in the existing urban area.



North West of Basingstoke Area 1 north

The Northern half of the West of Basingstoke MDA, and the developments around Park Prewett and North of Popley will be served by a new strategic foul sewer that Thames Water have recently constructed. Figure 7-4 shows the location of the new strategic sewer serving this area.

North of Basingstoke – Area 4

Any development around Popley and Popley fields will be drained by the new strategic sewer that Thames Water has constructed. Figure 7-4 shows the location of the new strategic sewer serving this area.

North East of Basingstoke - Area 5

There is no capacity in the local system around Razors Farm and Cufaude Farm, and any development in this location will either need to drain through a new connection to the strategic sewer, or will need to requisition sewer upgrades to the local network. Development to the North east must not be allowed to drain to Sherfield on Loddon STW because of the impact of Sherfield on Loddon STW on the Bow Brook and downstream River Loddon.

East of Basingstoke - Area 7

Development to the East of Basingstoke in the vicinity of Chineham can drain directly to Basingstoke STW, and hence will not require significant sewerage reinforcements within the existing urban area.

This sewerage capacity assessment should inform the spatial allocation of developments to ensure that strategic allocations make best use of existing sewerage infrastructure, minimise the need for new infrastructure, and are most resilient to climate change.

The underlying conclusion is that sewerage and urban drainage can be provided to serve any of the locations assessed. Where possible, from a sewerage and urban drainage perspective, developments should be allocated sequentially to firstly take up existing capacity in the new strategic sewer serving the north West of Basingstoke. Once this capacity has been taken up, it is recommended allocations are made in locations that limit the amount of new physical infrastructure required and that limits disruption to the existing urban area.

Should strategic allocations be made where this water cycle study has identified infrastructure incapacity, it is recommended that detailed infrastructure analysis and planning is undertaken immediately following allocation. It is recommended that connections from new strategic allocations should not be allowed to the existing drainage



network until the organisation responsible sewerage (currently Thames Water Utilities) have confirmed that there is capacity within the system to allow connection without increasing the risk of foul flooding.

7.4.2

Urban drainage and flood risk in other settlements

The impact of allocating new developments on the smaller settlements in Basingstoke and Deane borough are highly dependant on the exact location of development, and it is not possible to determine the impact on foul flood risk in more strategic terms.

It is possible that any large development in a small urban area could be connected directly to a sewage treatment works via a dedicated new sewer. Therefore foul sewerage capacity should not be considered a constraint for allocating housing. However, the water company responsible for sewerage in any allocation area should be advised of the number and location of any significant allocations housing at the earliest possible opportunity to allow detailed assessment of the infrastructure requirements to be determined. Table 7-2 below identifies the water company for each of the settlements assessed.

Table 7-2 – Summary of development site by water company which serves it

| Catchment | Water company |
|-------------------------------|---------------|
| Basingstoke | Thames |
| Silchester | Thames |
| Bramley & Sherfield on Loddon | Thames |
| Overton | Southern |
| Whitchurch | Southern |
| Sherborne | Thames |

7.5

Conclusions

Some sites are already at risk from one or more sources of flooding, or have the potential to increase downstream flood risk. In some cases this can be mitigated by: restricting the exact location of development within those areas; using suitable SuDS; or, by identifying strategic, off-site storage areas.

It is recommended that a surface water management plan be developed to investigate these possibilities and facilitate the production of a surface drainage masterplan, which will ensure that a coordinated approach to these issues is taken by developers as the options progress.

The drainage and flood risk issues associated with each area are summarised in Table 7-3 below, and this should be used to inform the spatial distribution of development within Basingstoke.



| Area | Drains to | Is there a fluvial flood risk? | Is there a groundwater flood risk? | Is there planned capacity in the foul network? | Surface water drainage requirements | Suitability for SUDS | Recommendations for proposed development area |
|--------------|---------------------------------------|--------------------------------|------------------------------------|---|---|--|---|
| Area 1 North | Chalk aquifer feeding Loddon and Test | | | Currently no capacity in downstream sewer network. Phase 2 of the Basingstoke north relief sewer is likely to have capacity that could be used for development in this area | Low greenfield runoff which requires high storage volumes | Suitable for infiltration SUDS | It will be difficult to match greenfield runoff rates, which could cause an increase in downstream surface water flood risk |
| Area 1 South | Chalk aquifer feeding Loddon and Test | | | Currently no capacity in downstream sewer network, and uncertainty about whether the infrastructure could be delivered | Low greenfield runoff which requires high storage volumes | Suitable for infiltration SUDS | Concerns over available capacity in the foul network need to be addressed. Also it will be difficult to match greenfield runoff rates, which could cause an increase in downstream surface water flood risk |
| Area 2 | Chalk aquifer feeding Loddon and Test | | | Currently no capacity in downstream sewer network, and uncertainty about whether the infrastructure could be delivered | Low greenfield runoff which requires high storage volumes | Suitable for infiltration SUDS | Similar to area 1; concerns over the capacity in the foul network need to be addressed |
| Area 3 | Chalk aquifer feeding Loddon and Test | | | Development would be served by Phase 2 of the Thames Water new strategic sewer | Low greenfield runoff which requires high storage volumes | Suitable for infiltration SUDS – but only from roof drainage because it is within SPZ1 | Foul network has planned capacity; but high surface water storage requirements likely due to low greenfield and limited use of infiltration (it lies in SPZ1) |
| Area 4 | Loddon catchment | | | Development would be served by Phase 2 of the Thames Water | High greenfield runoff rates which require lower | Attenuation, unsuitable for infiltration | |



| | | | | | | | |
|---------------|---------------------------------------|---|--|--|---|--|---|
| | | | | new strategic sewer | storage requirements | SUDS | |
| Area 5 | Bow Brook catchment | | | No capacity in the downstream sewer network | High greenfield runoff rates which require lower storage requirements | Attenuation, unsuitable for infiltration SUDS | Concerns over the capacity of the foul network need to be addressed |
| Area 6 | Chalk aquifer feeding Loddon and Test | High risk of fluvial flooding (Flood Zone 3) | High risk of groundwater flooding due to high groundwater levels | Infrastructure for foul network already in place | Low greenfield runoff which requires high storage volumes | Attenuation, unsuitable for infiltration SUDS due to high groundwater levels and valley position | Not suitable for residential development due to concerns over fluvial and groundwater flood risk, unless PPS25 sequential and exception test has been carried out. |
| Area 7 | Loddon catchment | High risk of fluvial flooding (Flood Zone 3) but large enough to accommodate proposed option outside of floodplain. | | Connections can be made directly to Basingstoke sewer and therefore not an absolute barrier to development | High greenfield runoff rates requiring relatively low storage volumes | Attenuation, unsuitable for infiltration SUDS | Need to apply sequential test to avoid vulnerable land uses in Flood Zone 3; however, there the development site is large enough to accommodate development outside of the floodplain |

