# Bedford Borough and Mid Beds District
# Outline Water Cycle Strategy
May 2009
FINAL REPORT

Renaissance Bedford

Bedfordshire county council

Bedford Borough Council

Mid Beds District Council

IDB Bedford Group

Natural England

Government Office for the East of England

Environment Agency

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# Outline Water Cycle Strategy
# Final Report
# May 2009

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# Bedford Borough and Mid Beds District Outline Water Cycle Strategy

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# 1 Executive Summary

1.1.1 A Water Cycle Strategy (WCS) is usually undertaken in three stages, an outline, a detailed and an implementation stage. The outline WCS assesses the strategic water services infrastructure needed to support development. The detailed stage assesses the site specific infrastructure requirements. The implementation stage focuses upon stakeholder coordination and the delivery of the required infrastructure. In some locations the outline WCS is preceded by a water cycle scoping study. This outline WCS report follows a scoping study which was produced by Halcrow in June 2008.

1.1.2 Halcrow and Hannah Reed Associates were commissioned by Renaissance Bedford to prepare this outline WCS for Bedford Borough and Mid Beds District. The primary purpose of the outline WCS is to assess the effect of the planned growth (as identified in the Local Development Frameworks (2021 for Bedford Borough and 2026 for Mid Beds) upon water supply, water resources, wastewater collection and treatment, surface water management, flood risk and the ecological interaction of all of these elements. In addition, the Strategy considers the implications of the proposed Marston Vale eco-town. During the stakeholder review of this document, a proposal for the eco-town was withdrawn by the developer O&H. The information regarding the impact of the eco-town upon the WCS remains included within in Section 9 for information purposes and will provide context for the allocation of future development sites and consideration of current and future planning applications.

1.1.3 The project is managed by Renaissance Bedford in partnership with key stakeholders Bedford Borough Council, Mid Beds District Council, Bedfordshire County Council, Anglian Water, the Environment Agency, the Bedford Group of Drainage Boards, Natural England and the Government Office for the East of England. This group of key stakeholders set out the objectives for the strategy.

1.1.4 This approach of formulating a group of key stakeholders to develop project objectives and define the relevant parameters within which to develop the strategic direction for the study area is in accordance with Policy WAT2, reproduced below, of the East of England Plan.

> **Policy WAT 2: Water Resource and Waste Water Infrastructure Development**
>
> The Environment Agency and water companies should work with….local authorities, delivery agencies and others to ensure timely provision of the appropriate additional infrastructure for both water supply and waste water treatment to cater for the levels of development provided through this plan, whilst meeting agreed surface and ground water standards.
>
> A co-ordinated approach to plan making should be developed through a programme of water cycle studies to address water supply, water quality, wastewater treatment and flood risk issues in receiving water courses relating to development proposed in this RSS.
>
> East of England Plan, May 2008

1.1.5 The key areas investigated within this outline WCS are flood risk management, sustainable drainage systems and surface water management, wastewater and water quality, water resources and water supply and ecological constraints and opportunities.

Flood Risk Management

1.1.6 The majority of the proposed flood risk mitigation measures around Bedford and the Marston Vale are in alignment with the Marston Vale Surface Waters Plan and provide

betterment to the catchment. The Bedford Group of Internal Drainage Boards has indicated that it will consider the adoption of any scheme that contributes towards the principles of the Marston Vale Surface Waters Plan. For the planned levels of development in Mid Beds, this WCS identifies the amounts of storage that would be required to prevent increases in flood risk downstream of new development. An assessment of the increased flows and volumes from wastewater treatment works has been provided. No clear precedent has been set for this issue and further discussion is required between all stakeholders within the detailed WCS, to agree whether mitigation is required for any or all of the affected sites.

Sustainable Drainage Systems and Surface Water Management

1.1.7 This report provides an introduction to sustainable drainage systems (SUDS) and explains how they can be used for surface water management. A summary of the geology for the study area is also provided in order to assess the suitability of SUDS within Bedford Borough and Mid Beds. The majority of Bromham and Southern Clapham are located within the Outer Source Protection Zone as defined by the Environment Agency which may mean that any proposed development may be restricted in the use of infiltration drainage methods.

1.1.8 Currently, no standard framework exists for the adoption and maintenance of SUDS infrastructure, however the DEFRA publication 'Making Space for Water' (2004) advises a long term adoption strategy is crucial for the success of SUDS measures. This implies the involvement of "durable, accountable organisations that can be expected to have the financial capacity to meet their responsibilities in the longer term". Responses to the Government's consultation on 'Surface Water Drainage' identified that Internal Drainage Boards, County and District Councils each have a significant interest in the adoption and maintenance of SUDS. The Government's response to Recommendation 20 of the final Pitt Review report, published in December 2008, proposed that County and Unitary Authorities, as part of their overall responsibility for local flood risk management, should take formal responsibility for adoption to ensure that effective funding and maintenance arrangements are put in place for adopted SUDS. Full proposals on SUDS arrangements should be addressed in the Government's draft Floods and Water Bill due for publication in Spring 2009. A review of potential adoption measures is included within this strategy.

Wastewater and Water Quality

1.1.9 The existing major wastewater treatment works (WwTW), Bedford WwTW will require upgrades to treat flows from the planned growth in the area. The extent of the capital programme available to Anglian Water Services Ltd (AWS) for the region is dependent upon Ofwat determination based on the AMP5 business plan currently being finalised by AWS. The AMP5 programme covers expenditure for the period 2010-2015. AWS is aware of the urgency of the situation and Bedford WwTW growth is a key scheme in the AWS business plan for AMP 5.

1.1.10 There is limited treatment capacity available in the Marston Vale to accommodate development. The short term strategy is to remove the operational constraints at Marston Moretaine WwTW. Further investigation will be required before a preferred wastewater strategy for the Marston Vale can be agreed. The potential for a new treatment works in the Marston Vale could be limited by water quality constraints and will depend upon the water quality scenarios enforced by the Environment Agency. If the WwTW outfalls into an watercourse within the IDB's district, then consent under the Land Drainage Act is also required from the IDB, an issue that will be addressed within the detailed study.

1.1.11 The Bedford sewer network has capacity for the planned urban extensions to Bedford. Further investigation is required to determine a long term wastewater treatment strategy for the Marston Vale. Depending on the finalised locations for growth within Mid Beds and the

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extent of development at each location, sewer network upgrades and possibly upgrades to treatment works will be required within the LDF period.

Water Resources and Water Supply

1.1.12 Implementing the water efficiency measures contained within the East of England Plan (25% reduction in new homes and 8% reduction in existing homes) will not be sufficient to achieve 'water neutrality'[1] across the study area. Additional water efficiency measures have to be considered to meet water neutrality, including raising customer awareness. The potential to achieve Water neutrality could also be considered at the Water Resource Zone level, which is be beyond the scope of this study, but should be considered within the detailed study

1.1.13 AWS has identified the water resource and supply upgrades required in Bedford, with local and regional Water Treatment Works (WTW) as the source of supply. There is a major ongoing scheme to increase the capacity of the regional WTW in Rutland and provide strategic mains in order to accommodate anticipated growth in the area until 2021. In Mid Beds, local water supply network improvements will be required to serve growth in the Stotfold and Arlesey area. The Cranfield and Marston Moretaine area is currently fed from a local groundwater source at Birchmoor however additional resource to meet growth will come from the regional WTW south-west of Huntingdon (taken off the trunk main system to Milton Keynes), requiring water supply network improvements.

Ecological Constraints and Opportunities

1.1.14 The potential risks, constraints and opportunities concerning water and wetland features have been identified. Where these are identified as part of the proposed development areas, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the mitigation of identified risks can be incorporated into the detailed design of the developments and green infrastructure.

Summary

1.1.15 A summary of the strategic water services infrastructure improvements as identified in this outline WCS is shown in the infrastructure timeline below (Figure 1.1). Table 1.1 lists the actions required by the WCS stakeholders to help ensure that the water related infrastructure identified on the infrastructure timeline is provided in association with development. A developer checklist is included within the appendices which should be used when reviewing planning applications to ensure compliance with the principles of this WCS.

[1] Water neutrality is the concept where the total water used after a new development is no more than the total used before the development. This definition is derived from the Water Neutrality High Level guidance fact sheet – Environment Agency.

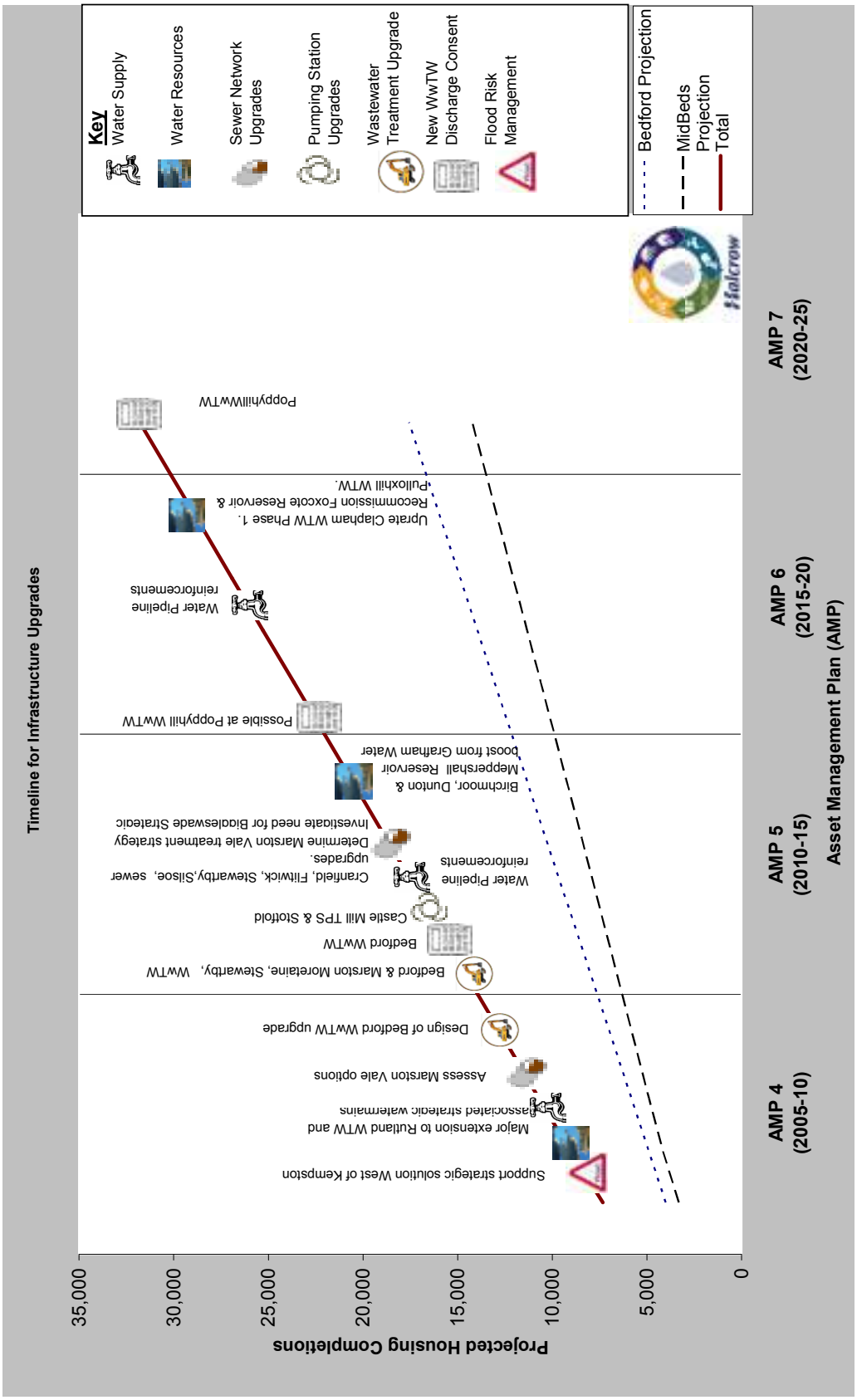


**Figure 1.1: Infrastructure Timeline**

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| Item | Action | Stakeholders responsible | Timeline* |
|---|---|---|---|
| 1 | Support the strategic flood risk management solution to West of Kempston | EA, developer, LPA and AWS | **AMP4 (2005-10)** |
| 2 | Major upgrade to Rutland WwTW and associated water main reinforcements | AWS & developer | |
| 3 | Assess Marston Vale sewer options | AWS, EA and LPA | |
| 4 | Design of Bedford WwTW upgrade | AWS | |
| | | | |
| 5 | Upgrade Bedford WwTW | AWS | **AMP5 (2010-15)** |
| 6 | Revise Bedford WwTW discharge consent. | EA | |
| | Review WwTW flow data at Marston Moretaine, Clifton, Sandy, Clophill and Potton. | | |
| 7 | Determine Marston Vale treatment options | AWS, EA, LPA & developer | |
| 8 | Upgrade Marston Moretaine WwTW | AWS | |
| 9 | Upgrade Castle Mill foul Terminal Pumping Station | AWS | |
| 10 | Investigate Stotfold foul Pumping Station upgrade | AWS | |
| 11 | Water pipeline reinforcements | AWS & developer | |
| 12 | Cranfield, Flitwick and Stewartby sewer upgrades | AWS & developer | |
| 13 | Upgrade and boost Birchmoor reservoir capacity from Grafham Water | AWS | |
| 14 | Upgrade and boost Dunton reservoir capacity from Grafham Water | AWS | |
| 15 | Upgrade and boost Meppershall reservoir capacity from Grafham Water | AWS | |
| | | | |
| 16 | Potential to revise discharge consent at Poppyhill WwTW | AWS & EA | **AMP6 (2015-20)** |
| 17 | Upgrade Poppyhill WwTW | AWS | |
| 18 | Water pipeline reinforcements | AWS | |
| 19 | Uprate Bedford Ouse WTW | AWS | |
| 20 | Recommission Foxcote reservoir | AWS | |
| 21 | Recommission Pulloxhill WTW | AWS | |

**Table 1.1: Stakeholder action timeline to address the infrastructure timeline**

*It should be noted that the timescales given for schemes is indicative and dependant on the timing of development.

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# 2 Introduction

## *2.1 Context*

2.1.1 The Deputy Prime Minister launched the Sustainable Communities Plan (Sustainable Communities: Building for the future) on 5 February 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in the South East, low demand in other parts of the country, and the quality of our public spaces. The Plan includes not just a significant increase in resources and major reforms of housing and planning, but a new approach to how we build and what we build.

2.1.2 The Government has promoted substantial increases in jobs and housing numbers in the Growth Areas of Southern and Eastern England. Increases in population and employment will intensify pressures on limited water resources in parts of the country where the water dependant environment is under stress.

2.1.3 The ongoing impacts of climate change will increasingly be experienced in terms of wetter winters, drier summers and more intense rainfall events. This will have an effect on the water resources, flood intensity, ecology and the infrastructure associated with water and wastewater. It is against this background that sustainability issues are considered and acted upon when making proposals for future developments and to enable sustainable homes to be built considering the ongoing effects of climate change.

2.1.4 Water services infrastructure requirements need to be included in development plans. If the water services infrastructure is not considered in line with other infrastructure requirements this may result in slower growth and/or environmental damage and impact on water quality if wastewater treatment systems are overlooked. This ensures that water related policy and recommendations as set out in the Regional Spatial Strategy (the East of England Plan) are considered during the preparation of the Local Development Frameworks (LDFs) by local authorities. It also provides the required evidence base to demonstrate that water issues have been considered in the strategic planning process.

2.1.5 In addition to the development planned within the LDF, there is potential for an eco-town in the Marston Vale. During the stakeholder review of this document, a proposal for the eco-town was withdrawn by the developer O&H. The information regarding the impact of the eco-town upon the WCS remains included within in Section 9 for information purposes.

## *2.2 A WCS for Bedford Borough and Mid Beds District*

2.2.1 A WCS is usually undertaken in three stages, an outline, a detailed and an implementation stage. An outline WCS assesses the strategic water services infrastructure needed to support development. The detailed stage assesses the site specific infrastructure requirements. The implementation stage focuses upon stakeholder coordination and the delivery of the required infrastructure. In some locations the outline WCS is preceded by a water cycle scoping study.

2.2.2 Halcrow was commissioned to prepare the outline WCS for Bedford Borough and Mid Beds District (Figure 2.1) which was preceded by the WCS Scoping Study (June 2008). The detailed WCS will address the issues that are raised within this outline WCS and provide additional detail to support site specific development proposals.

2.2.3 The primary purpose of the outline WCS is to assess the effect of the planned growth (as identified in the Local Development Frameworks (2021 for Bedford Borough and 2026 for Mid Beds) upon water supply, water resources, wastewater collection and treatment, surface

water management, flood risk mitigation and the ecological interaction of all of these elements. In addition, the Strategy will consider the implications of the proposed Marston Vale eco-town. This information will provide a context for the allocation of future development sites and the consideration of current and future planning applications.

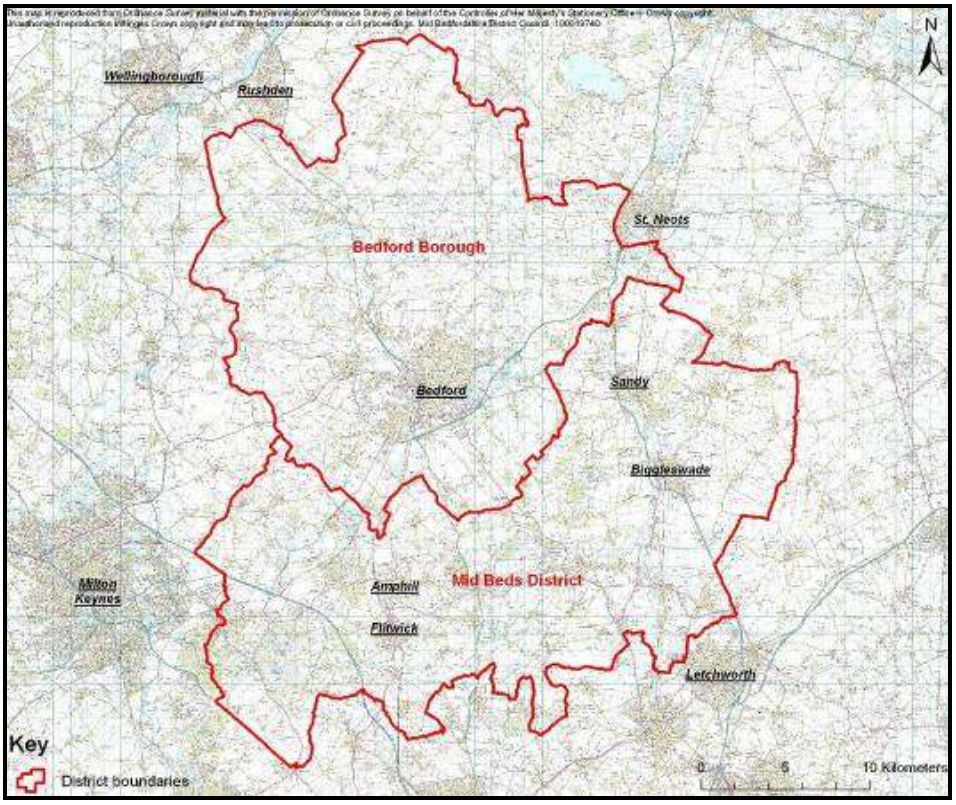


**Figure 2.1: The study area for this WCS**

2.2.4 The outline WCS comprises a high level constraints assessment to determine whether the existing water services infrastructure has sufficient capacity to support the development identified in the Local Development Frameworks. It addresses;

- whether environmental resources can cope with the development planned in the Local Development Frameworks ;
- whether this development would overload the existing water services infrastructure;
- any additional water services infrastructure required to enable this development;
- where there is capacity within the existing and planned water services infrastructure for new development to meet the regional development targets;
- the impacts of the study area water cycle on neighbouring areas, and their effect on this study area; and
- the evidence base for both local authority Local Development Frameworks.