Table 7-3 – Summary of drainage and flood risk issues in each development area



7.6

Sewage effluent and flood risk

Increased discharges from WWTW due to development may adversely affect flood risk downstream. PPS25 requires that there is no significant increase in flood risk due to development. Therefore, in some circumstances it may be necessary to provide mitigation for additional discharge. We have assessed the significance of the additional volume of treated effluent as part of this WCS, however this assessment does not imply that mitigation will be required, only advise the Environment Agency as to the scale of the additional flood risk and the scale of mitigation that would be required if the flood risk was deemed to be significant.

The additional treated sewage effluent discharge from Basingstoke STW will lead to a 3.7% increase in the QMed flow in the River Loddon. If this increase is deemed to be significant, there will be a requirement to mitigate the additional flood risk. An assessment has been undertaken to identify how much attenuation storage may be required to mitigate the impact of the additional discharge and this is shown below.

There is no clear line of responsibility covering who should provide, operate and maintain such mitigation at this present time. It is possible that over attenuation of surface water runoff on a development site could provide the additional mitigation, although the costs for providing such could not be passed onto a single developer, because all developments would be contributing to the additional flood risk.

Table 8.4 lists the storage volume required to mitigate the increased discharge for the 1 in 100 year event for each watercourse. Considering the worst-case option of discharge to the River Loddon, approximately 10,000 m³ storage would be required.

Development in areas 4, 5, 6 and 7 could potentially provide attenuation beyond that discussed in section 5.1 to ensure that this additional risk is controlled. Any major development in area 7 should consider providing flood risk mitigation for sewage effluent as part of its drainage strategy.



| Watercourse | River Loddon upstream of confluence |
|---|-------------------------------------|
| DWF * 3 (m ³ /s) 2016 | 0.98 |
| DWF * 3 (m ³ /s) 2026 | 1.10 |
| QMED (m ³ /s) | 2.32 |
| QMED + DWF * 3 (m ³ /s) 2016 | 3.30 |
| QMED + DWF * 3 (m ³ /s) 2026 | 3.42 |
| Increase (%) | 3.7 |

Table 7-5 Increase in QMED due to increased STW discharge

| Watercourse | River Loddon upstream of confluence |
|--|-------------------------------------|
| Increase in DWF * 3 (m ³ /hr) | 433.8 |
| Hydrograph duration (hrs) 100 year flood | 23 |
| Storage volume (m ³) | 9978 |

Table 7-4 Storage volume required to mitigate increased STW discharge in a 100 year event.



8 Strategic risk and opportunity testing

An overall strategic risk and opportunity testing has been undertaken on the potential development sites assessed in this study. The assessment looks at the water environment, infrastructure and ecological constraints and opportunities and discusses how each development site performs against a number of criteria. These criteria have not undergone verification by the stakeholders, and no weighting has been attached to any of the criteria. The list of criteria should not be read as complete, and should only be used as a to guide develop an understanding of the combined risk and opportunities in each potential development area. Detailed analysis of each site may change the assessment and it is recommended that the assessment is kept as a living draft through the LDF process and updated when additional evidence is available.

The assessment used expert opinion of the Halcrow water cycle study team to asses the potential allocations being tested against the following factors. The development locations assessed are shown in Figure 8-2.

The criteria assessed were:

- Impact on groundwater recharge
- Impact on downstream surface water flooding
- Impact on downstream fluvial flooding
- Risk of fluvial flooding on site
- Potential to provide attenuation on site to offset increase in flood risk from foul effluent
- Impact on downstream foul flood risk and foul sewerage infrastructure
- Climate change adaptability, with respect to drainage and flood risk

The potential development areas being assessed have been divided into spatial areas based on the geographical location, catchment parameters and water infrastructure constraints. The development locations and areas assessed are shown in Figure 8-2.



8.1 *Area 1 - West of Basingstoke*

The west of Basingstoke area comprises the following sites within the draft SHLAA (September 2008): BAS099, BAS105, BAS115, BAS116, BAS049 and BAS098.

8.1.1 *Flood risk and Sustainable Drainage*

The natural role of surface drainage in this area is to recharge the chalk aquifer, which supports flow in both the Loddon and Test catchments. This area has a very low Standard Percentage Runoff (SPR), leading to very low greenfield or undeveloped runoff rates. Should this site be developed, it may not be possible to infiltrate all the runoff generated from the additional impermeable surface created by development back into the soil, therefore additional runoff from this site may be generated compared to the greenfield situation. Storage volumes will therefore be relatively high in order to ensure that the runoff rates are managed. We estimate that the storage requirements for this area will be approximately 428m³/ha of developed area. Infiltration drainage techniques should therefore be mandatory in this area and the area of impermeable surface created by development minimised as far as practicably possible. Any development within the site will need a drainage masterplan or strategy to show that the any new runoff created by development does not have an impact on the downstream surface water or river system. Additional storage volume may be needed beyond that required just for hydraulic control in order to provide treatment of water to improve water quality, before it is discharged into the ground.

8.1.2 *Impact on groundwater recharge*

As a result of the high greenfield soil permeability in this area, it is considered unlikely that the amount of groundwater recharge post development will be the same as that before development. Any allocation in this area will therefore require site specific hydrological investigations to ensure that development maximises infiltration drainage infrastructure will not adversely effect groundwater recharge and river flows in the River Loddon and Test.