## *2.3 Study partners*

2.3.1 The project is managed by Renaissance Bedford in partnership with key stakeholders: Bedford Borough Council, Mid Beds District Council, Bedfordshire County Council, Anglian Water, the Environment Agency, the Bedford Group of Drainage Boards, Natural

England and the Government Office for the East of England. This group of stakeholders set out the objectives of the strategy.

2.3.2 This approach of formulating a group of key stakeholders to develop project objectives and define the relevant parameters within which to develop the strategic direction for the study area is in accordance with Policy WAT2, reproduced below, of the East of England Plan.

> **Policy WAT 2: Water Resource and Waste Water Infrastructure Development**
>
> The Environment Agency and water companies should work with….local authorities, delivery agencies and others to ensure timely provision of the appropriate additional infrastructure for both water supply and waste water treatment to cater for the levels of development provided through this plan, whilst meeting agreed surface and ground water standards.
>
> A co-ordinated approach to plan making should be developed through a programme of water cycle studies to address water supply, water quality, wastewater treatment and flood risk issues in receiving water courses relating to development proposed in this RSS.
>
> East of England Plan, May 2008

## *2.4 WCS Objectives*

2.4.1 The objectives set by the study partners for the outline WCS are:

- to ensure development occurs in the most sustainable location in terms of water infrastructure issues taking due account of risk;
- to consider the impacts of climate change upon the water cycle;
- to identify ecological constraints and opportunities;
- to ensure environmental and water services infrastructure constraints do not compromise development;
- to identify opportunities for more sustainable or multi-use water services infrastructure options; and
- to ensure compliance with relevant legislation, e.g. the Water Framework Directive.

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# 3 Planning Policy and development

## *3.1 Introduction*

3.1.1 This section presents a review of the key planning and economic development policies at national, regional and local levels. Where appropriate we identify where these policies make specific reference to water infrastructure and water issues. These policy documents provide the framework which will shape future growth patterns. In turn the WCS will form an important part of the evidence base for the Local Development Frameworks, so this section also identifies major development areas and their planning status. It is important to understand the spatial distribution of future growth in housing, employment, social/community facilities and other development in order to ensure that water infrastructure is provided in a timely manner and to ensure there is no damage to the water environment.

3.1.2 The Bedfordshire Sub-Area comprises the south-eastern part of the Milton Keynes/South Midlands Sub Region (Refer to Appendix A). Bedfordshire is a focus for regional and sub-regional growth and Bedford and Mid Beds have a key role to play. Particular emphasis has been placed on the Bedford/Kempston/Northern Marston Vale and Milton Keynes Growth Areas to deliver a step change in housing delivery and in the local economy. Bedford Borough Council (See Figure B in Appendix A) and Mid Beds District Council are responsible for the delivery and monitoring of housing and employment in Bedfordshire. Both councils make decisions on planning applications in their designated area and are jointly responsible for the integration of plans for northern Marston Vale.

3.1.3 Renaissance Bedford was established in June 2005 as the Local Delivery Vehicle for the Bedford and Northern Marston Vale Growth Area. This Growth Area crosses the Bedford Borough and Mid Beds District boundaries. Renaissance Bedford is tasked with assisting the Councils with the delivery of 19,500 dwellings, 19,800 jobs and the infrastructure required to support and sustain development in the Growth Area.

3.1.4 Detailed housing trajectories and data on present and future planning applications have been supplied by the Study Partners. For employment purposes, data from Annual Monitoring Reports 2006-2007 and information supplied by the Study Partners has been used.

## *3.2 Planning Context of the WCS*

3.2.1 The UK has a comprehensive hierarchy of planning and economic policies, beginning with national guidance which provides a broad framework for regional plans and strategies through to local development plans and policies. The Government is currently implementing reforms to the planning system as outlined in the *Planning and Compulsory Purchase Act 2004* with Planning Policy Statements (PPS) replacing Planning Policy Guidance (PPG), Regional Spatial Strategies (RSS) replacing Regional Planning Guidance (RPG) and Local Development Frameworks (LDF) replacing Structure and Local Plans and Unitary Development Plans (UDPs). In addition, within the area, there are numerous water related strategies, such as the Surface Waters Plan, which have significant implications for the study area and which will also influence and shape the proposed project. These strategies are referenced where appropriate throughout this document

## *3.3 National Context*

Sustainable Communities Plan, Communities and Local Government (2003)

3.3.1 The Government's Sustainable Communities Plan is a long term national programme of action setting out how the Government intends to achieve sustainable communities in both

urban and rural areas. It highlights actions to address housing, planning and neighbourhood renewal issues. One of its main aims is to tackle housing supply issues in the South East and low demand in other parts of the country.

3.3.2 The document suggests that a sustainable community must be of a sufficient size, scale, and density to support effective use of resources including basic amenities. It should provide a "sense of place" and contain a well-integrated mix of different types and tenures of housing. It should also aspire to promote a diverse culture locally and links well to communities and its hinterland.

3.3.3 The Government has promoted substantial increases in jobs and housing numbers in the Growth Areas of Southern and Eastern England. As Bedford is one of the five major growth areas it will face increases in population and employment. This will intensify pressures on limited water resources in parts of the country where the water dependant environment is under stress. It is imperative that development is planned to consider strain on environmental water quality associated Water Services Infrastructure (WSI) alongside other impacts in managing future growth.

Planning Policy Statement 1(PPS1): Delivering Sustainable Development (2005)

3.3.4 PPS1 sets out the Government's objectives for the planning system. It confirms that good planning should deliver the right development in the right place and time, and protect the environment. It identifies sustainable development as the core principle underpinning planning and requires that development plans ensure it is pursued in an integrated manner.

3.3.5 A supplement to PPS1 dealing principally with the need to address climate change issues and the objective of reducing CO2 emissions was published in December 2007.

Planning Policy Guidance 2 (PPG2): Greenbelts (1995)

3.3.6 This PPG outlines the history and extent of Green Belts and explains their purposes. It describes how Green Belts are designated and their land safeguarded. Green Belt land-use objectives are outlined and the presumption against inappropriate development is set out.

Planning Policy Statement 3 (PPS3): Housing (2006)

3.3.7 PPS3 has been developed in response to the Barker Review of Housing Supply (2004). Its principle aim is to underpin the necessary step change in housing delivery, improving the supply and affordability of housing in all communities including rural areas.

3.3.8 PPS3 states that the Government's key housing policy is to ensure that everyone has the opportunity of living in a decent home, which they can afford, in a community where they want to live.

Planning Policy Statement 6 (PPS6): Planning for Town Centres (2005)

3.3.9 PPS6 encourages the creation of vital and viable town centres as an essential component of successful, thriving, safer and inclusive communities. By making more efficient use of land and buildings, increasing the density of development where appropriate, it should be possible to accommodate growth within town centres.

Planning Policy Statement 9(PPS9): Biodiversity and Geological Conservation (2005)

3.3.10 PPS9 sets out policies on protection of biodiversity and geological conservation through the planning system. The broad aim is that development should have minimal impacts on biodiversity and geological conservation interests and enhance them where possible. Appropriate weight should be attached to the need to protect international and national designated sites.

Planning Policy Statement 12 (PPS12): Local Spatial Planning (2008)

3.3.11 PPS12 sets out the Government's policy on local spatial planning, which plays a central role in the overall task of place shaping and in the delivery of land uses and associated activities. When considering extensions to local plan and unitary development plan saved policies it looks at the following issues;

- PPS12 takes the following issues into account in considering extensions to local plan and unitary development plan saved policies and pay particular regard to;
- Policies that support the delivery of housing, including unimplemented site allocations, up-to-date affordable housing policies and policies relating to the infrastructure necessary to support housing;
- Policies on Green Belt general extent in structure plans and detailed boundaries in local plans or unitary development plans;
- Policies that support economic development and regeneration, including policies for retailing and town centers;
- Policies for waste management, including unimplemented site allocations; and
- Policies that promote renewable energy, reduce impact on climate change or safeguard water resources.

Planning Policy Statement 25 (PPS25): Development and Flood Risk (2006)

3.3.12 PPS25 sets out a plan led approach to flood risk. It confirms that all forms of flooding and their impact on the natural and built environment are material planning considerations. It clarifies the sequential test that matches types of development to degrees of flood risk and strengthens the requirement to include flood risk assessments at all levels of the planning process.

3.3.13 Regional planning bodies and local planning authorities (LPA) should, inter alia, reduce flood risk by safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water and flood defences.

## *3.4 Regional and Local Planning Policy Guidance*

3.4.1 Key sources of data that have been used in this study consist of;

- Milton Keynes South Midlands (MKSM) Sub-Regional Strategy (SRS) (March 2005);
- East of England Plan (RSS14) (May 2008);
- The Draft South East Plan (RSS9) (March 2006).

3.4.2 The various LDF documents provide the primary planning context for WCS, however reference also needs to be made to the 'saved' Local Plan Policies. Relevant policies are summarised in Appendix B.

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Milton Keynes South Midlands Sub Regional Strategy, 2005

3.4.3 The Milton Keynes – South Midlands Sub Regional Strategy (MKSM SRS) sets out the scale of development for Milton Keynes and South Midlands up to 2021. The strategy is based on the need for planned sustainable communities to be served by adequate infrastructure. The strategy advocates a step change in the supply of housing as well as offering a strategic direction for local authorities and delivery vehicles and other stakeholders in the sub-region.

East of England Plan, May 2008

3.4.4 The East of England Plan sets the minimum housing target of 19,500 additional homes for the Bedford, Kempston and Northern Marston Vale Growth area. It also sets out additional housing targets outside the Bedford, Kempton and Northern Marston Vale Growth Area up to 2021 of 1,300 homes within Bedford Borough and 11,000 within Mid Beds. As part of the joint working between the Districts and County to inform the East of England Plan, the employment figure was disaggregated and a split agreed between Bedford Borough and Mid Beds District of 16,000 and 11,000 jobs respectively. However, Mid Beds has planned for a higher level of growth in their Draft Submission Core Strategy of 14,000 new jobs. This can be seen in Table 3.1 below. The Mid Beds Draft Submission Core Strategy looks ahead to 2026 which includes an additional 3,560 homes and 3,000 jobs for the period 2021-26, 2,750 of which are planned by the LDF 2021-2026 for outside the growth area in the same period, which leaves 810 to be allocated within the growth area. In accordance with PPS3, paragraph 34, the Mid Beds Draft Submission Core Strategy looks ahead to 2026 which includes an additional 3,560 homes and 3,000 jobs for the period 2021-26, 2,750 of which are planned by the LDF 2021-2026 for outside the growth area leaving a remaining 810 to be planned in the Growth Area for the same period.

| Local Authority Area | Dwellings in the Growth Area | Dwellings outside of the of Growth Area | Total growth in dwellings 2001-2021 | Jobs (District/Borough-wide) |
|---|---|---|---|---|
| **Bedford Borough** | 16,270 | 1,300 | 17,570 | 16,000 |
| **Mid Beds** | 3,230 | 11,000 | 14,230 | 14,000 |
| **Study Area Total 2001-2021** | 19,500 | 12,300 | 31,800 | 30,000 |
| **Additional development in Mid Beds 2021-2026** | 810 | 2,750 | 3,560 | 3,000 |
| **Mid Beds Total 2001-2026** | 4,040 | 13,750 | 17,790 | 17,000 |

**Table 3.1: Housing and Employment Targets 2001-2021 (including 2001-2026 for Mid Beds) )**

3.4.5 The study area (Figure 2.1) for the Bedford WCS will cover Bedford Borough and Mid Beds. The growth targets in the table are used as the baseline figures for the assessment with this WCS. Consideration is also given to the potential Marston Vale Eco-Town, which discussed in Section 9.

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3.4.6 The key diagrams from the Bedford Borough Core Strategy (Figure 3.1) and the Mid Beds Draft Submission Core Strategy (Figure 3.2) indicate the extent of the Bedford and Northern Marston Vale growth area.

**Figure 3.1: Bedford Borough Key Diagram (Core Strategy & Rural Issues Plan 2008)**


**Figure 3.2: Mid Beds Draft Key Diagram (Draft Submission Core Strategy, October 2008)**

Draft South East Plan, March 2006

3.4.7 In response to the Milton Keynes expansion set out in the Draft South East Plan, work has been undertaken by Mid Beds Council, jointly with Milton Keynes partnership, Milton Keynes Council and Aylesbury Vale District Council to determine the broad housing and development capacity of the strategic development area proposed. This work has concluded that taking account of the proposed extension to the South Bedfordshire Green Belt North of Aspley Guise, approximately 2,000 dwellings can be accommodated in the Mid Beds part of the Strategic Development Area. The Secretary of State considers that the inclusion of 5,600 dwellings in Mid Bedfordshire goes beyond the scope of what can be committed through the South East Plan RSS and instead must be a matter for the East of England RSS to address. The Secretary of State issued Proposed Changes to the South East Plan in July 2008; consultation closed in October and the final version is expected in early 2009.

## *3.5 Bedford Borough*

3.5.1 Both the Core Strategy & Rural Issues Plan and The Town Centre Area Action Plan were submitted to the Secretary of State in July 2006. It has been formally examined and found to be sound. The Core Strategy was adopted by the Council in April 2008. The Town Centre Area Action Plan has also been found to be sound and was adopted by the Council in October 2008.

3.5.2 Work has started on an Allocations & Designations Development Plan Document which will identify sites (primarily employment sites) for development to 2021. This is scheduled for completion in 2011.

Housing

3.5.3 Of the total 19,500 dwellings to be provided in the Growth Area as a whole, 16,270 are to be located in Bedford Borough. In the period 2001-07, 2,433 dwellings were completed in the Growth Area. For the remainder of the Borough outside the Growth Area (Rural Policy Area) 1,078 dwellings were complete in the period 2001-07 against the target of 1,300 by the year 2021. This makes a total of 3,511 completed dwellings in Bedford Borough, in the period 2001-2007.

3.5.4 At the end of March 2007, 10,061 of the required growth area target of 16,270 dwellings had been completed or had been granted planning permission. The current position of housing supply is shown in Appendix C. The Council considers that with the current reliance on 'windfall' development the total 16,270 dwellings can be developed in the Growth Area without the need for future allocations. This can be seen in Figure 3.3 and Table 3.2. The source of new dwellings within Bedford Borough is summarised in Table 1-1 in Appendix C.

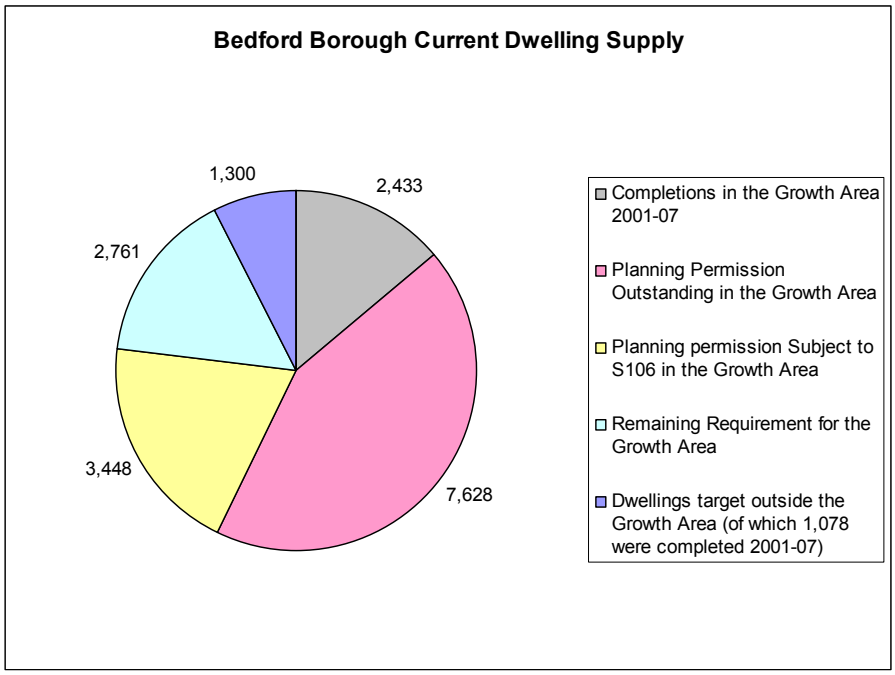


**Figure 3.3: Bedford Borough Current Dwelling supply 2001 – 2021**

3.5.5 Figure 3.4 shows the housing trajectory for the growth area and is taken from the 2006/07 AMR and Appendix C provides information on the status of housing allocations as well as a break down of development both built and committed.

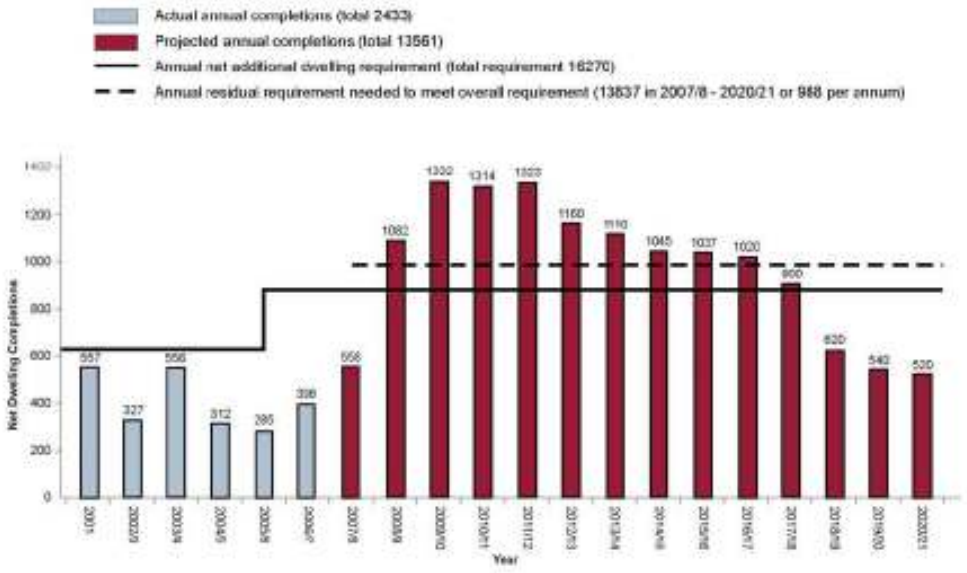


**Figure 3.4: Bedford Borough AMR Housing Trajectory 2006/07 (Growth area only)**

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| Source of dwellings | Predicted growth area dwelling completions | | | |
|---|---|---|---|---|
| | 2007-10 | 2011-15 | 2016-21 | Total |
| other permissions | 487 | 0 | 0 | 487 |
| Local Plan sites with planning permission | 2359 | 2975 | 1550 | 6884 |
| TCAAP* sites with planning permission | 257 | 0 | 0 | 257 |
| Local Plan sites with resolution to grant (S106) | 160 | 1510 | 1350 | 3020 |
| other sites with resolution to grant (s106) | 173 | 0 | 0 | 173 |
| Local Plan site without planning permission | 200 | 155 | 0 | 355 |
| TCAAP* sites without planning permission** | 350 | 285 | 0 | 635 |
| Managed brownfield/ employment releases | 300 | 750 | 700 | 1750 |
| | | | | 13561 |

*Note: TCAAP refers to the submitted Town Centre Area Action Plan (July 2006)
**Note: This takes account of the expected loss of 262 dwellings through re-development

***Source**: Bedford Borough Council AMR 06/07*

**Table 3.2: Bedford Growth Area Housing Position**

Rural Policy Area

3.5.6 Policies for the location of much more modest levels of housing development in the Rural Policy Area beyond the Bedford Growth Area are set out in the Core Strategy and Rural Issues Plan (which is based on the East of England Plan).