8.1.3 *Sewerage infrastructure requirements*

Our assessment of drainage infrastructure based on wastewater network modelling has identified the impact of development on the sewerage network. For the southern part of this area any major development will need major new sewerage infrastructure to convey sewage effluent to the sewage treatment works, because of insufficient capacity in the existing network. Even minor development in the southern part of the west of Basingstoke, may cause an increase in flood risk in the drainage system through Basingstoke. This could be reduced by the application of strong water demand management policies or by the targeted removal of surface water from the drainage system. However, it must be noted that there are currently no legislative mechanisms to enforce demand management measures beyond building regulations, and the removal of surface water through a surface water management plan cannot be guaranteed. As a



result, demand management measures would need to work alongside a strategy which could deliver the necessary certainty to allow development to occur. Any proposed development in the southern half of Area 1 will need a sewerage feasibility assessment to be commissioned from the water company by the developer.

For the northern part of BAS098 and sites BAS100, BAS116, BAS106, BAS115, BAS105 and BAS099, a new strategic foul sewer has already been constructed by Thames Water to serve recent development in this area, and a second phase of the strategic sewer has been planned but not yet delivered. Developments in this area could therefore be served by planned existing infrastructure, although further discussion will be needed between developers and Thames Water to facilitate the delivery of the second phase of the strategic sewer should the AMP5 business plan not be able to fund it.

8.1.4 *Climate change adaptability for surface water management*

The drainage characteristics of this area mean that it will by necessity drain through artificial infrastructure within the existing urban area of Basingstoke. The artificial infrastructure has a finite capacity and the characteristics of this area means that it will be difficult to mitigate for climate change rainfall patterns or design for exceedance without impacting on the existing urban area. The existing drainage infrastructure could potentially be upgraded to allow for the impacts of climate change to be mitigated. However, current uncertainty around climate change rainfall patterns means that these impacts cannot be accurately modelled and hence an accurate feasibility and cost benefit analysis could not be carried out. Our recommended approach to facilitate climate change adaptability is to ensure that surface water drainage is managed above ground and that major drainage routes are above ground and not directed through artificial below ground infrastructure. This should not be considered as a barrier to development, but any allocation to the west or south west of Basingstoke would need detailed surface water and drainage masterplanning to ensure that there were no downstream impacts.

8.1.5 *Impact on biodiversity*

Within this area there are a number of sites identified as lowland mixed deciduous BAP priority habitat which may be at risk from the physical impacts of development. Figure 8-1 shows the location of the BAP sites.

8.2 **Area 2: South West of Basingstoke**

The south west of Basingstoke area comprises the following sites within the draft SHLAA: BAS114 and BAS132.

8.2.1 *Flood risk and Sustainable Drainage*

The natural role of surface drainage in this area is to recharge the chalk aquifer, which supports flow in both the Loddon and Test catchments. This area has a very low Standard Percentage Runoff (SPR), leading to very low greenfield or undeveloped runoff



rates. Should this site be developed, it may not be possible to infiltrate all the runoff generated from the additional impermeable surface created by development back into the soil, therefore additional runoff from this site may be generated compared to the greenfield situation. Storage volumes will therefore be relatively high in order to ensure that the runoff rates are managed. We estimate that the storage requirements for this area will be approximately 428m³/ha of developed area. Infiltration drainage techniques should therefore be mandatory in this area and the area of impermeable surface created by development minimised as far as practicably possible. Any development within the site will need a drainage masterplan or strategy to show that the any new runoff created by development does not have an impact on the downstream surface water or river system. Additional storage volume may be needed beyond that required just for hydraulic control in order to provide treatment of water to improve water quality, before it is discharged into the ground.

8.2.2 *Impact on groundwater recharge*

As a result of the high greenfield soil permeability in this area, it is considered unlikely that the amount of groundwater recharge post development will be the same as that before development. Any allocation in this area will therefore require site specific hydrological investigations to ensure that development maximises infiltration drainage infrastructure will not adversely effect groundwater recharge and river flows in the River Loddon and Test.

8.2.3 *Sewerage infrastructure requirements*

Our assessment of drainage infrastructure identifies the impact of development on the sewerage network. For this area any major development will need major new sewerage infrastructure to convey sewage effluent to the sewage treatment works, because of insufficient capacity in the existing network. Even minor development in this area may cause an increase in flood risk in the drainage system through Basingstoke if infrastructure upgrades are not provided when the impacts of climate change are taken into account. This could be reduced by the application of strong water demand management policies or by the targeted removal of surface water from the drainage system. However, it must be noted that there are currently no legislative mechanisms to enforce demand management measures beyond building regulations, and the removal of surface water through a surface water management plan cannot be guaranteed. As a result, demand management measures would need to work alongside a strategy which could deliver the necessary certainty to allow development to occur. Any proposed development in Area 2 will as a minimum need a sewerage feasibility assessment to be commissioned from the water company by the developer.

8.2.4 *Climate change adaptability for surface water management*

The drainage characteristics of this area mean that it will by necessity drain through artificial infrastructure within the existing urban area of Basingstoke. The artificial



infrastructure has a finite capacity and the characteristics of this area means that it will be difficult to mitigate for climate change rainfall patterns or design for exceedance without impacting on the existing urban area. The existing drainage infrastructure could potentially be upgraded to allow for the impacts of climate change to be mitigated. However, current uncertainty around climate change rainfall patterns means that these impacts cannot be accurately modelled and hence an accurate feasibility and cost benefit analysis could not be carried out. Our recommended approach to facilitate climate change adaptability is to ensure that surface water drainage is managed above ground and that major drainage routes are above ground and not directed through artificial below ground infrastructure.

8.2.5

Impact on biodiversity

Within this area there are a number of sites identified as lowland mixed deciduous BAP priority habitat which may be at risk from the physical impacts of development. Figure 8-1 shows the location of the BAP sites.

8.3

Areas 3, 4 and 5: North of Basingstoke

The north of Basingstoke area comprises the following sites within the draft SHLAA: BAS104, BAS107, BAS122 and BAS123. In addition the following outstanding commitments and allocations have been included: Popley Fields/Marnell Park, Taylors Farm/Sherfield Park, North of Popley/Merton Rise, Basingstoke Hospital Aldermaston, Land north of Park Prewett, Beechwood Lodge/Carribbean Club Site, Aldermaston Road Triangle, Old Kempshott Lane, A339 Newbury Road 'Trumpet Junction', Park Prewett.