3.5.7 In the Rural Policy Area, development is focused in key service centres which are identified as Bromham, Clapham, Great Barford, Harrold, Sharnbrook and Wilstead. 1,300 new homes and affordable housing (most of which are already built or committed) are to be delivered in the Rural Policy Area. Any additional allocations will respond to identified local needs. This may include the allocation of sites for 100% affordable housing for local people (Bedford Core Strategy and Rural Issues Plan, 2008).

Employment

3.5.8 Most employment sites and centres of excellence are located within the Growth Area, in or near to Bedford. Since the Borough's main Business Park is now largely developed, the supply of high quality B1 office environments has become critical and, in addition to promoting redevelopment within the town, it is likely that the local planning authority will need to seek out new strategic business sites.

3.5.9 A minimum of 16,000 net additional jobs will be provided in the Borough 2001- 2021. Taking account of completions and planning permissions granted since 2001, the Core Strategy & Rural Issues Plan identifies a strategic need for an additional 21ha of employment land to be allocated. The Plan explains that this strategic growth will be focused on the Bedford, Kempston and Northern Marston Vale Growth area rather than the Rural Policy Area. However it is to be expected that some economic development will occur focused on key service centres (where a local need can be identified) and associated with existing employment locations.

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3.5.10 The total amount of employment land needed by 2021 is not expected to be significantly different to the existing land supply.

3.5.11 Information on the supply of land for employment purposes can be found in Appendix D.

## *3.6 Mid Beds District*

3.6.1 In order to provide a framework for considering the levels of new development to be directed at the strategic level through the Core Strategy and at a more detailed level through the site allocations process a settlement hierarchy is used. The Mid Beds hierarchy takes account of local sustainability credentials such as access to services and facilities and is based on the current level of provision. There are four tiers included in the Settlement Hierarchy for Mid Beds split between; Major Service Centres, Minor Service Centres, Large Villages and Small Villages.

3.6.2 Between late February and April 2008 a consultation was held on the first stage of Mid Beds Site Allocations Development Plans Document (DPD). This will help determine which sites might be suitable to take forward as allocations. Once adopted, the DPD will identify specific locations for all types of development in line with the Mid Beds Core Strategy.

Housing

3.6.3 The Mid Beds emerging Core Strategy plans for the delivery of:

- 14,230 new homes in the district between 2001-2021;
- 3,560 (2,750 outside the Growth Area) new homes in the period 2021-2026, making a total of; 17,790 between 2001-2026

3.6.4 The emerging South East Plan has allocated 5,600 new homes to beg delivered within Mid Beds's administrative boundaries. The Mid Beds Core Strategy allows for the growth of Milton Keynes into Mid Beds in line with the proposals for a south –eastern expansion of the city.

3.6.5 In the period 2001-08, 346 dwellings were completed against the 3,230 growth target for Marston Moretaine and Houghton Conquest (Northern Marston Vale). In the same period 4,539 dwellings were completed in the remainder of the Mid Beds against the 11,000 RSS14 housing target, making a total of 4,885 completions in the district in that period, this can be seen in Figure 3.5.

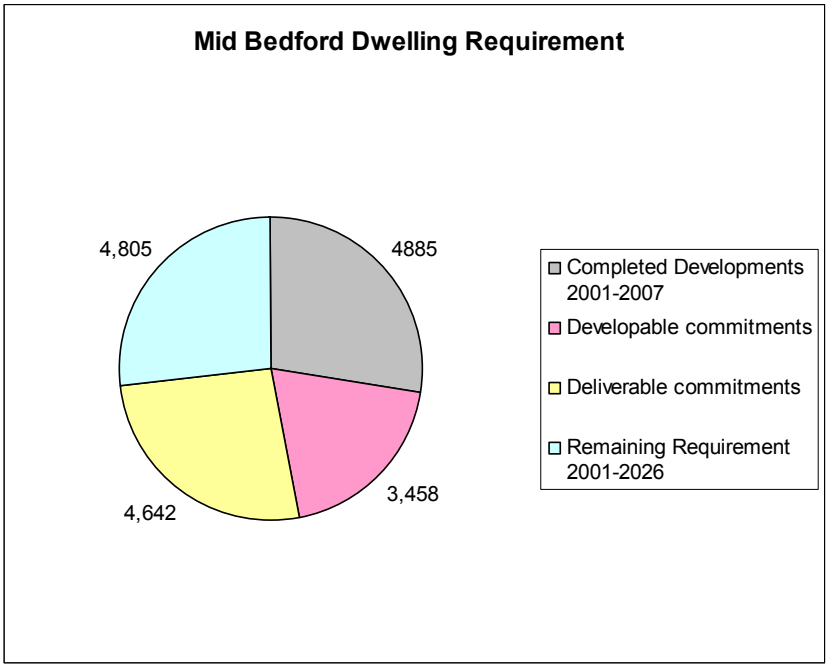


**Figure 3.5: Mid Beds dwelling requirement 2001-2026**

3.6.6 Figure 3.6 summarises the future housing trajectory and Table 1.2 in Appendix C provides information on the status of housing allocations as well as a break down of development both built and committed while Table 1.3 shows the main settlement break down in Mid Beds from the Draft Submission Core Strategy.

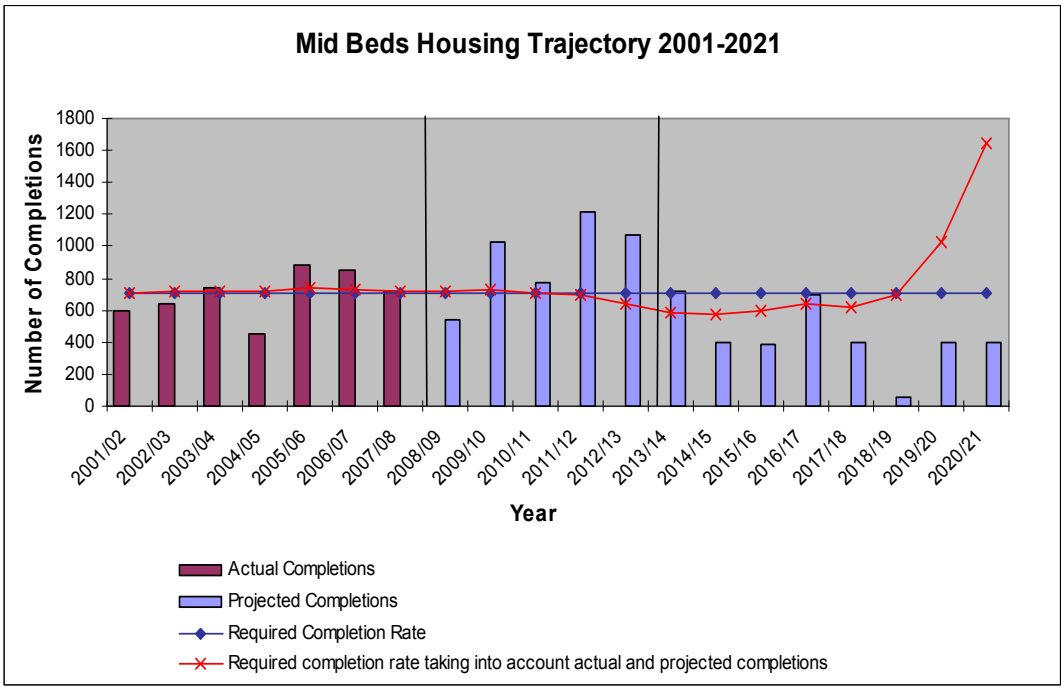


**Figure 3.6: Mid Beds AMR housing trajectory 2006/07**

Employment

3.6.7 Mid Beds has a relatively strong economy and past trends in employment growth has provided a strong case for improving residents access to jobs. The Council considers the RSS target of 11,000 jobs to be the minimum required to support the economy of Med Beds to 2026. However the Core Strategy will plan for a higher level of growth up to 2021 of 14,000. In addition, the Draft Submission Core Strategy is aiming to deliver 17,000 jobs in the 2001-2026 plan period. In support of this target, approximately 77ha (excluding 16ha as part of the Wixams new settlement) of net additional B1-B8 employment land will be identified for the remainder of the period 2010-2026 (the Employment Land Review 2008 accounts for jobs already created up to 2005 and a lower job creation rate up to 2010 and so are deducted from the overall requirement up to 2010). There is currently an existing supply of allocated land of 56.79ha (as at 31st March 08) which can be brought forward for development now. Information on the supply of land for employment purposes can be found in Appendix D. In terms of locating new employment land, it is important to provide a better balance where job levels may currently be low or where further housing growth is being planned.

## *3.7 Bedford, Kempston and Northern Marston Vale*

3.7.1 Renaissance Bedford has produced a housing trajectory which shows that the main period of delivery on the major sites in the Growth Area (Bedford, Kempston and the Northern Marston Vale) is expected to be from 2008/09 to 2014/15. During this period completions are forecast to be above 1,000 units per annum. This can be seen in Figure 3-3 and 3-4 below.

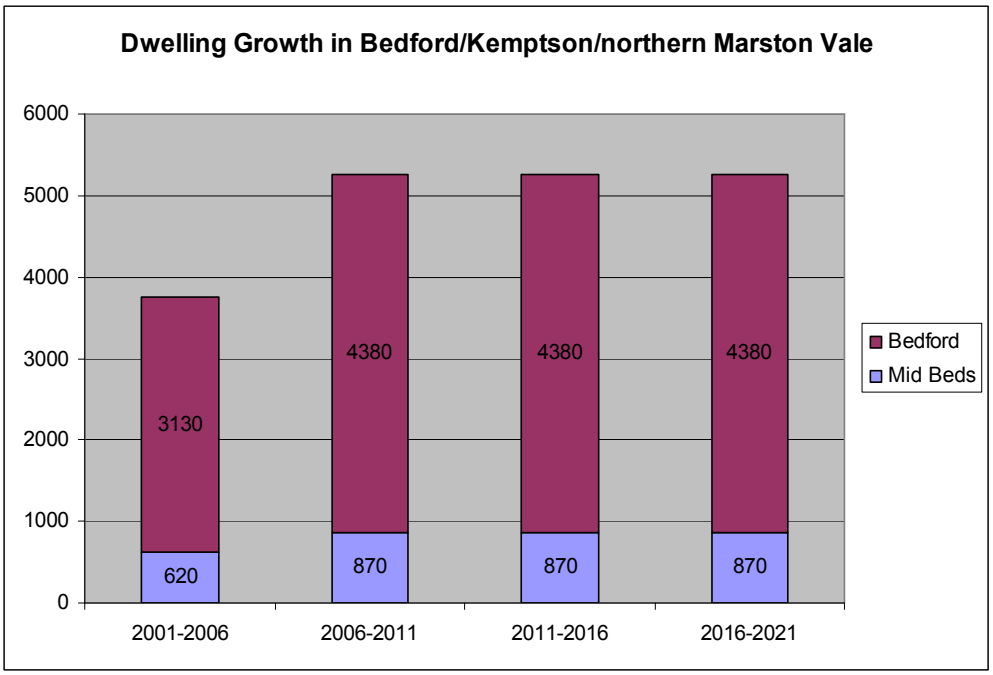


**Figure 3.7: Housing Targets 2001-2021 (Source; Renaissance Bedford, 2006/07)**

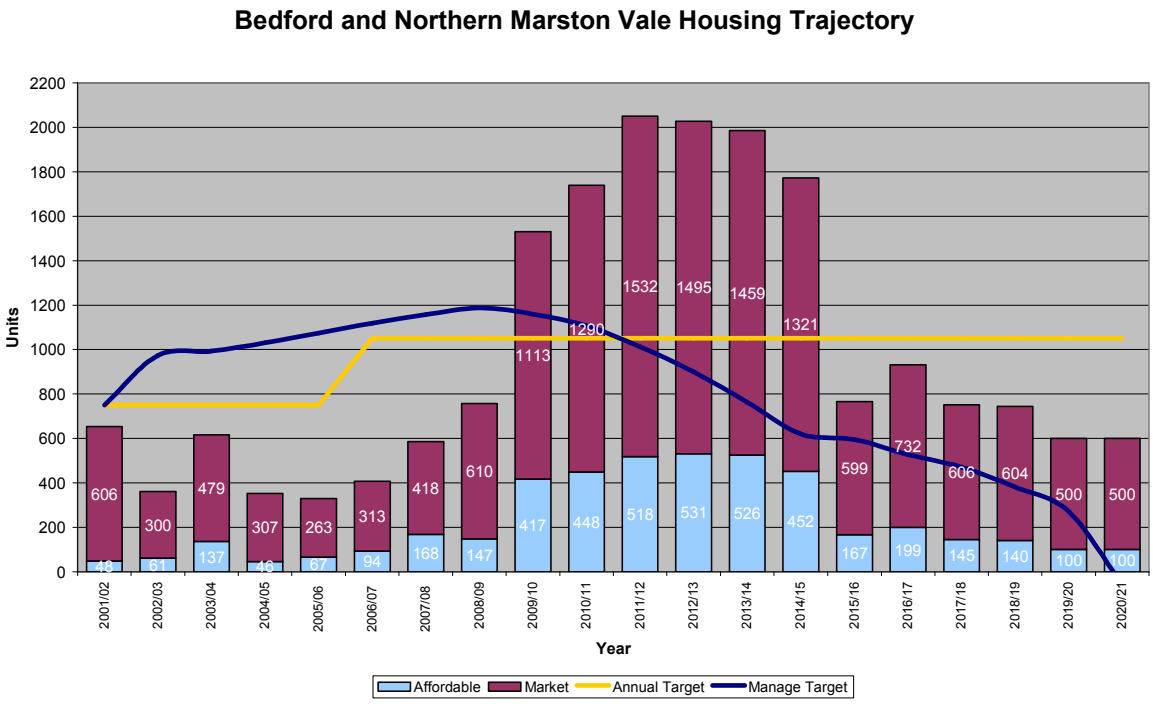


**Figure 3.8: Detailed Housing Trajectory 2001-2021 (Source; Renaissance Bedford 2006/07)**

## *3.8 Employment*

The Milton Keynes and South Midlands Sub Regional Strategy sets a target of 19,800 jobs to be created in the Growth Area by 2021. A step change is required if this target is to be achieved. New employment sites will be brought forward in the Marston Vale to help create a better balance of homes and jobs in the Growth Area and to support economic regeneration of Bedford.

## *3.9 Major Developments*

3.9.1 Where new development is located is a key sustainability issue and is probably the most important influence the planning system has in creating sustainable development. This section sets out the broad scale of development already being brought forward in the two local authority areas so that its impact upon infrastructure capacity can be assessed alongside the infrastructure improvements required to support future development. The developments listed below are residential and mixed use developments incorporating in some cases not just housing but also employment, community and leisure facilities, educational facilities, retail facilities, open space and transport infrastructure.

<u>The Wixams (Bedford/Mid Beds)</u>

3.9.2 The Councils have approved outline planning permission with a Section 106 agreement securing over £200m of infrastructure and community benefits for a new town named the Wixams which lies to the South of the County Town of Bedford. The development comprises a total of 4,500 homes with 3 village centres and a town centre, 6 new schools, 25% affordable housing, first class health, community and leisure facilities, a new railway station and a new employment area with 1 million sq ft of commercial floor space. The Wixams will be one of the largest new communities to be built in the UK. Part of the site is also in Mid Beds and the total amount of homes is divided between the two authorities. Residential development commenced during the autumn 2008 in Village 1 and it is anticipated that the first school which is located within Village 1 will open September 2009.

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An extension with additional housing of between 800 and 1,000 is planned at the Wixams site between 2011 and 2026.

Land North of Bromham Road, Biddenham (Bedford)

3.9.3 Local Plan Policy H8 identifies the land North of Bromham Road, Biddenham for comprehensive development. The development will include a mixed use community comprising 1,200 homes (including affordable housing), employment, local shopping facilities, community facilities, educational facilities and open space.

Land at Biddenham Loop and Land West of Kempston (Bedford)

3.9.4 Local Plan Policies H6 and H7 identify the Land at Biddenham Loop and West of Kempston for comprehensive development. With approximately 1,500 dwellings planned at Biddenham Loop and approximately 1,250 dwellings planned on the Land west of Kempston. The Biddenham Loop will have provision of Country Park, golf course, open space, playing fields, foothpaths/cycle routes, district centre, social housing, lower school and sports/communities facilities. Provision for a park and ride will be met and a road link from southwards across the River Great Ouse to the A421 will also be developed.

3.9.5 The West of Kempston development will comprise of additional service such as community and educational facilities including a local centre, openspace, playing fields and foothpaths/cycle routes with a road link from southwards across the River Great Ouse to the A421.

Land at Shortstown (Bedford)

3.9.6 The site located to the south east of Bedford is approximately 42 hectares, comprising 1,100 dwellings is a comprehensive development of a mixed use area with commercial and community areas, village hall/sports pavilion, playing field, landscaping and a pocket park. Thus far 970 of the 1,100 dwellings have planning permission. The remaining 130 are subject to signing of Section 106 agreement.

Land North of Fields Road, Wootton (Bedford)

3.9.7 A planning application for outline permission was submitted for a mixed use development including the erection of dwellings, local convenience store and community facilities; provision of recreational facilities and open space and associated works. This site is located on the east side of Wootton, between the existing village and the A421, north of Fields Road. It covers an approximate area of 47 ha. Local Plan Policy H12 states that development on land at Fields Road shall be undertaken in accordance with the adopted development brief. The decision is still pending subject to a legal agreement.

Land South of Fields Road, Wootton (Bedford)

3.9.8 An outline planning application was submitted for a residential and employment development with ancillary open space, recreational facilities and associated works. This site is located on the south-east side of Wootton, between the existing village and the A421, north of Fields Road. It covers an approximate area of 76 ha. Local Plan Policy H11 is specific to the site and proposal. The proposal includes up to 500 dwellings and an employment area of approximately 8.5 ha. The decision is still pending subject to a legal agreement.

Fairfields Site (Mid Beds)

3.9.9 The Council manages and monitors the construction of Fairfield Park a new village of 1,200 new homes which includes a retail facility, a new school and a new community building. The development includes 273 new apartments. At the present time 500 dwellings have Reserved Matters consent with 240 occupations on site.

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Center Parcs (Mid Beds)

3.9.10 This application for 5th Village from Center Parcs includes 700 villas, a 75 bedroom hotel, two 12-18m High Centre Buildings, Retail units, Conference facilities for 500 people and 1,400 space car park. The application was allowed on appeal following refusal of planning permission.

Nirah (Mid Beds/Bedford)

3.9.11 An International Visitor Destination and Science Research Park, including tropical biotope, water adventure park, spa, three hotels, conference and exhibition centre 50 seater cinema and associated ancillary retail and food and drink uses. On site car parking (Quest Pit) and dedicated park and shuttle bus facility (Elstow North) (Use Classes A1, A3, A5, B1, C1, D1, D2 and sui generis). Only a small part of the main site lies within Bedford Borough. The car park and part of the proposed shuttle bus access route (via the Wixams) is also within the Borough. Nevertheless, the development as a whole is likely to have substantial impact on Bedford and the surrounding area. Application to be forwarded to the Secretary of State with an indication that the County Council is minded to grant permission subject to a Section 106 Agreement and conditions.

Arlesey (Mid Beds)

3.9.12 This is one of the six Minor Service Centres in the Mid Beds district and a Core Strategy proposal for the area up to 2026. Arlesey will be planned to grow over the plan period to bring forward large scale new mixed-use development. 333 dwellings and 5.7ha of employment land was completed in the period 2001-2008 and at least a further 1,000 dwellings will be provided in the plan period together with employment land and services and 10-15 ha of employment land will be provided in the period 2011-2026.

Silsoe (Mid Beds)

3.9.13 This study assesses the Major and Minor Service Centres of Mid Beds only, and therefore detailed assessment of the impact of development at Silsoe (classed as large village) is beyond the scope of the study. The scale of development proposed for Silsoe is significant and therefore it is specifically mentioned below because Silsoe is within the catchment of Clophill wastewater treatment works which is assessed within this report.

3.9.14 Silsoe will grow over the plan period as part of the Core Strategy proposals for the area up to 2026 as opportunity is taken to redevelop the former Cranfield University Campus. Redevelopment will consist of a mix of uses including housing, employment and new community facilities. 37 dwellings have been completed 2001-2008, with 90 more already planned for along with 28ha of employment land. The housing requirement for 2011-2026 is 400 dwellings and 1-2ha of employment land.

Biggleswade (Mid Beds)

3.9.15 The proposed developments at Biggleswade comprise an existing commitment as well as further development proposals for the town as set out in the Core Strategy. In the Eastern part of the District the Council is currently dealing with all planning aspects of a housing allocation site to the East of Biggleswade, the largest town in the District. The development comprises 2,100 dwellings with 28% affordable housing a neighbourhood centre and a new lower school. The Section 106 agreement secures over £60m of infrastructure and community benefits. There are also between 250 and 500 new allocations at Biggleswade in the new LDF, however these allocations have not been identified as yet. The site is split into four parcels, and to date outline planning permission has been granted for 1,545 residential dwellings, the Eastern Relief Road, a countryside linear park, a local centre, primary school and public open space. It is hoped that development will commence on site towards the end of 2009.

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Bedford and Milton Keynes Waterway

3.9.16 The Bedford and Milton Keynes Waterway is being promoted by the Bedford and Milton Keynes Waterway Trust working as a joint unit. The waterway involves a canal 24km long connecting the Grand Union Canal in Milton Keynes to River Great Ouse in Kempston, Bedford. The route is proposed to pass through the potential eco-town.

3.9.17 The section between Milton Keynes to M1 was granted conditional planning permission in July 2007 and a planning application for the remainder of the route is being prepared. Halcrow on behalf of Bedford and Milton Keynes Trust is carrying out the planning for the route section between Stewartby Lake and Bedford Great Ouse.

3.9.18 Halcrow undertook an outline assessment along the Stewartby Lake to Bedford route section. No assessment on the water resource requirements or availability, water quality impacts and flood risk (and modelling) has currently been undertaken as the focus of the current study is to focus upon the route selection. The projected increase in boat traffic due to the Bedford Milton Keynes link and the Fens waterway link may have an impact during drought situations where numbers of lock cycles increase, due to more craft movements on the system. This could have a potential impact on water levels through Bedford.

3.9.19 The Catchment Abstraction Management Strategy (CAMS) identifies the non availability of water for consumptive uses in the area where the waterway will be required to abstract water. The leakage losses were estimated to be 2Ml/week and evaporation losses of 5mm/$m^2$ per day were estimated in the eco-town WCS.

3.9.20 The waterway crosses a 400mm diameter sewer from Wootton to Bedford orbital sewer, a 975mm diameter Bedford orbital sewer (across Cemetery Road) and water mains along Fields Road in Wootton, Ridge Road in Kempston and Green Lane in Stewartby. This is not currently expected to cause a constraint to housing growth.

Rowing Lake

3.9.21 The course of the proposed rowing lake crosses a large diameter water transfer main from Grafham Water

3.9.22 A local 225mm diameter rising main (pumped sewer) from Willington to Bedford WwTW also passes through the proposed site of the rowing lake.

3.9.23 The consultant Bidwells is aware of the location of these assets and their diversion can be planned now that planning approval is in place.

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### *3.10 Conclusions*

3.10.1 From the information supplied above, of the total 19,500 homes to be provided in the Growth Area between 2001 and 2021, 2,779 dwellings have been completed in the period 2001-2007/8. Outside the Growth Area, 5,617 dwellings have been completed in the same period. This means that a total of 8,396 dwellings have been completed against the 31,800 dwellings to be provided for in Bedford and Mid Beds as a whole. This is summarised in Table 3.3.

| Local Authority Area | Dwelling Completions in the Growth Area | Dwelling Completions Outside of Growth Area | Total Dwelling Completions 2001-2007/8 |
|---|---|---|---|
| Bedford Borough | 2,433 | 1,078 | 3,511 |
| Mid Beds | 346 | 4,539 | 4,885 |
| Total | 2,779 | 5,617 | 8,396 |

**Table 3.3 : Dwelling Completions 2001-07/8**

3.10.2 The remaining requirement of 23,404 dwellings is to be provided throughout Bedford and Mid Beds up to 2021. 16,721 dwellings are to be provided in the Growth Area and 6,683 remain to be provided outside the Growth Area. These will comprise a combination of LDF allocations and additional windfall sites within the parameters set by statutory plans. The WCS can influence the location, means and phasing by which this future element of future growth is delivered, as well as being an important consideration in relation to additional employment allocations.

3.10.3 No additional strategic housing sites need to be allocated to 2021 in Bedford. The Council considers the uncommitted requirement for 2,761 dwellings can be accommodated on windfall sites in the growth area. However the Core Strategy does identify a strategic need for employment allocations of approximately 21ha. The allocation of strategic employment sites will be focused on the Growth Area of Bedford, Kempston and the Northern Marston Vale. In Mid Beds an additional 4,805 dwellings need to be allocated between 2001 and 2026. For Mid Beds, Appendix C illustrates the indicative range of housing and 77 hectares of employment development to be allocated at each of the main settlements in line with the Development Strategy set out in the Draft Submission Core Strategy.

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# 4 Water Resources and Water Supply

## *4.1 Introduction*

4.1.1 The East of England is a water-stressed area and has one of the highest water consumption figures in the country. The purpose of the water resources and supply section of the WCS is to identify whether sufficient water resource is available to support the planned level of growth, whether a reduction of water consumption will eliminate the need for additional water resources and what upgrades are required to supply this resource to where it is needed.

4.1.2 The East of England Plan identifies a target reduction of 25% per capita water consumption for new housing (and 8% for existing housing) as a minimum to ease water stress with the aim of achieving water neutrality across the East of England region.

**Water neutrality definition:**

For every new development, total water use across the wider area [East of England Region] after the development must be equal to or less than total water use across the wider area before the development.

Environment Agency, water neutrality high level guidance fact sheet

4.1.3 The impact of implementing this reduction in consumption is considered within this WCS and its affect upon the water resource requirements are discussed. No consideration of achieving water efficiency in existing houses has been commissioned at this point

4.1.4 The study area lies within Anglian Water's Ruthamford zone and is a water stressed area. AWS has a long term deficit of water resources in the Ruthamford water resource zone.

## *4.2 Water Efficiency Requirements*

4.2.1 In order to reduce the reliance on developing additional water resources to support developments, a reduction in per capita consumption will be required. The policies relevant to reducing water consumption are;

- Code for Sustainable Homes; and
- Future Water
- Policy WAT1 East of England Plan, reproduced below;

**Policy WAT1 – Water Efficiency (East of England Plan)**

The government will work with the Environment Agency, water companies, OFWAT, and regional stakeholders to ensure that development provided for in the Spatial Strategy is matched with improvements in water efficiency, which will be delivered through a progressive, year on year, reduction in per capita consumption rates. Savings should be monitored against the per capita per day consumption target in the Regional Assembly's monitoring framework.

4.2.2 Implementing the water efficiency measures contained within the East on England Plan (25% reduction in new homes and 8% reduction in existing homes), will not be sufficient to achieve 'water neutrality' across the study area, and therefore additional water resources will

be required. AWS may address the 'water neutrality' at the Water Resource Zone rather than growth area as this is more achievable rather than looking at only the growth area. This requires meeting new demand through improving the efficient use of existing water resources through a combination of measures. This should make use of Code for Sustainable Homes attaining level 5.

The Code for Sustainable Homes (CSH)

4.2.3 This sets the minimum standards for energy and water use as a step-change and forms a basis for future developments to the Building Regulations. Table 4.1 defines the Carbon and Water Efficiency requirements for each Code Level rating.

**Achieving a sustainability rating**

| | Minimum Standards | | | | |
|---|---|---|---|---|---|
| | Energy | | Water | | |
| Code Level | Standard (Percentage better than Part L' 2006) | Points Awarded | Standard (litres per person per day) | Points Awarded | Other Points[4] Required |
| 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 ($CO_2$) from all energy use in the home).
4. All points in this document are rounded to one decimal place.

**Table 4.1: Code Level requirements for energy and water efficiency**

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

4.2.4 All new social housing already has to be built to CSH level 3, and the Environment Agency recommends measures be adopted to allow the efficient use of water. The water consumption is set at 105 litres per head per day (i.e. Code for Sustainable Homes level 3 or 4) or better. Currently compliance with the CSH is voluntary for private housing.

4.2.5 The result of a consultation by Communities and Local Government suggests that an assessment for CSH will become mandatory for private housing. However, it is likely that a developer would be able to avoid the code requirement and achieve a Code Level 0 or 'no rating' standard.

4.2.6 The Environment Agency recommends that, due to the specific pressures faced, the region should adopt the following measures:

- Efficient use of water in all new homes with water consumption set at 105 litres per head per day (i.e. level 3/4 for water within Code for Sustainable Homes) or better;
- That all growth point plans liaise with water companies to ensure that the companies have the water resources and associated environmental infrastructure (such as new resources and adequate distribution) now, and in the future, to meet planned development;
- All new buildings, including flats, must be metered
- Whenever possible developments should consider the benefits of rainwater harvesting and water recycling in new developments;
- Use of low water use landscaping and gardens; and
- Local authorities to follow their duties, as noted in the Water Act 2003 (Part 3 Sections 81 & 83), that 'the relevant authority must, where appropriate, take steps to encourage the conservation of water'.

4.2.7 On the other hand, the Government's new water strategy for England, *Future Water* was published in February 2008. The Vision by 2030 includes the following measures:

- Reduced per capita consumption of water to an average of 130 litres per capita per day (l/c/d) by 2030 including garden use.
- Amend the Building Regulations to include a requirement for new homes to achieve a performance standard set at 125 litres per day (l/p/d) (excluding garden use.)
- In areas of serious water stress (such as Bedford and Marston Vale) it is believed that near universal metering will be needed by 2030.

## *4.3 Future Water Resource Demand Scenario Testing*

4.3.1 Demand scenario testing based upon projected housing figures has been undertaken within this strategy and the outcomes are shown in Table 4.2 and Figure 4.1. The two scenarios are described below and have been based upon the following assumptions.

- The population of the WCS area is assumed to be 293,300 based on data provided by the census data from the ONS super output areas.
- The occupancy rate of the new (2.1) and existing properties remains constant throughout the planning period.
- The proportion of existing metered and unmetered properties remains constant throughout the planning period.
- The per capita consumption (pcc) for unmetered properties remains constant throughout the planning period. .

Scenario 1: Business as usual - with proposed LDF growth:

4.3.2 This scenario looks at how total potable demand would increase should current pcc rates be maintained in the new and existing development areas, assuming that all new properties are metered. The pcc for existing homes (metered and unmetered) also remains constant throughout the planning period.

Scenario 2: East of England Plan (RSS 14) recommendations:

4.3.3 This scenario follows the recommendation of the RSS14 panel and reduces the pcc of all existing houses by 8% by 2026. The pcc for new properties is reduced by 25% by 2026.

4.3.4 The results of the scenarios testing are shown below in Figure 4.1.

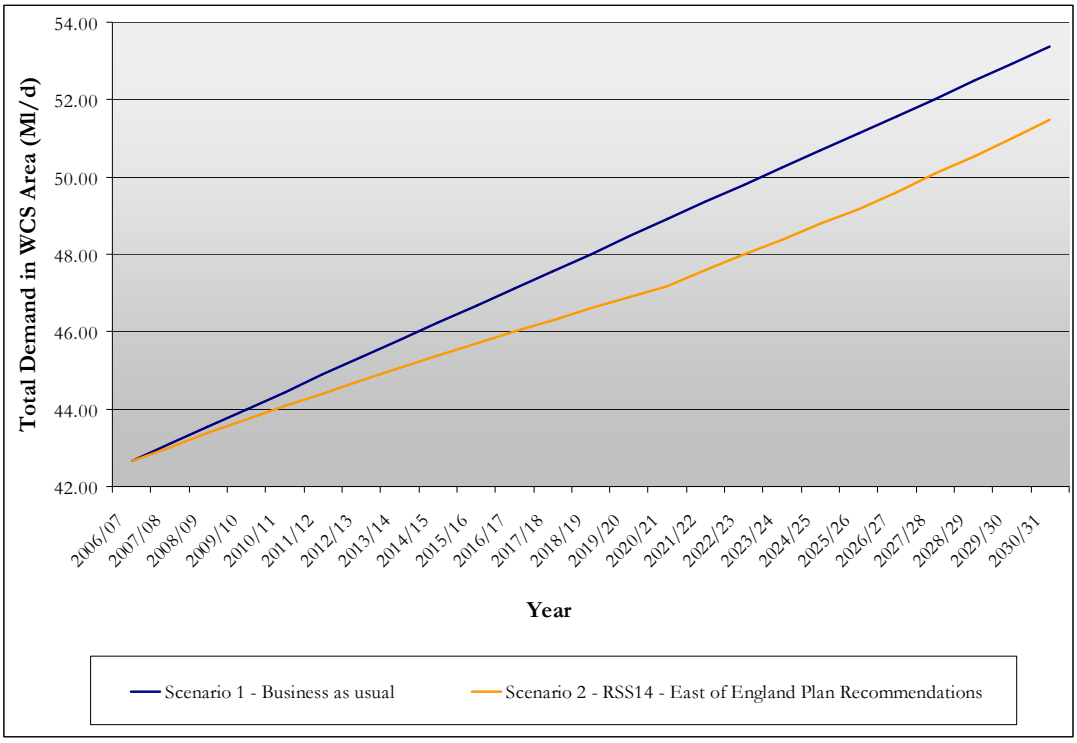


**Figure 4.1: Anticipated demand with projected growth**

The results can further be tabulated for the mentioned scenarios as shown in Table 4.2 below;

| Scenario | Year | |
|---|---|---|
| | 2021 | 2031 |
| 1 | 6.69Ml/d required above 2006/7 levels | 10.7Ml/d required above 2006/7 levels |
| 2<br>(RSS14 new & existing growth excluding eco-towns Lowers additional demand, but demand still increases) | 4.93Ml/d required above 2006/7 levels | 8.88Ml/d required above 2006/7 levels |
| | Decrease in demand of 1.76Ml/d | Decrease in demand of 1.9Ml/d |

**Table 4.2: Demand Scenario testing results**

4.3.5 Based on the assumption in 9.6.1, an additional 10.7Ml/day will be required to support development if no reduction is made in consumption. If the recommendations of the East of England Plan are implemented, this reduces the additional resource requirement to 8.9Ml/day. Therefore if water neutrality is to be achieved within this study area, more ambitious targets will be required within local planning policy. The reduction in consumption required to achieve this, and the testing of alternative scenarios will be agreed with the stakeholders and assessed within the detailed WCS.

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## *4.4 Water Resources: Management and Planning*

4.4.1 The duties and responsibilities of the Environment Agency and AWS for the management and future planning of the use and development of water resources are summarised below.

Environment Agency

4.4.2 The Environment Agency manages water resources at a local level through Catchment Abstraction Management Strategies (CAMS), which were previously managed on a six yearly cycle.

4.4.3 The CAMS process has changed and will become a 'live strategy' called the Future CAMS, in order to feed into the WFD. The figure below gives the overview of the three stages that will be adopted. The CAMS products will be more customer focused. Customers can be within the Environment Agency and external such as current and future abstraction licence holders.

4.4.4 The future CAMS process has been divided into three stages which are;

- Stage 1: Resource Assessment Management (RAM) (Blue in Figure 4.2)
- Stage 2: Licensing strategy (Green in Figure 4.2)
- Stage 3: Measures appraisals process (Purple in Figure 4.2)

4.4.5 The first two are the main CAMS processes; the third stage is where CAMS links with other Water Resource activities.