8.3.1

Flood risk and Sustainable Drainage

The natural role of surface drainage in site BAS 123 is to recharge the chalk aquifer, which supports flow in both the Loddon and Test catchments. This area has a very low Standard Percentage Runoff (SPR), leading to very low greenfield or undeveloped runoff rates. Should this site be developed, it may not be possible to infiltrate all the runoff generated from the additional impermeable surface created by development back into the soil, therefore additional runoff from this site may be generated compared to the greenfield situation. Storage volumes will therefore be relatively high in order to ensure that the runoff rates are managed. We estimate that the storage requirements for this area will be approximately 428m³/ha of developed area. Infiltration drainage techniques should therefore be mandatory in this area and the area of impermeable surface created by development minimised as far as practicably possible. Any development within the site will need a drainage masterplan or strategy to show that the any new runoff created by development does not have an impact on the downstream surface water or river system.

However it should also be noted that site BAS123 lies within a Source Protection Zone 1 and therefore infiltration of anything other than roof drainage is unlikely to be permitted.



A possible solution would be to convey runoff to a downstream holding area where infiltration would be permitted.

Sites BAS104, 113, 107 and 122 have a fairly high Standard Percentage Runoff and therefore runoff rates are already high. Therefore, in order to maintain the greenfield runoff rates storage requirements are relatively low, at 284 m³/ha of developed area. The effectiveness of infiltration in this area may be limited as a result of the geology, although it is recommended that drainage assessments for development sites carry out soil porosity test to ensure that post development runoff matches pre development.

Sites BAS104 and 113 naturally drain into the River Loddon catchment. Development in this area will need attenuation storage provided on site and outside of the existing floodplain.

8.3.2

Sewage infrastructure requirements

Sites BAS123, BAS104, BAS113 could be drained by the Thames Water strategic foul sewer. Developments in this area could therefore be served by planned existing infrastructure, although further discussion will be needed between developers and Thames Water to facilitate the delivery of the second phase of the strategic sewer if necessary should the AMP5 business plan not be able to fund it.

However, there is no capacity in the drainage network around sites BAS122 and 107. Any development of these sites will need to drain through a new connection to the strategic sewer or will need to requisition sewer upgrades to the local network. Development of these sites must not be allowed to drain to Sherfield on Loddon Sewage Treatment Works, unless an effluent quality improvement programme has been planned, because of the current impact from the sewage treatment works on the Bow Brook and downstream River Loddon.

8.3.3

Attenuation opportunities to compensate for flood risk from additional Sewage Treatment Works Discharge

Sites BAS122 and 107, although upstream of the sewage treatment works, are close to the main river and may provide opportunities for compensatory attenuation in lieu of attenuation at or downstream of the sewage treatment works.

8.3.4

Climate change adaptability for surface water management

The drainage characteristics of BAS104 mean that it will by necessity drain through artificial infrastructure within the existing urban area of Basingstoke. The artificial infrastructure has a finite capacity and the characteristic of this area means that it will be difficult to mitigate for climate change rainfall patterns or design for exceedance without impacting on the existing urban area. The existing drainage infrastructure could potentially be upgraded to allow for the impacts of climate change to be mitigated.



However, current uncertainty around climate change rainfall patterns means that these impacts cannot be accurately modelled and hence an accurate feasibility and cost benefit analysis could not be carried out. Our recommended approach to facilitate climate change adaptability is to ensure that surface water drainage is managed above ground and that major drainage routes are above ground and not directed through artificial below ground infrastructure.

For the remaining sites to the north of Basingstoke, major site drainage may not need to drain via existing artificial infrastructure and there are hence increased opportunities for mitigating impact of changing rainfall patterns on site.

8.3.5 *Impact on biodiversity*

Within this area there are a number of sites identified BAP priority habitat which may be at risk from the physical impacts of development. Figure 8-1 shows the location of the BAP sites.

8.4 ***Area 6: East of Central Basingstoke***

The east of Basingstoke area comprises the following sites within the draft SHLAA; BAS024, BAS101 and BAS128.

8.4.1 *Flood risk and Sustainable Drainage*

The site tested in Area 6 fall almost entirely within area of higher flood risk. Detailed modelling of the River Loddon and its floodplain has not been undertaken in this location, and the extent of the flood plain and reliability of the flood zones is uncertain. The Strategic Flood Risk Assessment (unpublished) recommends that in such cases, Flood zone 2 be treated as flood zone 3a, and flood zone 3 a be treated as an extension to flood zone 3b. As per PPS25, the sequential test should be applied before considering allocation of development in this location. If, having applied the sequential test, it is not possible for the development to be located in zones of lower probability of flooding, the Exception test can be applied. The Exception test is only appropriate for use when there are large areas of Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons. If the exception test is applied consideration will need to be given to the types of land use allowed within the areas of land in flood zone 2 and 3, based on the land use compatibility table within PPS25, to ensure that that the most vulnerable uses are not located within the highest risk areas.

The natural role of surface drainage in this area is to recharge the chalk aquifer, which supports flow in both the Loddon and test catchments. This area has a very low Standard Percentage Runoff (SPR), leading to very low greenfield or undeveloped runoff rates. Should this site be developed, it is unlikely to be possible to infiltrate all the runoff



generated back into the soil, therefore additional runoff from this site will be generated compared to the greenfield situation. Storage volumes will therefore be relatively high in order to ensure that the runoff rates are managed. We estimate that the storage requirements for this area will be approximately 428m³/ha of developed area. Infiltration drainage techniques should therefore be mandatory in this area and the area of impermeable surface created by development minimised as far as practicably possible. Any development within the site will need a drainage masterplan or strategy to show that the any new runoff created by development does not have an impact on the downstream surface water or river system. Additional storage volume may be needed beyond that required just for hydraulic control in order to provide treatment of water to improve water quality, before it is discharged into the ground.

Sites BAS024, 101 and 128 within the draft SHLAA, are considered to be at risk of groundwater flooding, from high groundwater levels in the chalk aquifer. This area of land is located within the floodplain of a groundwater fed river and ground levels, even outside in the floodplain, are below those at which groundwater flooding has occurred locally in the past. This area is at high risk from both fluvial and groundwater flooding, and in accordance with PPS25 development should be steered away from such higher risk areas, unless there are no alternative suitable sites.