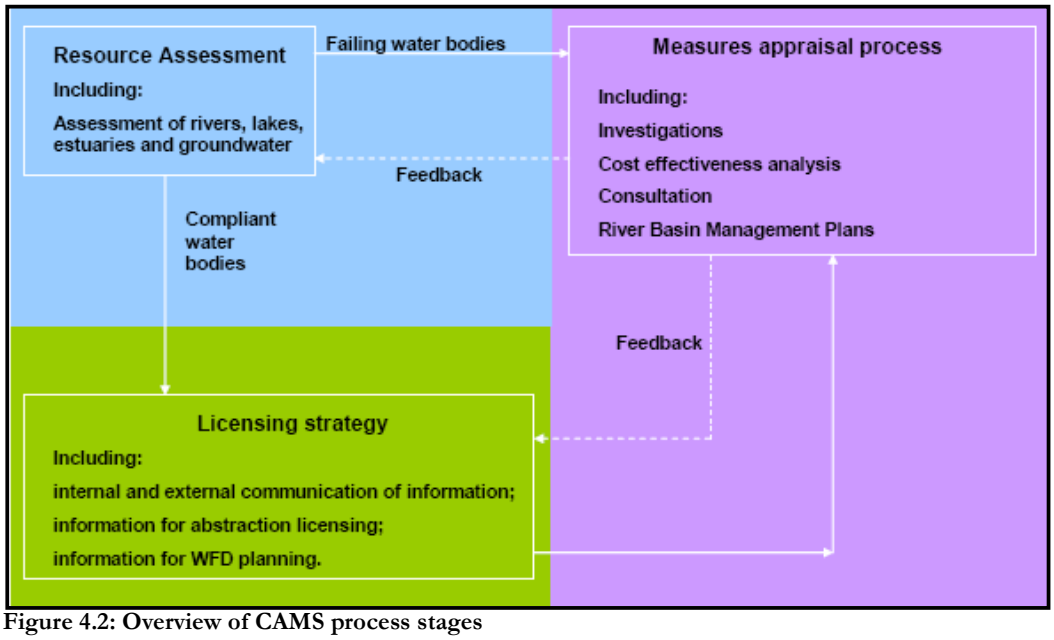


**Figure 4.2: Overview of CAMS process stages**

4.4.6 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:

a) The relative balance between the environmental requirements for water and how much is licensed for abstraction;

b) Whether water is available for further abstraction;

c) Areas where abstraction needs to be reduced.

`

4.4.7 The categories of resource availability status are shown in Table 4.3 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 4.3: CAMS resources availability status categories**

4.4.8 This classification can be used to help assess the potential for additional water resource abstraction opportunities. The effects of climate change are likely to further reduce supply and could also actually increase demand.

4.4.9 The EA are also responsible for implementing the Water Framework Directives, and the River Basin Management Plans, both of which may impact on existing water resources and the way they are used.

Anglian Water Planning

4.4.10 Information regarding the strategic water resources for the study area has been obtained for each company's supply area from its newly prepared draft Water Resources Management Plan (WRMP) 2008. These documents are currently undergoing public consultation.

4.4.11 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 4.3 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. Phase 2 of this WCS will identify specific water infrastructure requirements for the adopted and draft Core Strategies, taking this AMP funding cycle into account.

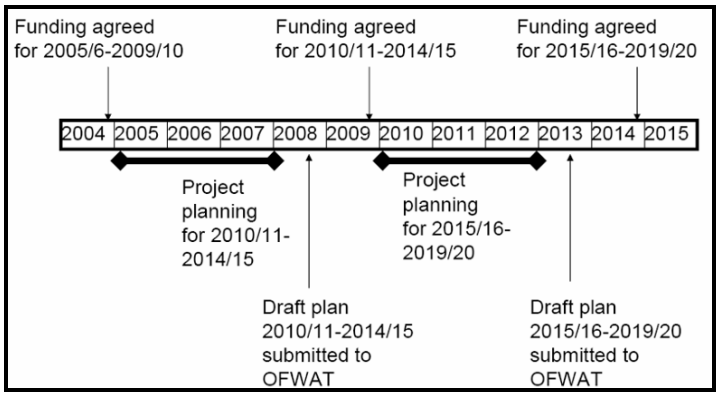


**Figure 4.3: Water company funding cycle**

## *4.5 Review of the relevant CAMS documents*

4.5.1 The WCS study area lies within the Upper Ouse and Bedford Ouse CAMS area, with the Eastern extent of the study area falling near the boundary with the Cam and Ely Ouse CAMS region. The boundaries of these respective CAMS areas can be seen in Figure 4.4.

4.5.2 The Upper Ouse and Bedford Ouse CAMS region is 3,000km$^2$ and covers the Great Ouse catchment and a number of its tributaries down to Earith.

4.5.3 AWS is the only water company entitled to make surface abstractions within its catchment, which abstractions accounts for 75% of all water abstracted from the CAMS region. Three water supply companies are able to abstract groundwater (Anglian Water, Three Valleys Water, and Cambridge Water Company).

4.5.4 There are a number of international, national, and locally ecologically significant sites within the catchment area, and these will be looked at in more detail in Section 8. The major discharges within the catchment are mainly from public Wastewater Treatment Works and groundwater protection is important due to the reliance of the surrounding areas on the local aquifers for water supply. The EA's Restoring Sustainable Abstractions programme (RSAp) is likely to have an impact on the way this groundwater is used in the future. Currently no 'Sustainability Reductions' are planned in Bedford or Mid Beds.

4.5.5 The EA assesses the status of water resource based upon a combination of separate surface water and groundwater assessments. The majority of the Upper Ouse and Bedford Ouse CAMS have been designated as *no water available* (Figure 4.4). Approximately half of the study area falls within this designation, while the other half is divided between *Over-abstracted* and *Over-licensed*. For these reasons AWS are unable to obtain new abstraction licences which can be relied upon in times of drought. AWS future water resource strategy is discussed below. It is important to note that CAMS are based on environmental need and focus on periods of low flow and not the high flows used to fill reservoirs. The limitations on licensed quantities are taken into account in AWS WRMP.

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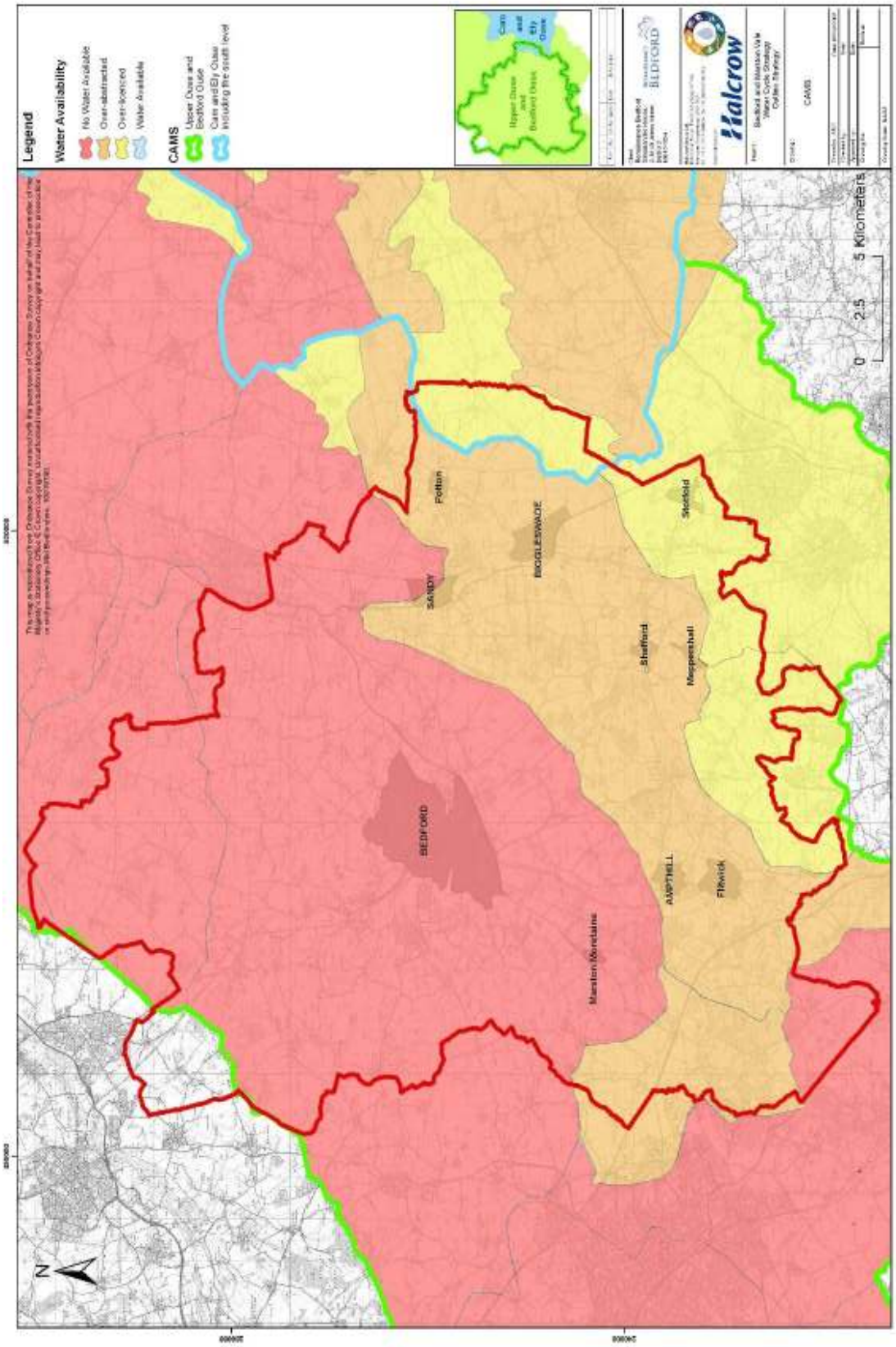


Figure 4.4: CAMS classifications water availability

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## *4.6 Water Resources Strategy*

Water Company Strategic Overview

4.6.1 Anglian Water provides both water and wastewater services in the UK to approximately six million industrial, commercial and domestic customers. The relevant Water Resource Zone (WRZ) for this study area's growth is Ruthamford. This is the largest WRZ in the Anglian network which integrates three large water treatment and storage facilities in Rutland to the south-west of Huntingdon and to the north of Northampton These provide water to a large area which includes Peterborough, Huntingdon, Corby, Kettering, Bedford, Wellingborough, Northampton, Milton Keynes and Daventry.

4.6.2 AWS has identified within its Strategic Direction Statement (SDS) that the main risk to supply faced over the next 25 years is climate change, which it will manage through mitigation and adaptation. The assumptions made by AWS within its draft Water Resources Management Plans 08 have been 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.

4.6.3 The final Water Resource Management Plans are to be submitted in Spring 2009 and it should be noted that the strategies and conclusions may vary from the draft to the final submission. As this WCS coincides with the preparation of the new WRMPs, the information used for the WCS is the most comprehensive and up-to-date possible. The water resources section will be updated during the detailed WCS to account for any new information available from the WRMP consultation.

4.6.4 In response to risks associated with climate change, AWS have considered impacts on both demand and supply. Demand impacts relate customer consumption with climate. For example longer periods of hotter weather will lead to higher peak demand. When considering impacts of climate change on water supply, the latest expert information has been sourced to aid predictions in variation of the hydrological cycle.

4.6.5 AWS 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 by AWS' optioneering model, including:

- Targeted customer metering;
- More effective customer tariffs and service pricing,
- Targeted leakage control,
- Grey water reuse and recycling,
- Regulation and targets for water efficiency, and
- Encouraging water efficient behaviour.

4.6.6 It should be noted that many aspects of demand management rely on customer behaviour and whilst AWS can influence this, it is ultimately outside of their control to enforce. 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.

4.6.7 AWS is investigating strategic resource development options to accommodate future growth, and compensate for sustainability reductions. These options are shown in Figure 4.5 below and include:

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- storage of winter rainfall runoff and transfer to the lower River Witham or the Ely-Ouse catchment using pipelines;
- transfers from the River Trent to winter storage in Rutland Water or direct to a water treatment works by pipeline;
- additional groundwater development, including reallocation of the use of the Environment Agency's Great Ouse Groundwater Development Scheme;
- managed aquifer recharge / aquifer storage recovery where hydro geological conditions are suitable.

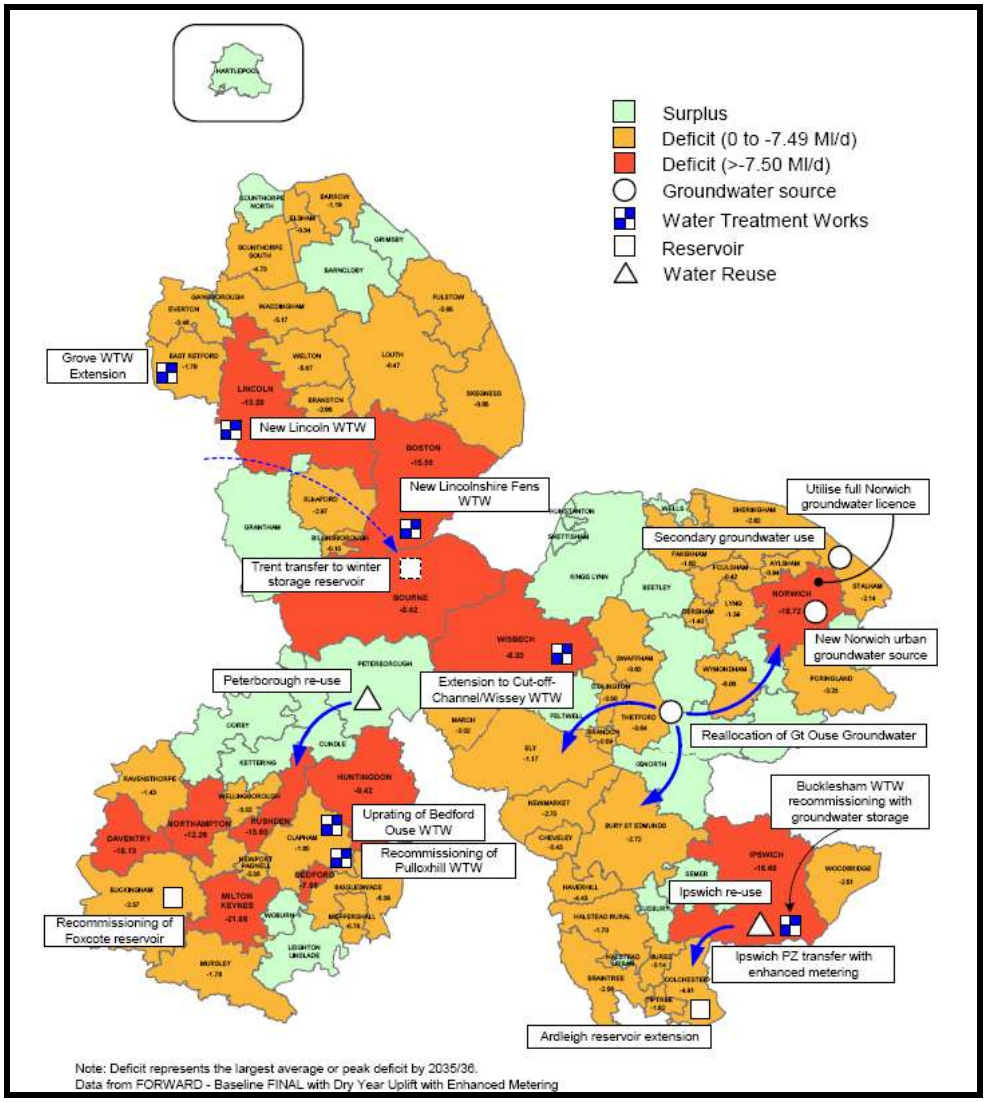


**Figure 4.5: Selected resource development options**

4.6.8 The Ruthamford WRZ was identified by AWS as having a surplus of available supply against target headroom during AMP5 (owing to significant investment to increase output from the WTW in Rutland during the AMP 4 period). AWS' draft WRMP 08 predicts a deficit for this WRZ by the end of AMP 6 (i.e. around 2020 below indicates the schemes relevant to the Ruthamford Water Resource Zone to support new and existing customers.

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| Location - WRZ | Scheme name | Period | Output Ml/d |
|---|---|---|---|
| Ruthamford | Recommisioning of Foxcote reservoir | AMP6+ | 12 |
| | Uprating of Bedford Ouse WTW ph1 | AMP6+ | 10 |
| | Recommisioning of Pulloxhill WTW | AMP6+ | 6 |
| | Peterborough discharge re-use | AMP6+ | 19 |
| | Uprating of Bedford Ouse WTW ph2 | AMP9 | 10 |

**Table 4.4: Selected new resource development schemes**

4.6.9 The following information for the study area is based upon liaison with AWS, and their draft Business Plan submission to Ofwat:

- Bedford and Biggleswade planning zones have a targeted metering penetration of around 90% by 2015, and 80% for the remaining zones,
- no sustainability reductions have been identified at this point for the study area, and
- the strategy to extend local Bedford Ouse WTW may be implemented to support development in the Marston Vale.

Water Resources Conclusion

4.6.10 In conclusion, AWS' strategic resource planning within the Ruthamford Water Resource Zone will support the proposed growth that AWS anticipate within the study area until 2035 in accordance with its 25 year Strategic Direction Statement. Consideration of other developments, around the study area, that require supply from this zone has been undertaken. Three Valleys Water holds a licence to abstract and transfer from the reservoir to the south-west of Huntingdon to Thames region, which has been considered in making the conclusion to supply to the study area. 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.

## *4.7 Water Supply: Current Network*

4.7.1 The significant majority of the study area is supplied by Anglian Water Services (AWS), with Three Valleys Water supplying the housing development on the grounds of the former Fairfield's Hospital to the South of the study area by inset agreement with Ofwat.

4.7.2 Anglian Water Services export water to Three Valleys Water (TVW) via a reservoir to the north of Luton. Water is transported southward to this reservoir via a reservoir to the north of Ampthill. TVW is entitled to an average of 91ML/day and a peak of 109ML/day from AWS under the Great Ouse Water Act, 1961. Currently TVW is not using their full entitlement, however proposed growth in its supply area will increase its use of this resource. This will place additional demand upon the water resources in the Ruthamford WRZ.

4.7.3 The primary water source for the study area is the reservoir located to the south-west of Huntingdon, from which water is transferred by a series of bulk transfer mains to key population centres including Bedford and Milton Keynes and the export to TVW. Bedford itself is supplied from a local reservoir, which stores a blend of water from the local treatment facility and the WTW to the south-west of Huntingdon..

4.7.4 There are a number of borehole abstractions, associated treatment works, and service reservoirs operating throughout the rural areas of the Bedford and Mid Beds districts that support local demand. These generally feed into small, discrete network areas

- Clapham Boosters (fed from local Bedford Reservoir) – supply the rural areas to the North of Bedford and associated water towers - Turvey, Milton Ernest and Ravensden.

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- Toplers Hill Reservoir – supplies half of Biggleswade and is fed from Newspring WTW and regional WTW , (Biggleswade is split into two zones, one fed from the 355mm connection to the Grafham bulk transfer main, and one fed from Toplers Hill Reservoir).

- Toplers Hill Tower – supplies south towards Stotfold and Arlesey, and is supplied primarily by Newspring WTW with some support from Dunton WTW.

- Dunton WTW – supplies mainly Northward towards Potton, with excess flowing to Toplers Hill Water Tower.

- Meppershall WTW – feeds the immediate surrounding areas including Shefford and Clifton.

- Pulloxhill Tower – is supplied indirectly from Grafham WTW feeds the local surrounding area to the South of Bedford. The boreholes and WTW may be re-commissioned in the future, releasing a small amount of capacity on Grafham, which will assist with meeting growth elsewhere.

- Birchmoor WTW – supplies the local surrounding area to the South West of Bedford and the associated Bow Brickhill Reservoir.

4.7.5 Bedford is the main urban centre within the study area, and it has two water supply works which are blended in a local reservoir before entering the network. These are;

- regional supply works located south-west of Huntingdon and

- local Bedford Ouse WTW

4.7.6 Both treatment works abstract from the Ouse. During winter months it is often necessary to blend water from the two sources to reduce nitrate levels to an acceptable level for supply. The proportion of water that may be contributed by the local WTW at Bedford, is constrained by abstraction licensing linked to minimum allowable flows in the River Great Ouse.

4.7.7 The water supply to Bedford from the local storage reservoir is fluoridated at the request of the Strategic Health Authority. The strategy to supply the growth in Bedford and Mid-Bedfordshire has to maintain the existing Agreement. As such, growth areas to the south which fall outside of the existing Agreement, will be fed from a reservoir located to the north of Ampthill which is a non-fluoridated supply.

4.7.8 Biggleswade supply is shared between direct connection to the transfer main from the major storage reservoir near Huntingdon and groundwater resource from Newspring boreholes via Toplers Hill Reservoir. Water from Toplers Hill Water Tower also supplies southward from Biggleswade to Stotfold and Arlesey areas.

4.7.9 Dunton boreholes and WTW located east of Biggleswade supply its immediate zone, and northward to Potton. Local borehole abstractions and treatment at Meppershall supply the immediate surrounding areas. Strategic mains from the reservoir to the north of Ampthill provide water supply toward Milton Keynes, and also to the south and south-west of the study area. Birchmoor boreholes and associated WTW to the east of Milton Keynes supply the immediate surrounds, and also a significant area of rural land northward towards Bedford via Bow Brickhill reservoir .

4.7.10 The Fairfield's Hospital site is supplied by Three Valleys Water through an inset agreement mentioned above and has approval for 1,200 new dwellings, of which 75% are built and operational. The development is supplied from the existing distribution zone by connection to a local transfer main. A ring main has been constructed around the site, and the remaining

distribution mains required for future parcels of development will be constructed when development demands. The existing system has the capacity to support this development.

## *4.8 Water Supply: Infrastructure Requirements*

Bedford Borough

4.8.1 AWS has identified the upgrades required to supply the agreed levels of growth in the Bedford Kempston and Northern Marston Vale growth area.

4.8.2 The Table 4.5 shows some of the Local Plan allocations and provides an indication of the proposed development sites, and the strategy that Anglian Water Services have devised to supply this LDF growth.

4.8.3 AWS has considered the construction of 17,000 new dwellings within this strategy, whereas MKSM Policy requires 16,270 new dwellings. A strategy provided by AWS to support this growth and the associated employment has been developed and is summarised in Table 4.5 Based on standard water industry costs, this upgrade is estimated to cost £3.5m.

| Construction | Serving Sites | Served by | Schedule |
|---|---|---|---|
| Phase 1 – 2.6 km main | Marsh Leys | local Bedford reservoir | Constructed |
| Phase 2 Section 1 – 3 km main | Biddenham | local Bedford reservoir | Constructed |
| Section 2 – 5.2 km main | Biddenham Loop<br>The Bury | local Bedford reservoir | 2008/09 – 13/14<br>2007/08 – 14/15 |
| Section 3 – 3.1 km main | Wootton<br>Kempston | local Bedford reservoir | 2010/11 – 20/21 |
| Section 4 – 3.6 km main | Stewartby<br>Kempston / Hardwick<br>Broadmeadow Park | Ampthill reservoir | 2008/09 – 15/16 |
| Section 5 – 5km main | Houghton Conquest<br>Stewartby<br>Wixams | Ampthill Reservoir | 2007/08 – 21/22 |
| **Development Phasing (Renaissance Bedford, Quarter 1 – Housing Report, 2008)** | | | |

**Table 4.5: Infrastructure requirements for the Bedford Growth Area**

4.8.4 The majority of these strategic main reinforcements will be development led. The proposed boundary located south of Marsh Leys is the zone boundary between the fluoridated water supply from local reservoir and the non-fluoridated water supply from Ampthill reservoir.

Mid Beds

4.8.5 Based upon the sites proposed within the Mid Beds Allocations DPD, AWS provide to Mid Beds District Council on the capacity of the water supply network and the capacity of the Water Treatment Works to support these sites. This is summarised in Table 4.6 and Table 4.7 below. The tables indicate that minimal water supply improvements that would be required if growth within Mid Beds is focused upon the major service centres. Development within the minor service centres will require offsite reinforcements.

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| *Major Service Centres* | | | |
|---|---|---|---|
| **Area** | **Served By** | **Treatment Requirements** | **Network Requirements** |
| Biggleswade | Regional WTW to SW of Huntingdon and Dunton/Newspring WTWs | None | Strategic and local reinforcements |
| Sandy | Regional WTW to SW of Huntingdon | None | None |
| Flitwick | Regional WTW to SW of Huntingdon | None | Local offsite reinforcements may be required |
| Ampthill | Regional WTW to SW of Huntingdon | None | None |
| Wixams | Regional WTW to SW of Huntingdon | None | New strategic main |

**Table 4.6: Mid Beds Major Service Centre Growth requirements**

| *Minor Service Centres* | | | |
|---|---|---|---|
| **Area** | **Served By** | **Treatment Requirements** | **Network Requirements** |
| Potton | Dunton WTW | None – additional resource will be met by regional WTW to SW of Huntingdon. | None |
| Shefford | Meppershall WTW | None | None |
| Cranfield | Birchmoor WTW | None – additional resource will be met by regional WTW to SW of Huntingdon. . | Substantial local reinforcements may be required |
| Stotfold | Dunton and Newspring WTWs | None – additional resource will be met by regional WTW to SW of Huntingdon. . | Offsite reinforcements required from Topler hill reservoir, including. reinforcements across Stotfold Common. |
| Arlesey | Dunton and Newspring WTWs | None – additional resource will be met by regional WTW to SW of Huntingdon.. | Offsite reinforcements required from reservoir to SE of Biggleswade, inc. reinforcements across Stotfold Common. |
| Marston Moretaine | Birchmoor WTW | None – additional resource will be met by regional WTW to SW of Huntingdon.. | Substantial local reinforcements may be required |

**Table 4.7: Mid Beds Minor Service Centres Growth Requirements**

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## *4.9 Water Network Summary*

4.9.1 A significant portion of development within the study area will be urban extensions to Bedford. The infrastructure strategy to supply this development is well advanced by AWS and an initial phase of this work has already been undertaken. Water will be augmented predominantly from reservoir to the south-west of Huntingdon.

4.9.2 The development planning for Mid Beds is less progressed and at this stage, AWS has identified the extent of works associated with the various service centres. For the major service centres, Biggleswade and Wixams have been identified as needing additional infrastructure. For the minor service centres, Cranfield and Marston Moretaine will require additional infrastructure.

## *4.10 Conclusions*

4.10.1 AWS has a long term deficit of water resources in the Ruthamford water resource zone and it has identified the upgrades required to support growth, such as the recommissioning of Foxcote and Pulloxhill WTWs. The additional homes required in the Bedford, Kempston and Northern Marston Vale area will require an additional 6.69Ml/d by 2021.

4.10.2 Implementing the water efficiency measures contained within the East on England Plan (25% reduction in new homes and 8% reduction in existing homes), will not be sufficient to achieve water neutrality across the study area, and therefore additional water resources will be required. To achieve water neutrality, much more ambitious water efficiency measures will be required. The detailed of the WCS should investigate the impact of demand management measures and their effectiveness in reducing the amount of water required.

4.10.3 A number of the more localised borehole supplies are reaching capacity and development in these areas will be supported by a higher import from Grafham Water.

4.10.4 AWS has an upgrade strategy to supply the urban extension to Bedford Growth Area. Capacity is available to support development within the major service centres in Mid Beds as planned in the Draft Submission Core Strategy, but improvements will be required to support development in the minor service centres.

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# 5 Wastewater and Water Quality

## *5.1 Introduction*

5.1.1 The purpose of the wastewater section is to identify the available wastewater treatment and sewer capacity and what strategic upgrades or local improvements are required to accommodate the level of development identified in the Local Development Framework. The objective of the Councils is to be able to use this information in the preparation of Site Allocations DPDs. Within Bedford Borough Council LPA area, the target housing provision is largely made up from committed sites which have a right to connect to the sewer network.

5.1.2 Anglian Water Services (AWS) is responsible for the operation and maintenance of the existing foul drainage network within the study area. AWS is also responsible for surface water drainage from roofs, driveways and hard standings relating to properties, if they are connected directly to the public sewer system or if the surface water system has been adopted by AWS. They are not responsible for soakaways, land drainage, highway drainage, SUDS or private water systems.

Bedford

5.1.3 The existing major wastewater treatment works, Bedford WwTW will require upgrades to treat flows from the planned growth in the area. Anglian Water Services Ltd (AWS) will be including a growth scheme for Bedford WwTW for the investment period AMP5 covering 2010-2015. AWS is aware of the urgency of the situation. Undertaking the works will result in a temporary overload of the remaining treatment units until the upgrade is completed. Further discussion between the Environment Agency and AWS is required to agree a methodology of how this upgrade can be undertaken to avoid detriment to water quality. It is important that a methodology is agreed as soon as possible to prevent delay to the upgrade of Bedford WwTW. Previous enquiries have concluded that there would be restrictions to AWS in terms of purchase additional land to expand Bedford WwTW. This purchase of additional land would both allow the continued use of existing assets and enable more sustainable (but higher footprint) process treatment to be used.

5.1.4 It is expected that the Bedford Southern Orbital Trunk sewer can accommodate additional discharge from the proposed AMP5 developments within Bedford. However, beyond 2015, consideration needs to be given to a sewerage strategy to serve LDF development within the Bedford works catchment eg at Houghton Conquest. Upgrades to Castle Mill TPS will be required to support the developments, North of Brickhill, Bedford; North of Norse Road, Bedford and Norse Road Bedford.

Mid Beds

5.1.5 To inform the production of the Mid Beds Site Allocations DPD, AWS has provided a list of wastewater constraints for each site under consideration. This information is summarised within the full WCS report. Within Mid Beds, the existing wastewater treatment infrastructure for a number of the settlements likely to receive growth is operating close to flow consent capacity. Further studies are to be undertaken by AWS in the majority of settlements to establish where infrastructure reinforcements are required to support the proposed growth. AWS will carry out the following improvements if the proposed developments are certain to proceed;

- Home Farm, Cranfield; by upsizing the existing sewer mains.
- Stotfold; by increasing the size of the pump station and still undertake further studies

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- Biggleswade; by construction of a foul Pumping Station and rising main.

5.1.6 To ensure no deterioration of water quality due to growth, tighter discharge consents will be required at Bedford. Further investigation of current and future flows is required for Biggleswade, Marston Moretaine, Clophill, Potton, Poppyhill, , Clifton and Sandy.AWS is planning to upgrade Bedford and Marston Moretaine WwTW in AMP5 to accommodate the planned levels of growth

5.1.7 It is unlikely to be feasible to upgrade Marston Moretaine WwTW to accommodate the proposed eco-town development as the site is congested and has little room for expansion beyond the existing boundary. Either a new WwTW or transfer of flows to Bedford WwTW will need to be considered. The potential for a new treatment works in the Marston Vale would seem to be limited by water quality constraints (see Section 9) and will be reliant upon the actual water quality scenarios enforced by the Environment Agency. Further investigation into the water quality constraints and wastewater treatment to develop a long term strategy are an essential part of the detailed WCS scope (see Section 11). This should include an assessment of the water quality impacts of upgrading Marston Moretaine WwTW against the financial and carbon cost of transferring flows to Bedford WwTW.

5.1.8 AWS has been the main source of information relating to the existing foul drainage network and wastewater treatment facilities for this study. This study has summarised the information supplied by AWS for the Bedford and Mid Beds site allocations DPD and provides additional assessment of six WwTWs which will receive the largest proportion of growth in the study area, with the aim of identifying the shortfall in available treatment capacity to treat all flows from planned levels of development.

5.1.9 This study also proposes and assesses four outline strategic options for wastewater treatment for the Marston Vale growth area and reiterates the importance of the need to upgrade Bedford WwTW prior to accepting additional flows.

## *5.2 Wastewater Treatment*

5.2.1 The largest Wastewater Treatment Works (WwTW) in the study area is Bedford WwTW. There are forty four other treatment works in the study area (see Figure 5.1). The works that are most likely to receive the largest proportion of development;

- Biggleswade WwTW
- Clifton WwTW
- Clophill WwTW
- Flitwick WwTW
- Marston Moretaine WwTW
- Poppyhill WwTW
- Potton WwTW; and
- Sandy WwTW

5.2.2 Sandy WwTW is currently undergoing improvements and Clifton WwTW has recently been reconstructed. For this reason, details of the new works and their capacity to accommodate new growth are not currently available. The projected growth in these catchments is relatively modest, but the ability of the new treatment units to accommodate this additional load cannot be established until sufficient flow and quality data has been collated. Further assessment within the detailed study shall be required to determine the permissible growth at these two works.

`

5.2.3 Flitwick wastewater treatment works has adequate flow headroom and process capacity to accommodate the projected growth without the need for a new consent or works improvements.

5.2.4 For these reasons, this study assesses Bedford, Biggleswade, Clophill, Marston Moretaine, Poppyhill and Potton WwTW in more detail and is described in more details in Table 5.1 to Table 5.6 below.

5.2.5 The following tables 5.1 to 5.6 summarises the status of each Wastewater Treatment Works and highlights the potential to accept flows from the proposed developments. The tables also shows the water quality requirements and the associated headroom available in terms of dwellings at each WwTW which gives an indication of the upgrades or improvements that will be required to sustain growth.

`

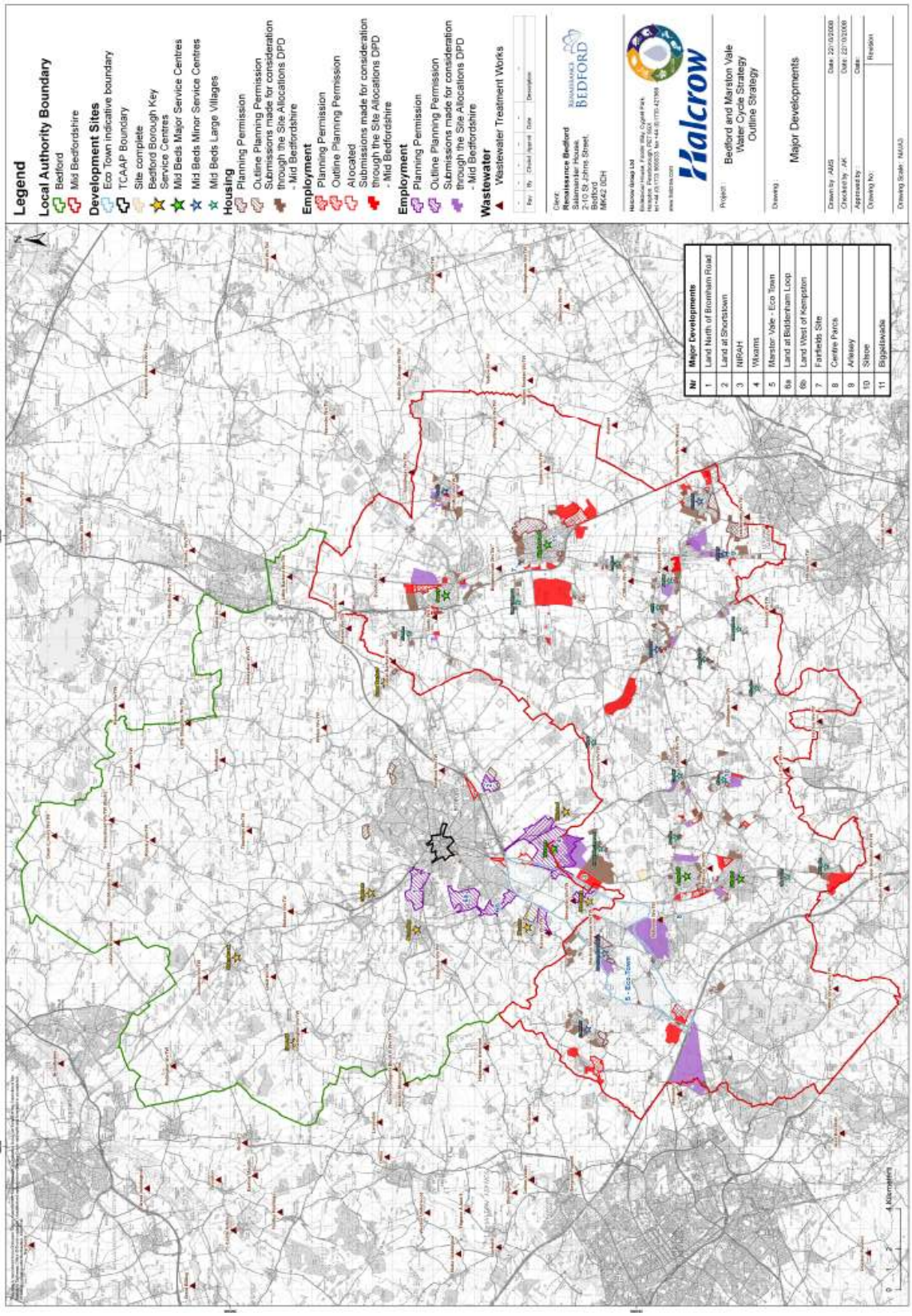



Figure 5.1: Major Developments and WwTW locations

| Bedford WwTW | | | | | |
|---|---|---|---|---|---|
| **Final effluent discharge watercourse:** | | | River Great Ouse | | |
| | | | | | |
| **Towns and villages served:** | | | | | |
| Bromham | Cardington | Cople | Elstow | Kempston | Renhold |
| Biddenham | Clapham | Eastcotts | Oakley | Ravensden | Stevington |
| Willington | Wilstead | Wootton | Bedford | Houghton conquest | |

**Current Situation**

| Water quality consented limits | | | | Current DWF ($m^3$/day) | Available headroom dwellings |
|---|---|---|---|---|---|
| BOD (mg/l) | SS (mg/l) | Ammonia (mg/l) | DWF ($m^3$/day) | | |
| 20 | 30 | 7 | 35,000 | 32722* | 5,420 |

*AW measured flow 2007

- Currently meets discharge limits
- Flow compliance scheme agreed with EA increasing cDWF to 45 422 m3/d with no change to BOD, TSS, ammN
- Limited capacity, needs upgrades to accommodate growth
- Wixams development already connected with 2,250 dwellings proposed
- Treatment site congested
- Potential restrictions upon AWS to purchase adjacent land to date
- Extension by demolition of part of works and replacing with a more compact treatment process
- Based upon measured flow data, a revised discharge consent will be required before 2016

**Anglian Water Plans & Comments**

- Revised DWF volumetric discharge consent under AMP5 from 35,000$m^3$/d to 45,422 $m^3$/d
- Plans to extends works in AMP5
- Aware of the urgency of the situation
- To upgrade decommissioning part of the works, results in temporary overload of remaining WwTW
- Reliant on Ofwat approval to confirm the level of AMP5 capital expenditure before scheme commitment

**Growth**

| Year | Population Growth | | Projected Load (persons) | % Increase | Comments |
|---|---|---|---|---|---|
| | Domestic | Commercial* | | | |
| 2006 | | | 173,917 | | Will require extension to meet future load |
| 2011 | 7,382 | 2,235 | 183,534 | 6% | |
| 2016 | 14,764 | 4,470 | 193,151 | 11% | |
| 2021 | 22,146 | 6,704 | 202,767 | 17% | |
| 2026 | 29,528 | 8,939 | 212,384 | 22% | |

**Table 5.1: Bedford WwTW existing and future status. Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids**

| Biggleswade WwTW | | | | | |
|---|---|---|---|---|---|
| **Final effluent discharge watercourse:** | | | River Ivel | | |
| | | | | | |
| **Towns and villages served:** | | | | | |
| Biggleswade | Northill | | | | |

**Current Situation**

| Water quality consented limits | | | | Current DWF ($m^3$/day) | Available headroom dwellings |
|---|---|---|---|---|---|
| BOD (mg/l) | SS (mg/l) | Ammonia (mg/l) | DWF ($m^3$/day) | | |
| 25 | 40 | 10 | 4,080* | 4,100 | 45 |

AWS measured flow 2007

- Currently meets discharge limits
- Treatment works site has space for limited extension and surrounded by agricultural land
- Further investigation into reduction of trade flows and potential capacity for growth

**Anglian Water Plans & Comments**

- Revised DWF volumetric discharge consent under AMP5 from 4100$m^3$/d to 4895 $m^3$/d includes some allowance for growth
- A reduction in trade flows from a major food trader has created capacity for development.
- Revised consent limit will determine the extent of any improvement required to accommodate further growth.