8.4.2 *Sewerage infrastructure requirements*

The sewerage modelling and infrastructure assessment indicated that there are unlikely to be issues with sewerage capacity serving this location.

8.4.3 *Climate change adaptability for surface water management*

Surface water drainage from this area will not need to drain through existing below ground surface water drainage infrastructure, therefore is at low risk of causing downstream surface water flooding under climate change rainfall scenarios. With good surface water management masterplanning, this site offers good opportunities for ensuring exceedance flow is managed above ground, and for ensuring surface water management structures are climate change adaptable.

8.4.4 *Impact on biodiversity*

The River Loddon Corridor is of significant importance to nature conservation. There are a number of different types of priority habitat as shown in Figure 8-1. Poorly planned and controlled development can have a significant impact on the biodiversity and ecology of these sites and of the biodiversity and ecology of the River Loddon corridor in general. However, there may also be opportunities for improving the quality of the priorities sites by improved management of the sites and protection of the green infrastructure and ecological links between sites.



8.5

Area 7: East of Basingstoke

The east of Basingstoke area comprises the following sites within the draft SHLAA; BAS121, BAS102, BAS103.

Flood risk and Sustainable Drainage

The sites tested in Area 7 fall partly within an area of higher flood risk. Detailed modelling of the River Loddon and its floodplain has not been undertaken in this location, and the extent of the flood plain and reliability of the flood zones is uncertain. The Strategic Flood Risk Assessment (unpublished) recommends that in such cases, Flood zone 2 be treated as flood zone 3a, and flood zone 3 a be treated as an extension to flood zone 3b. As per PPS25, the sequential test should be applied before considering allocation of development in this location. If, having applied the sequential test, it is not possible for the development to be located in zones of lower probability of flooding, the Exception test can be applied. The Exception test is only appropriate for use when there are large areas of Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons. If the exception test is applied consideration will need to be given to the types of land use allowed within the areas of land in flood zone 2 and 3, based on the land use compatibility table within PPS25, to ensure that that the most vulnerable uses are not located within the highest risk areas.

Sites BAS121, 102 and 103 have a fairly high Standard Percentage Runoff and therefore runoff rates are already high. Therefore, in order to maintain the greenfield runoff rates storage requirements are relatively low, at 284 m³/ha of developed area. The effectiveness of infiltration in this area will be limited as a result of the geology. The sites naturally drain into the River Loddon catchment and development in this area will need attenuation storage provided on site and outside of the existing floodplain. Although a substantial proportion of the total area of these sites falls within flood zone 3, the area assessed is large, and subject to strong planning policy, it should be possible to keep any development well clear of the floodplain.

8.5.1

Sewerage infrastructure requirements

Development to the east of Basingstoke could drain directly to the Basingstoke sewage treatment works at Chineham, and will not therefore require significant sewerage reinforcements within the existing urban area to prevent the risk of foul flooding.

8.5.2

Attenuation opportunities to compensate for flood risk from additional Sewage Treatment Works Discharge

Sites BAS102 and 103, are in close proximity to both the sewage treatment works and the watercourse. The sites therefore provide the opportunity to provide attenuation storage



for additional foul effluent discharge from the sewage treatment works to prevent an increase in downstream flood risk.

8.5.3

Climate change adaptability for surface water management

Surface water drainage from this area will not need to drain through existing below ground surface water drainage infrastructure, therefore is at low risk of causing downstream surface water flooding under climate change rainfall scenarios. With good surface water management masterplanning, this site offers good opportunities for ensuring exceedance flow is managed above ground, and for ensuring surface water management structures are climate change adaptable.

8.5.4

Impact on biodiversity

The River Loddon Corridor is of significant importance to nature conservation. There are a number of different types of priority habitat as shown in Figure 8-1. Poorly planned and controlled development can have a significant impact on the biodiversity and ecology of these sites and of the biodiversity and ecology of the River Loddon corridor in general. However, there may also be opportunities for improving the quality of the priorities sites by improved management of the sites and protection of the green infrastructure and ecological links between sites.

8.6

Summary of strategic risk and opportunity testing

Each of the areas assessed through this section have different water cycle opportunities and risks that need to be managed through the development plan process. Chapter 9 discusses proposed planning policy themes that need to be developed further through the core strategy consultation process to ensure that the risks identified here can be mitigated, and the opportunities achieved. The ongoing engagement of the Environment Agency, Natural England and the water companies in the development of these policies, and through the entire spatial planning process, is essential to ensure that the policies are robust, but also the policies and spatial planning decisions are flexible to improved understanding or new data.