**Growth**

| Year | Population Growth | | Projected Load PE | % Increase | Comments |
|---|---|---|---|---|---|
| | Domestic | Commercial* | | | |
| 2006 | | | 22,477 | | Improvement will be required to meet future load |
| 2011 | 1,507 | 371 | 24,355 | 8% | Revised consent required |
| 2016 | 3,014 | 743 | 26,233 | 17% | Additional treatment capacity required during period |
| 2021 | 4,520 | 1,114 | 28,111 | 25% | |
| 2026 | 6,027 | 1,485 | 29,989 | 33% | |

**Table 5.2: Biggleswade WwTW existing and future status. Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids.**

| Clophill WwTW | | | | | |
|---|---|---|---|---|---|
| **Final effluent discharge watercourse:** | | | River Flit | | |
| | | | | | |
| **Towns and villages served:** | | | | | |
| Clophill | Silsoe | Maulden | | | |

**Current Situation**

| Water quality consented limits | | | | Current DWF ($m^3$/day) | Available headroom dwellings |
|---|---|---|---|---|---|
| BOD (mg/l) | SS (mg/l) | Ammonia (mg/l) | DWF ($m^3$/day) | | |
| | 80 | 15 | 1,800 | 1527* | 1,395 |

*AWS measured flow 2008

- Currently meets discharge limits
- No storm water treatment facilities, all flows passed to full treatment
- Works is fully loaded hydraulically at consented flow, but is adequately sized to accommodate the consented flow to full treatment of three times the DWF.
- Headroom available greater than the levels of development planned in the catchment, capital expenditure will be required if more properties are to be connected above the above limit to maintain the quality of the effluent discharge to River Flit

**Anglian Water Plans & Comments**

- The consented DWF is adequate to accommodate the future load, and so a revision of discharge standards should not be necessary prior to year 2026

**Growth**

| Year | Population Growth | | Projected Load PE | % Increase | Comments |
|---|---|---|---|---|---|
| | Domestic | Commercial* | | | |
| 2006 | | | 6,226 | | |
| 2011 | 285 | 25 | 6,535 | 5% | |
| 2016 | 570 | 49 | 6,845 | 10% | |
| 2021 | 855 | 74 | 7,155 | 20% | |
| 2026 | 1,140 | 98 | 7,464 | 25% | |

**Table 5.3: Clophill WwTW existing and future status. Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids.**

| Marston Moretaine WwTW | | | | | |
|---|---|---|---|---|---|
| **Final effluent discharge watercourse:** | | | Marston Brook | | |
| | | | | | |
| **Towns and villages served:** | | | | | |
| Marston Moretaine | Cranfield | Lidlington | | | |
| | | | | | |
| **Current Situation** | | | | | |
| **Water quality consented limits** | | | | **Current DWF ($m^3$/day)** | **Available headroom dwellings** |
| **BOD (mg/l)** | **SS (mg/l)** | **Ammonia (mg/l)** | **DWF ($m^3$/day)** | | |
| 20 | 30 | 10 | 2,300 | tbc | nil |

- Currently meets sanitary discharge limits
- Candidate to receive a large amount of growth, possibly including unassigned growth of 3,560 dwellings
- Treatment site is congested with little room for extension, ongoing development is adjacent site
- Access to site is unsatisfactory and presently passes through a residential area.
- Present consent conditions are achievable with present treatment plant, but performance would be marginal against a load equivalent consent to accommodate the future load
- Discharge consent and measured flow data to be investigated.

**Anglian Water Plans & Comments**

- Limited growth can be accommodated through minor process improvements planned for AMP5
- Since the site is constrained by residential development to the South and West, Stewartby Lake to the North East and a leisure park to the South East, expansion will be difficult
- A strategy will be required to address the future treatment requirements, (regardless of whether eco-town is progressed) Treatment options for Marston Vale are discussed in Section 9.4.

**Growth**

| Year | Population Growth | | Projected Load PE | % Increase | Comments |
|---|---|---|---|---|---|
| | Domestic | Commercial* | | | |
| 2006 | | | 9,542 | | Access constraints, limited scope for future extension |
| 2011 | 651 | 375 | 10,568 | 11% | |
| 2016 | 1,302 | 750 | 11,594 | 21% | Additional treatment capacity |
| 2021 | 1,953 | 1,124 | 12,619 | 32% | |
| 2026 | 2,604 | 1,499 | 13,645 | 43% | |

**Table 5.4: Marston Moretaine existing and future status. Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids.**

| Poppyhill WwTW | | | | | |
|---|---|---|---|---|---|
| **Final effluent discharge watercourse:** | | | River Ivel | | |
| | | | | | |
| **Towns and villages served:** | | | | | |
| Arlesey | Stotfold | Langford | | | |

**Current Situation**

| Water quality consented limits | | | | Current DWF ($m^3$/day) | Available headroom dwellings |
|---|---|---|---|---|---|
| BOD (mg/l) | SS (mg/l) | Ammonia (mg/l) | DWF ($m^3$/day) | | |
| 20 | 40 | 8 | 4,700 | 3060* | 4,760 |

*Estimated from present load – 12 months measured flow data not available

- Currently meets discharge limits
- Until recently the works also received part of flow from the overloaded Clifton WwTW
- The works as recently reconstructed and the flow diversion has been curtailed and has freed up some treatment capacity
- No storm water treatment facilities and so all incoming flow is passed directly to full treatment
- EA has consented the use of storm tanks from the 2nd of March 2009. Works have adequate hydraulic capacity, and since any new development is likely to be served by a separate sewerage system this should continue to be the case.

**Anglian Water Plans & Comments**

- AWS are currently constructing storm tanks consented by the Environment Agency.
- Additional biological treatment capacity may be required in the AMP5 period (2011 to 2016), depending upon the performance of the trickling filters. This will certainly be required by the year 2021, when a revised consent will be required to accommodate the projected growth.

**Growth**

| Year | Population Growth | | Projected Load PE | % Increase | Comments |
|---|---|---|---|---|---|
| | Domestic | Commercial* | | | |
| 2006 | | | 13,645 | | |
| 2011 | 1,338 | 215 | 19,005 | 9% | Additional treatment capacity |
| 2016 | 2,676 | 430 | 20,558 | 18% | |
| 2021 | 4,015 | 644 | 22,111 | 27% | Revised consent required |
| 2026 | 5,353 | 859 | 23,664 | 36% | |

**Table 5.5; Poppyhill WwTW existing and future status. Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids.**

| Potton WwTW | | | | | |
|---|---|---|---|---|---|
| **Final effluent discharge watercourse:** | | | Sutton Brook, a tributary of the River Great Ouse | | |
| **Towns and villages served:** | | | | | |
| Potton | Sutton | | | | |

**Current Situation**

| Water quality consented limits | | | | Current DWF ($m^3$/day) | Available headroom dwellings |
|---|---|---|---|---|---|
| BOD (mg/l) | SS (mg/l) | Ammonia (mg/l) | DWF ($m^3$/day) | | |
| 15 | 30 | 8 | 1,200 | 1,100* | 1,690 |

*Estimated from present load.

- Currently meets discharge limits
- Works is almost fully loaded, with capacity to accept levels of growth planned.
- The proposed growth of approximately 8% to the year 2026 would result in a theoretical overload of the trickling filters, and so improvements may be required on this account.
- However, the performance of trickling filters does not normally deteriorate suddenly with increasing load, and so the need for and the timing of any improvements will be dependent on the present performance to a greater extent than the theoretical loading. It will therefore be necessary to look at the current performance of this works in order to assess the probable impact of the proposed growth.

**Anglian Water Plans & Comments**

- Flow requires investigation as recorded flow less than would be expected from population served

**Growth**

| Year | Population Growth | | Projected Load PE | % Increase | Comments |
|---|---|---|---|---|---|
| | Domestic | Commercial* | | | |
| 2006 | | | 5,401 | | |
| 2011 | 148 | 0 | 5,549 | 3% | |
| 2016 | 296 | 0 | 5,697 | 5% | |
| 2021 | 444 | 0 | 5,845 | 8% | |
| 2026 | 592 | 0 | 5,994 | 11% | |

**Table 5.6: Potton WwTW existing and future status. Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids.**

## *5.3 Water Quality*

5.3.1 The discharge consents for the WwTWs are set by the Environment Agency to protect the quality of the receiving watercourse. These consents are based on the ecological sensitivity of the receiving watercourses and specify a maximum dry weather flow and effluent quality that the WwTWs have to achieve to meet water quality targets without causing deterioration in water quality.

5.3.2 As the population connected to sewage treatment works increases, the amount of treated wastewater, or effluent, being discharged to the receiving water generally increases in proportion to the population increase. When this increased population causes the works to exceed the consented maximum discharge volume, improvements are likely to be required to the works to improve the standard of treatment and prevent failure of water quality targets.

Future Water Quality Requirements

5.3.3 The water quality modelling undertaken to support the WCS, calculated the water quality consents requirements for two scenarios in the years 2016 and 2026;

- "Business as usual" assuming no change in consumption figures (All new developments are assumed by Halcrow to be metered with a consumption of 120l/head/day, infiltration 45l/head/day, with trade discharges at the same as current rates)
- An outline assessment of climate changes; reducing the mean river flow by 20% and 95%ile low flow by 10%. (Adjustments to main river flows only at head and no adjustments were applied to the diffuse flows).

5.3.4 The modelling was undertaken using the Environment Agency's software SIMCAT, extracted from the Wash catchment. This has previously been calibrated for river flows, checked and updated, where required, using five flow gauges in the catchment. The water quality upstream was calibrated using upstream flows and quality by the Environment Agency and the WwTW flows and quality by Anglian Water.

5.3.5 For each assessment the SIMCAT model has been used to assess the discharge consent that would be required to meet each of the following eventualities:

- No deterioration; Required in order to ensure no deterioration of water quality against the 'planned' water quality downstream of the WwTW;
- River Quality Objectives (RQO): this assessment was carried out for BOD and ammonia because the RQO objectives have no target for phosphate; and
- Water Framework Directive (WFD): to assess the likely impact of the WFD, with the target set to achieve 'good ecological status'.

5.3.6 The modelling results suggested that the difference between the 'business as usual' and the 'climate change' scenario was minimal in terms of requiring tighter discharge consents. This will be confirmed in the detailed WCS when the impact of climate change is examined in further detail.

5.3.7 In this context the consents needed to ensure no deterioration of water quality has been assessed under the guise of the WFD, which has 'no deterioration' as its first principle. There is currently uncertainty in the application of WFD targets and standards, and compliance with the WFD will be achieved through a programme of measures delivered in the statutory River Basin Management Plans, to be consulted on in early 2009. Current phosphate consents in the catchment are derived to comply with the Urban Waste Water Treatment Directive (UWWTD). The UWWTD sets consents as an emission limit based on the Population Equivalent (PE) serving by a Wastewater Treatment Works, and is not calculated to ensure compliance with a River Quality Objective (RQO). Therefore, the consent set

under the UWWTD will not be required to be tightened under the UWWTD, even though this would mean a chemical deterioration in the river. The planned water quality relating to existing phosphate standards at the locations of the WwTW is shown in Table 5.7 and result from the UWWTD Sensitive Area designations downstream.

5.3.8 The Habitats Directive is relevant in Special Protection Areas and Special Areas of Conservation, and consents are defined based on the outputs from an Appropriate Assessment. For example, Potton WwTW has a future discharge consent limit of 1 mg/l phosphate under the Habitat Directive which is due to become effective in October 2009.

5.3.9 The relationship between the Habitats Directive and the WFD has still to be finalised. In the absence of clear guidance on how 'no deterioration' under the WFD will be applied, we have assumed no chemical deterioration will be permissible, and have calculated the consents required to maintain the current chemical load in the river.

5.3.10 Anglian Water took the option of using a catchment solution to achieve the Habitat Directive river phosphate target adjacent to the Ouse Washes. Therefore an increase in the consented flow at any WwTW upstream of the Ouse Washes within a particular area of influence, will trigger an Appropriate Assessment which will require modelling of the area of influence to assess impact on the Ouse Washes. The reduction in phosphate load within the watercourse, if required, does not necessarily need to be achieved by changing all of the discharge consents within the catchment of the Ouse Washes, providing that Phospahe concentration in the river adjacent to the Ouse Washes does not increase.

5.3.11 Clophill WwTW was assessed as part of this review of consents and did not require a new Phosphate consent. However, any increase in consented flow at this or other WwTWs in the catchment will require further modelling. This should be considered further in the detail WCS.

5.3.12 The Habitat Directive is only one reason for imposing a phosphate consent limit. Limits also need to consider WFD. Any breach in WFD targets may lead to the requirement in the following AMP period for new discharge consent limits irrespective of whether a change in flow has occurred.

River Ecosystem classification system

5.3.13 The system assesses the water quality in different rivers, based on chemical requirements of a healthy river ecosystem that is able to support fish[2]. The classification is based on a ladder of increasing quality to reflect the needs of plants and animals in rivers. There are five classes, with decreasing quality, RE1 being the highest quality and RE5 being the lowest quality. These classes are based on the following water quality criteria[3];

- Dissolved oxygen
- BOD
- Ammonia
- Un-ionised Ammonia
- pH
- Hardness
- Dissolved Copper and

[2] The definition is set out in The Surface Water (River Ecosystem) (Classification) Regulations 1994, SI 1994 No. 1057.

[3] Information obtained from www.environment-agency.gov.uk/commondata/103599/river_e1.doc on River Ecosystem Classification System.

- Total Zinc.

5.3.14 A summary of the three water quality targets for the chemical loading in the watercourse used in the analysis is shown in Table 5.7. The model results predict that the water quality at immediately upstream of Clophill STW would fail the limits required for the River Ecosystem Class 3. This was due to high strength (BOD) effluent from Chalton and Flitwick WwTWs. For this outline study, the observed water quality data was used rather than the modelling data. The impact of the upstream WwTWs upon the required discharge consent at Clophill needs to be further examined in the detailed WCS. This may require the, the consideration of a catchment based water quality study to inform this assessment.

5.3.15 The following table summarises the water quality targets (in the receiving watercourse and not of the wastewater effluent) used in the modelling to achieve 'no deterioration' of the current planned water quality and to meet the RQO and WFD standards. These standards are expressed as 90 percentiles values for Biochemical Oxygen Demand (BOD) and ammonia. An annual Average is used for the phosphorus values.

| | Current Planned Water Quality | | | RQO | | WFD | | |
|---|---|---|---|---|---|---|---|---|
| STW ID | BOD (90 %ile) (mg/l) | Ammonia (90 %ile) (mg/l) | Phosphate Annual Mean (mg/l) | BOD (mg/l) | Ammonia (mg/l) | BOD (mg/l) | Ammonia (mg/l) | Phosphate* (mg/l) |
| **Marston Moretaine** | 5.54 | 2.08 | 0.62 | 6 | 1.3 | 5 | 0.6 | 0.12 |
| **Clophill** | 3.71 | 0.86 | 0.27 | 6 | 1.3 | 5 | 0.6 | 0.12 |
| **Poppyhill** | 5.15 | 0.9 | 0.56 | 6 | 1.3 | 5 | 0.6 | 0.12 |
| **Biggleswade** | 3.39 | 0.46 | 0.41 | 6 | 1.3 | 5 | 0.6 | 0.12 |
| **Potton** | 4.11 | 1.36 | 0.71 | 6 | 1.3 | 5 | 0.6 | 0.12 |
| **Bedford** | 4.07 | 0.74 | 0.31 | 6 | 1.3 | 5 | 0.6 | 0.12 |

**Table 5.7: Water quality standards (within the watercourse) used in the modelling.**

* Achieving a phosphate standard of 0.12 mg/l for the effluent from a wastewater treatment works is not achievable with current technology and highlights the challenges of meeting the WFD meaning that catchment wide solutions will be required.

Consent required to meet regulated water quality

5.3.16 Marston Moretaine STW discharges to Marston Brook, which flows almost immediately into Stewartby Lake. The Marston Brook is an unclassified river, and thus there is no River Ecosystem target. For inclusion within this study, a target of RE3 was assumed for the RQO assessments, as this is consistent with classification for the downstream reaches of Elstow Brook. It is currently unclear what classification Elstow Brook will be required to achieve under the Water Framework Directive (WFD), and for the purposes of this modelling it has been assumed the Brook would be required to meet RE2 (i.e. an indication of good ecological status). This assumption can be further tested in the detailed WCS.

5.3.17 The Stewartby Lake has been designated as a Water Body in its own right under WFD, and is a designated Cyprinid Fishery under the Freshwater Fish Directive, but is known to suffer

from algal blooms. To represent the settling effect of the lake on the pollutants the SIMCAT model was adjusted until a good calibration was achieved with the downstream water quality monitoring point. This calibration represents a particular area of uncertainty in the water quality monitoring and should be further examined as part of the detailed WCS.