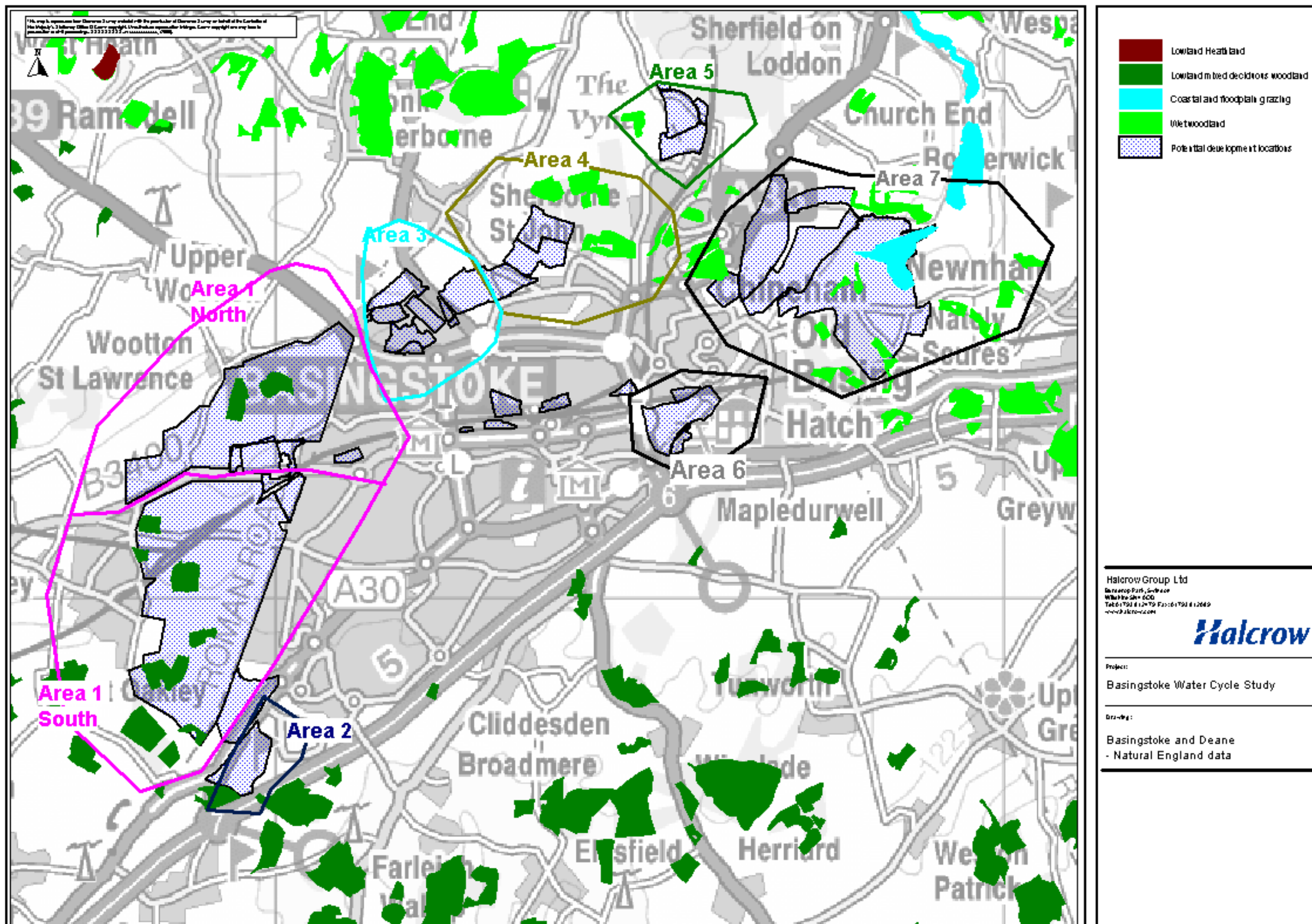


Figure 8-1 Location of BAP sites

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Project:
 Basingstoke Water Cycle Study

Drawn by:
 Basingstoke and Deane
 - Natural England data

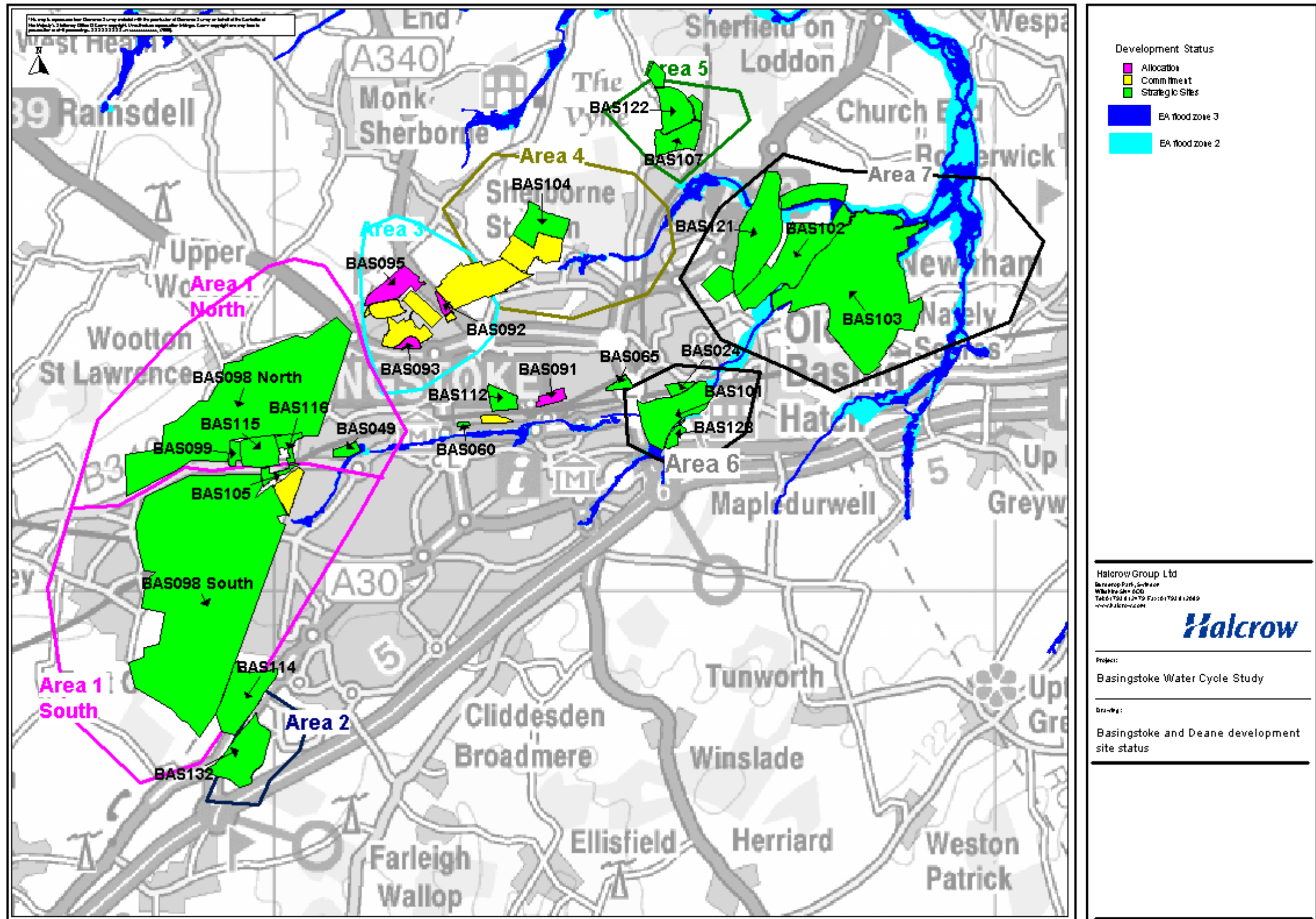


Figure 8-2 Potential development locations assessed by this study



9 Conclusions & policy recommendations

9.1

Conclusions

The WCS set out to:

- show how infrastructure can be put in place alongside the development, rather than afterwards;
- assess design standards for sustainable drainage;
- build on work undertaken in the SFRA, and;
- undertake a detailed ecology and water quality modelling assessment.

The WCS has identified that the Rer Loddon catchment is already failing to meet good status, as required under the WFD, and that achieving good status by 2027 is a significant challenge with respect to one pollutant, orthophosphate. Furthermore the evidence shows that achieving good status cannot be done by controlling diffuse pollution; rather it can only be achieved through tightening discharges from sewage effluent beyond currently accepted best available technology.

The study has confirmed even without further development, expensive and energy intensive novel sewage treatment processes with uncertain and unproven efficacy will be needed to meet the required standards. However, the phosphate compliance issue in the River Loddon is typical of many waterbodies in the Thames River Basin. The requirement for novel treatment techniques to achieve good ecological status should be investigated further through the river basin management planning process, to ensure that any pilot studies and any investment is focussed on priority locations and where risk can be managed.

The WCS has principally assessed whether growth would cause deterioration of the current water quality and ecology in the River Loddon catchment. The water quality assessment has concluded that the change in pollutant load due to population growth is unlikely to put significant additional stress on achieving good status, and none of the growth scenarios examined would cause a deterioration in



WFD physicochemical class²⁴. The study has identified a small, but unquantifiable risk that minor deterioration in phosphate levels due to growth may cause a deterioration in diatom quality and lead to a subsequent deterioration in biological classification. Despite the extensive survey and modelling work undertaken over the last three years, it is impossible to quantify this risk with modelling, and an ongoing risk assessment and monitoring procedure is recommended to manage this risk. Based on this assessment, the WCS has shown that planned growth of between 14,800 and 18,900 dwellings can be accommodated without causing significant additional pressure on Water Framework Directive status, but that there are residual risks that need to be managed through the planning process.

To manage the residual risks we recommend ongoing ecological surveys to monitor the impact of the development over time and create a long term (10-year) record to allow correlation of ecology, water quality and hydrology. Annual surveys for macrophytes (Mean Trophic Rank, Mean Flow Rank and Loddon Pondweed), aquatic macroinvertebrates (BMWP, ASPT and LIFE (F)) and diatoms are recommended.

Water resources are not considered to be a critical issue for growth. However, the region is water stressed, and firm implementation of the water efficiency standards in the Code for Sustainable Homes through the B&DBC Design and Sustainability Supplementary Planning Document (SPD) is essential to manage demand on the water environment. The project partners expect to see strong implementation of a 105l/hd/day whole homes standards in new homes, equivalent to the Code for Sustainable homes Code level 3 and 4. Consideration should be given to supporting retrofit measures in the existing urban area. The water efficiency scenarios testing has shown that moderate reductions in demand from the existing urban area can help Basingstoke move towards water neutrality. The implementation of increased water efficiency standards not only benefit environmental water resources but can have positive cost implications, both carbon and financial. Reductions in water demand equate to reductions in energy requirements and therefore carbon emissions, and may reduce the need for additional or upgraded infrastructure.

²⁴ There may be deterioration in numerical water quality, but there will not be deterioration of class



This study has shown that there is planned infrastructure capacity in Basingstoke for planned allocations and commitments up until 2016, and that strategic water services infrastructure has been assessed up to 2021.

The assessment of urban drainage and flood risk has built on the findings of the SFRA, and has identified key constraints and requirements for the proposed development options.

The principal existing groundwater and fluvial flood risk issues in the catchment lie to the east of Basingstoke, and if any development is to be allocated in areas of higher flood risk, robust evidence of sequential testing will be needed before allocations can be confirmed. The approach to managing uncertainty in flood zone boundaries, climate change impacts and sequential testing and exception testing is set out in PPS25 and the Strategic Flood Risk Assessment for Basingstoke.

To the east of Basingstoke (area 7) development may be able to be located away from Flood Zone 3, but in area 6 residential development is not recommended due to the combination of groundwater and fluvial flood risk.

Development to the west is constrained by existing capacity issues in the foul network in this part of the catchment. Additional infrastructure could be provided to remove this constraint but this would require planning and agreement of funding which is not yet in place. Any allocation in this area will need a detailed sewerage capacity assessment by Thames Water as a matter of urgency to confirm if sewerage infrastructure can feasibly be provided. In the north-west there is capacity in the foul network due to the construction of additional sewerage capacity in the area.

In the west and north-west, because the current infiltration regime is high, it will be difficult to maintain greenfield rate and volume from the site; this could lead to increases in runoff rate and volume to the culverted section of the Loddon, with a corresponding potential impact on surface water flood risk upstream of the culvert. Furthermore development West of Basingstoke will also probably lead to a reduction in groundwater recharge to aquifer, even with excellent implementation of the SUDS train. This will impact on the available developable land within these areas. It is recommended that a strategic approach to surface water drainage is adopted, which will help to address some of the drainage concerns.



If good design standards are implemented for surface water drainage and demand management measures proposed in the Design and Sustainability SPD enforced, this study considers it unlikely that development will cause a deterioration of the ecological status of the River Loddon. The requirement to provide attenuation to manage surface water runoff provides an opportunity to create new wetland habitat as part of the development, and mitigate for any loss of habitat as part of the development if not provide additional habitat.

A strategic environmental assessment of the impacts on designated sites of biodiversity importance and BAP habitats is being undertaken by the council's biodiversity officers. Therefore, the risk to priority BAP habitat from impacts other than water quality and changes in hydrological regime will be assessed through this process. Site specific policies for ecological and biodiversity protection, such as policies to protect and enhance the river corridor and minimise habitat fragmentation will be developed if these sites are included within a Local Development Framework allocation policy.

9.2

Policy theme recommendations

The following policy themes are suggestions based upon the findings of this report and as expressed by the WCS partners, for consideration in the development of the Core Strategy. It is recommended that the partnerships developed through the water cycle study process are continued through the ongoing development of the LDF to further explore these themes and identify clear planning policies that meet the requirements of the themes.

9.2.1

Implementation of a monitoring programme

Whilst growth is not predicted to cause significant additional stress on the ecology and water quality of the Loddon it is recommended that an ongoing monitoring programme is established, which will provide an early warning of any changes to water quality or ecology due to growth. The cause and effect of turbidity in some parts of the river needs to be examined as part of the monitoring programme. Given the sensitivity of the River Loddon catchment, it is recommended that a riverine ecological monitoring plan is agreed between the Environment Agency, Natural England and Basingstoke and Deane Borough Council. The monitoring programme should complement rather than replace the Environment Agency's routine biological monitoring programme.



9.2.2

Phasing of development & intervention mechanism

It is recommended that the housing trajectory is loaded towards the end of the plan period. This will allow time for the first review of the River Basin Management Plan in 2016, which is likely to have reviewed the technical feasibility and cost implications of achieving Good Ecological Status for phosphate across the whole Thames River Basin. It is further recommended that a policy allowing for review of the annual and total housing allocation be included in the Core Strategy should the monitoring programme proposed above identify ecological deterioration due to development.

9.2.3

Biodiversity protection and enhancement

If strategic allocations are made in Area 7, site specific design standards will need to be developed to protect and enhance ecological and biodiversity features in and adjacent to the Loddon and Lyde headwaters and river corridors. In order to achieve ecological opportunities in this area, the delivery of an Area Action Plan should be considered to promote water cycle and biodiversity enhancement through masterplanning. Consideration should be given to extend the policy extent beyond Area 7 boundaries, and should ensure that green infrastructure and habitat creation policy is in place to enhance biodiversity and ecology. This can only be achieved through ongoing partnership and agreement between the relevant organisations, which must include the Environment Agency, Natural England and B&DBC.

The council is currently revising its landscape and biodiversity strategy and will be including a strategic objective of seeking to enhance habitat along the upper reaches of the R. Loddon. This will include improvements to land that the council owns and, in addition, the council will seek to work in partnership with private land owners, the Hampshire and Isle of Wight Wildlife Trust, the Environment Agency, Natural England and other organisations to enhance the wetland biodiversity of private land within this area. To help deliver this objective, the council will integrate it into the green infrastructure elements of its Local Development Framework, including a Core Strategy green infrastructure policy and any relevant Supplementary Planning Documents and Area Action Plans.

9.2.4

Implementation of SPD on design and sustainability

Water resources are not a key constraint to development, and the WCS has shown there is sufficient water to meet additional demand due to growth. However, as the region is water stressed, stronger policies which relate to water efficiency measures would minimise the environmental impact of development, reduce the carbon cost



of treating and conveying clean water and sewage, and potentially offset the need for new infrastructure. Water efficiency measures, such as rainwater harvesting or greywater recycling, can help to reduce surface water runoff from a site, which can help to meet the requirements of surface water drainage and reducing flood risk due to development. The Code for Sustainable homes levels for water efficiency do not fall within the mandatory standards therefore without additional local policy, it is possible that new developments may not be designed to be water efficient. However, the B&DBC SPD on Design and Sustainability ensures that all developments will need to comply with the Code for Sustainable Homes level 3, a whole home efficiency standard of 105l/hd/d, and it is essential that this is rigorously enforced through the planning process.

Flood risk and surface water management

Given the concerns over surface water drainage in the development sites to the west of Basingstoke it is recommended that surface water masterplanning is undertaken for major allocations. Where strategic allocations are made in the Core Strategy, it is recommended that a policy requiring site specific water cycle masterplanning is specified. This policy should require a strategic assessment of site hydrology, surface water pathways, related ecology, and existing infrastructure.

The CFMP policy advice states

“To gain a more complete understanding of surface water and drainage related flooding so that any future improvements are part of a wider strategy for addressing these sources of flooding. A Surface Water Management Plan (SWMP) or Integrated Urban Drainage Plan (IUDP) could define the future approach. This is important in this policy unit because of both the existing and future risk.”

No connection to an existing surface water system should be permitted unless the operating authority can confirm that connection will not increase the risk of flooding, either to other properties connected to the drainage system or to properties downstream of the systems outfall. This is backed up by the SFRA policy suggestion, which is supported by this WCS:



'No development will be allowed unless it is demonstrated that: a) dry access and egress is provided b) the receiving watercourse has sufficient capacity and c) flood risk is reduced where possible, or at least not increased, in the development and in surrounding areas'

9.2.5

Water services infrastructure

The water cycle study has advised where water service infrastructure capacity may be limited, and has assessed the sustainability of providing water services infrastructure alongside environmental requirements. However, it is not possible to identify detailed infrastructure requirements until allocations are made. Therefore it is essential that the core strategy includes policies to ensure that water services infrastructure is provided before dwellings are occupied. Thames Water have proposed the following policy which is supported by this water cycle study:

Planning permission will only be granted for developments which increase the demand for off-site service infrastructure where:

- **sufficient capacity already exists or**
- **extra capacity can be provided in time to serve the development which will ensure that the environment and the amenities of local residents are not adversely affected.**

When there is a capacity problem and improvements in off-site infrastructure are not programmed, planning permission will only be granted where the developer funds appropriate improvements which will be completed prior to occupation of the development.

9.2.6

Development near to a sewage treatment works

Sewage treatment works can cause an odour nuisance. If strategic allocations are to be made in Area 7, we consider that a technical assessment should be undertaken by the Council / Developer to inform the detailed allocation of this land and to confirm that there is no adverse amenity effect on any proposed occupied use anticipated to take place therein.

Where impacts are identified these should be outlined along with potential approaches to mitigate such impacts that will be expected to be considered and implemented by the developers of the site.



Where a planning application for development at this is submitted, Thames Water may also request that the developer demonstrates that:-

- a) there will be no adverse amenity effect on the proposed occupied use, or,
- b) measures will be put in place before the development is occupied to mitigate the adverse effect. Such measures may be provided by Thames Water if we are funded for such measures, or if not, funding in full will have to be provided by the developer