5.3.18 Table 5.8, Table 5.9 and Table 5.10 give indicative water quality requirements for the proposed levels of development. This is to ensure no adverse effect on the existing water quality. The modelling results suggested that the difference between the 'business as usual' and the climate change scenario for DWF was minimal in terms of tighter consents. This will need to be tested in the detailed WCS when the impact of climate change is examined in further detail. Where a difference was observed these values have been included in the following tables.

| WwTW | Estimated DWF in 2026 (Ml/day) | Indicative consent adjustments to ensure no deterioration in current water quality | | |
|---|---|---|---|---|
| **Bedford** | **39.5** | BOD consent tightened from 20mg/l to 19mg/l by 2026 | Ammonia tightened by 1mg/l by 2026 (from 7 mg/l to 6 mg/l) | None |
| **Biggleswade** | **5.9** | BOD consent from 25mg/l to 21mg/l by 2016 | Ammonia tightened from 10mg/l to 7mg/l by 2026 | Phosphate tightening to 1mg/l |
| **Marston Moretaine** | **2.3** | None | Ammonia tightened from 10mg/l to 9mg/l (Under climate change scenario) | None |
| **Potton** | **1.3** | BOD consent tightened from 15mg/l to 14mg/l by 2026 | None | Phosphate tightening by 1mg/l |
| **Clophill** | **1.3** | None | None | Phosphate should be set to 1mg/l |
| **Poppyhill** | **4.0** | None | None | Phosphate tightened to 1mg/l |

**Table 5.8: Indicative consent adjustments to ensure no deterioration in current water quality**

| WwTW | Indicative consent adjustments to meet River Quality Objective |
|---|---|
| **Bedford** | None |
| **Biggleswade** | None |
| **Marston Moretaine** | Ammonia tightened from 10mg/l to 6-7mg/l by 2026 |
| **Potton** | Ammonia tightened from 8mg/l to 7mg/l by 2016 |
| **Clophill** | None |
| **Poppyhill** | None |

**Table 5.9: Indicative consent adjustments to meet River Quality Objectives**

| WwTW | Indicative Consent adjustments to meet the Water Framework Directive | |
|---|---|---|
| **Bedford** | None | Ammonia consent tightened from 7mg/l to 5mg/l by 2026 |
| **Biggleswade** | None | None |
| **Clophill** | None | Ammonia consent tightened by 9-10mg/l depending on scenario and time horizon |
| **Marston Moretaine** | BOD consent tightened from 20mg/l to 19mg/l by 2026 (or 18mg/l under climate change scenario) | Ammonia consent tightened by 3mg/l by 2026 |
| **Poppyhill** | BOD consent tightened from 20mg/l to 19mg/l by 2026 (under climate change scenario) | Ammonia consent tightened from 8 mg/l to 6 mg/l by 2026 |
| **Potton** | None | Target can not be met at Millbridge-Common Brook effluent discharge from Potton alone. The effluent from Gamlingay WwTW may need to be improved, but this has not been analysed as part of the outline WCS. This should be reviewed within the detailed WCS |

**Table 5.10: Indicative Consent adjustments to meet the Water Framework Directive**

5.3.19 Flitwick WwTW has not been included in the list of priority sites, since it has adequate flow headroom and process capacity to accommodate the projected growth without the need for a new consent or works improvements. However, the environmental impact of this significant discharge will be examined as part of the detailed study. The ammonia discharge consent at Flitwick WwTW may be revised to 3 mg/l to meet the requirements of WFD.

5.3.20 The future consent scenarios listed above are based upon projected effluent flow data prepared by Halcrow, and river quality and flow data, derived from "SIMCAT" modelling data provided by the Environment Agency.

5.3.21 In practice, consent conditions imposed will be influenced by the measured flows at the time of the consent review, and following negotiations between Anglian Water Services and the Environment Agency to balance the benefits of tighter consent limits with the environmental cost (in terms of energy and materials) of achieving tighter limits.

## *5.4 Foul Sewerage Network*

Existing Situation

5.4.1 There are a small number of sewer flooding locations within Bedford. AWS is currently assessing these locations in order to identify potential solutions. These are not considered to pose a constraint to development as they are dealt with separately under AWS' normal funding cycle.

Bedford

5.4.2 A new foul and surface water model and drainage area plan has recently been completed by AWS for Bedford. Strategic and local reinforcement options for serving development are being assessed by AWS.

5.4.3 The Bedford sewer network has two major network arrangements. The older part of the centre of Bedford has a large proportion of combined sewers. The North East of the town and some areas South of River Ouse have extensive separate foul and surface water networks.

5.4.4 A Southern Orbital trunk sewer runs from the Western outskirts of Kempston to the East of Bedford into Bedford Wastewater treatment Works and is shown in Figure 5.2. The Northern side of the River Great Ouse is served by a trunk sewer which runs from St Pauls Square and feeds into Bedford WwTW.

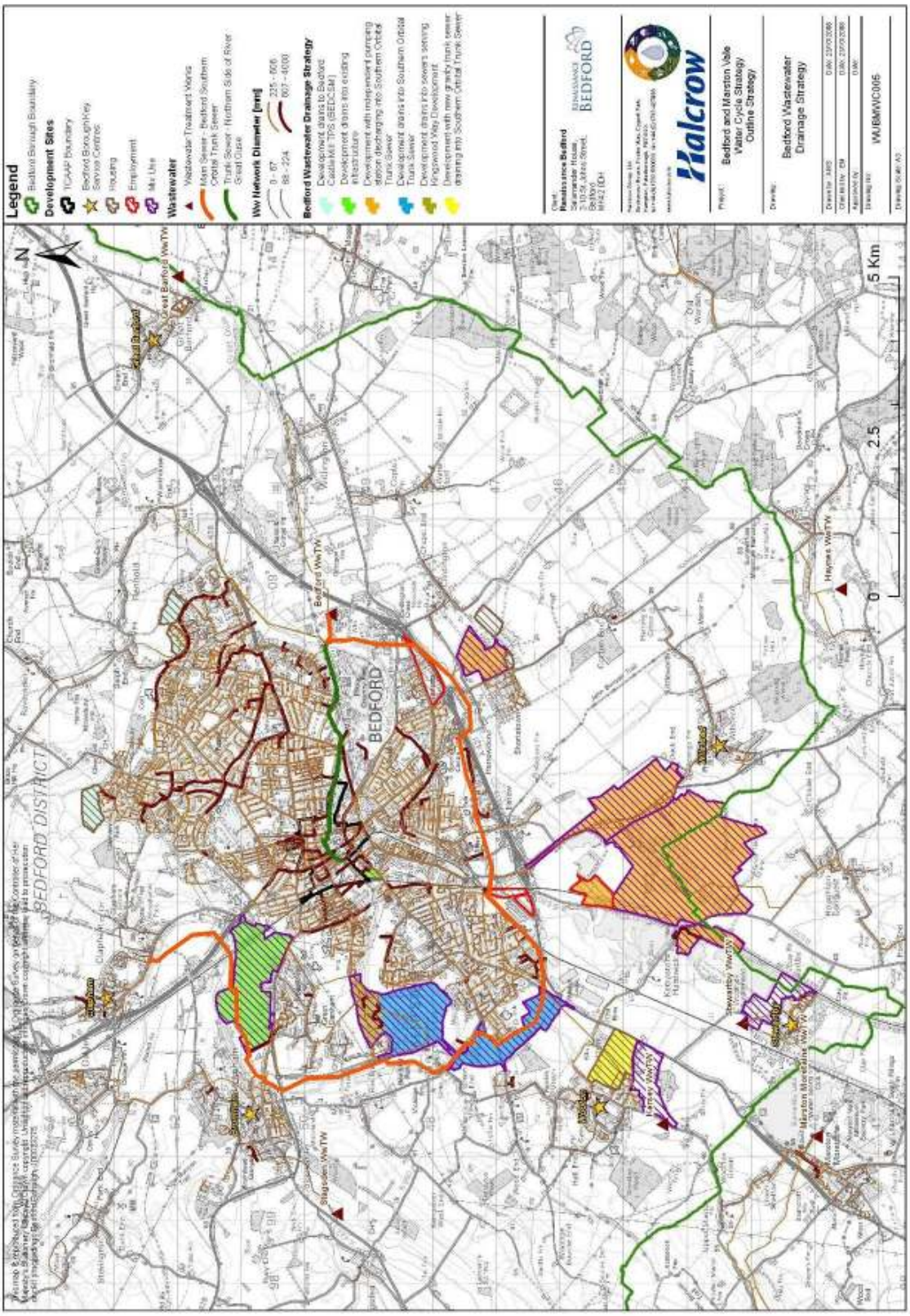



Figure 5.2: Bedford Existing Sewer Network

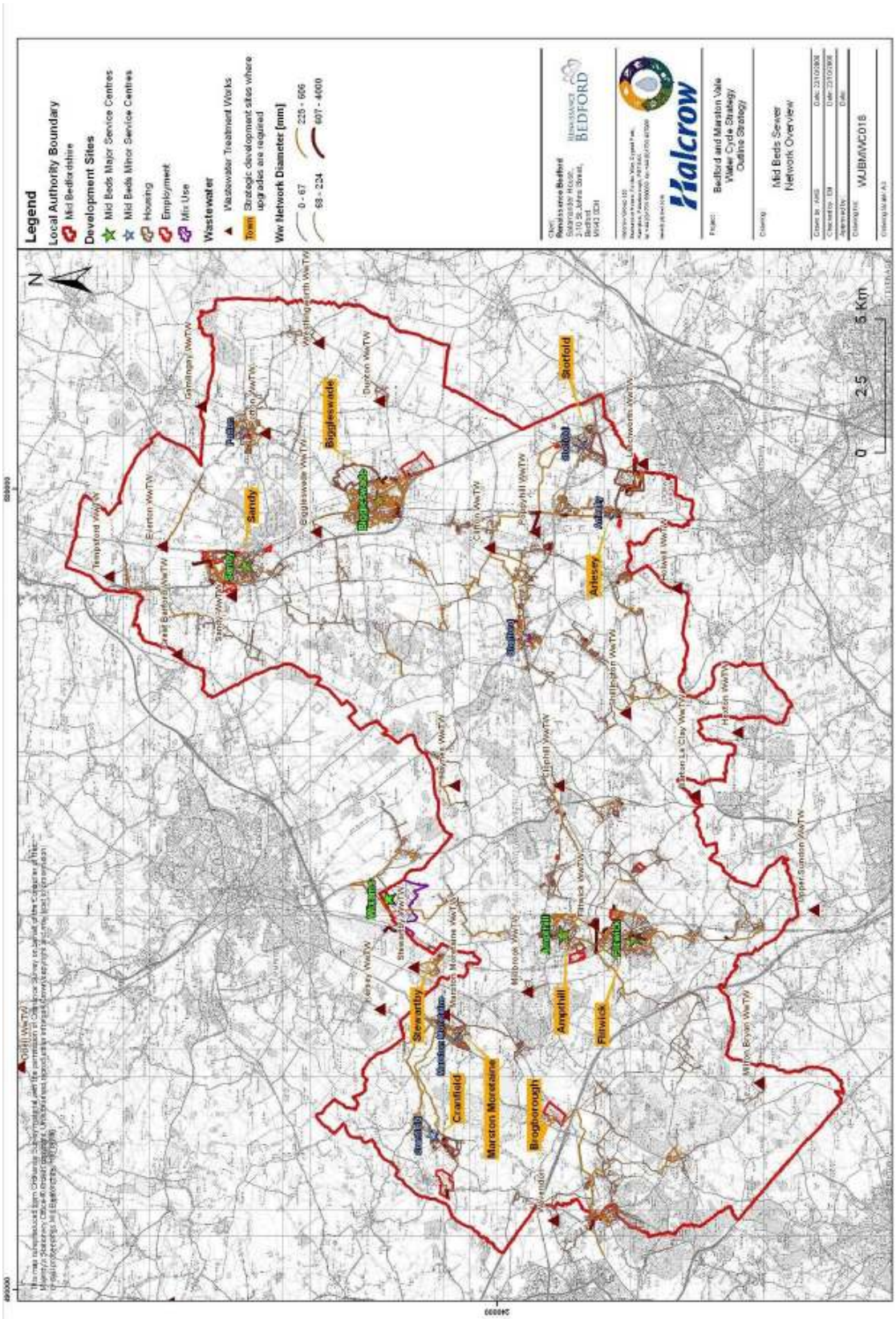



Figure 5.3: Mid Beds existing sewer network

## *5.5 Future capacity and upgrades requirements*

Major Development Sites within Bedford

5.5.1 AWS confirmed that the Bedford sewer network has capacity to accommodate the proposed urban extensions to Bedford development scenarios, although some local sections will require upsizing in the future AMP periods. This is not expected to cause a constraint to growth. AWS envisages that the flow generated by developments constructed within the existing catchment will continue to be directed to Bedford WwTW for treatment.

5.5.2 The following sites are to the West and South of Bedford:-

- Britannia Iron Works, Bedford;
- Biddenham Loop, Biddenham;
- Land West of Kempston,
- Land North of Bromham Road, Biddenham; and
- Land at Shortstown, Cardington (Can be accommodated within the Southern Orbital Sewer without further enhancement to the network (Figure 5.2))

5.5.3 The strategy developed by AWS for the connection of the development at Fields Road in Wootton (Figure 5.2) and its associated sub-catchments is expected to involve the construction of a new trunk sewer and gravity sewer which connect into the existing Bedford Southern Orbital Sewer. The completion of this scheme will result in abandonment of the existing Wootton Woburn Road Foul Pumping Station. The Wixams development site drains to a new Pumping Station (already constructed) at Elstow, Watson Road with a 450mm diameter rising main discharging into the Bedford Southern Orbital Sewer.

5.5.4 The following development sites are North of Bedford:-

- North of Brickhill,;
- North of Norse Road,; and
- Norse Road (Will connect into adjacent gravity systems which contribute flow to the Bedford Castle Mill Terminal Pumping Station).

5.5.5 Table 5.11 identifies connection points based on information supplied by AWS. It highlights any needs for upgrading or reinforcements to be undertaken.

| Name | Receiving WwTW | Foul network capacity and comments | Improvements |
|---|---|---|---|
| North of Brickhill, Bedford | Bedford | Connects to a new 525mm diameter trunk main | The network infrastructure to be upgraded or replaced as appropriate |
| North of Norse Rd, Bedford | Bedford | This site will have two connections. The Northern section will drain to Norse Road and the Southern section will drain to Castle Mill Terminal Pumping Station | The network infrastructure to be upgraded or replaced as appropriate |
| Norse Rd, Bedford | Bedford | Connection to Bedford Castle Mill TPS | The network infrastructure to be upgraded or replaced as appropriate |
| Britannia Iron Works, Bedford | Bedford | Connects into existing sewer main | The network infrastructure to be upgraded or replaced as appropriate |
| Biddenham Loop, Biddenham | Bedford | 10% of the flow into sewers serving Kingswood Way Development and 90% to be accommodated within the Southern Orbital Sewer | None |
| Land West of Kempston | Bedford | Connection at head of Southern Orbital Sewer | None |
| Land North of Bromham Road, Biddenham | Bedford | This site will connect to the Southern orbital sewer. Further investigation is required by AWS to determine the preferred option on how to connect to the orbital sewer. | None |
| Land at Shortstown, Cardington | Bedford | Strategy is to drain to an independent Pumping Station, which connects to the Southern Orbital Sewer. | None |
| Fields Road, Wotton | Bedford | Construction of a new Pumping Station with a new gravity sewer connecting into existing Bedford Southern Orbital Sewer | None |
| The Wixams | Bedford | A new Pumping Station has been provided which connects into the Southern Orbital sewer via a 450mm rising main. | The rising main has already been connected to the Bedford Southern Orbital Sewer |
| Stewartby | Stewartby | Inadequate capacity. | Further studies to be undertaken by AWS |

**Table 5.11: Bedford Foul Network**

Mid Beds Area

5.5.6 The majority of settlements within the Mid Beds district area have a separate foul and surface water network. However, the surface water infrastructure is limited in Marston Moretaine, Stotfold, Arlesey and the North-Eastern corner of Biggelswade. Biggleswade has a significant proportion of combined sewerage serving the western part. It also has a reasonable coverage of separate surface water sewers.

5.5.7 The growth areas where foul sewer networks may be affected by the potential development sites which were identified as part of the call for sites for the Site Allocations DPD, shown are in Figure 5.3. These sewer networks drain to respective WwTWs as described in Table 5.12. It should be noted that not all of these sites will be allocated following assessment of by Mid Beds and therefore some of these improvements will not be required.

| Name | Receiving WwTW | Foul network capacity and comments | Improvements |
|---|---|---|---|
| Arlesey | Poppyhill | Operating at capacity | Further studies to be undertaken by AWS |
| Ampthill | | Operating at capacity | Further studies to be undertaken by AWS |
| Biggleswade | Biggleswade | Limited capacity for major developments. | Some capacity available. Connection into new strategic main |
| Brogborough | Cotton Valley | Further studies to be undertaken by AWS | Further studies to be undertaken by AWS |
| Home Farm, Cranfield | Marston Moretaine | Limited capacity for major developments. Additional flows impacts the downstream gravity system which may cause flooding | Sewer upsizing approximately 1,815m of existing 375mm diameter, to 450mm diameter and 609m of existing 375mm diameter to be 600mm diameter. This solution may change following detailed design and consideration of other local development allocations. |
| Flitwick | Flitwick | Operating at capacity | Further studies to be undertaken by AWS |
| Land East of Bedford Road, Marston Moretain | Marston Moretaine | Operating at capacity | Further studies to be undertaken by AWS. Options discussed under the wastewater section |
| Sandy | Sandy | Capacity available | Capacity available |
| Stotfold | Poppyhill | The Pumping Station is operating at capacity | Increase the size of the Pumping Station. Further studies to be undertaken. |

**Table 5.12: Mid Bedford Foul Network**

## *5.6 Detailed WCS*

5.6.1 For the detailed WCS some of the assumptions made in the modelling will need to be refined and re-examined, for Stewartby, Clophill and Potton, to increase confidence in the consent standards.

5.6.2 Further investigation into the long term strategy for Marston Vale should be undertaken. AWS will also need to investigate the capacity of Southern Orbital sewer to accommodate the Marston Vale growth.

5.6.3 The following table summarises the actions that need to be carried out to in order to meet the growth requirements.

| Period | Action required |
|---|---|
| **AMP5 (2010-2015)** | • New consented DWF and upgrades to Bedford WwTW<br>• Review WwTW flow data at Marston Moretaine, Clifton, Sandy, Clophill and Potton.<br>• Upgrade Marston Moretaine WwTW<br>• Upgrade Castle Mill foul Terminal Pumping Station<br>• Investigate Stofold pumping station upgrade requirements<br>• Upgrade sewers at Cranfield, Flitwick and Stewartby<br>• Determine Marston Vale treatment strategy for AMP6 |
| **AMP6 (2015-2020)** | • Potential consent revision at Poppyhill WwTW |
| **AMP7 (2020-2025)** | • Potential upgrade of Marston Moretaine WwTW |

**Table 5.13: Wastewater Treatment upgrades required to meet growth**

## *5.7 Conclusion*

5.7.1 The existing Bedford WwTW requires treatment process upgrading to treat additional flows from the planned growth in the area. AWS is aware of the urgency of the situation, since undertaking the works will result in a temporary overload of the remaining treatment units until the upgrade is completed and increase the risk of consent failure.

5.7.2 There is limited available treatment capacity in the Marston Vale to accommodate development. The short term strategy is to remove the operational constraints at Marston Moretaine WwTW, but further investigation is required before a preferred wastewater strategy for the Marston Vale can be agreed. The potential for a new treatment works in the Marston Vale could be limited by water quality constraints within Elstow Brook and will depend upon the water quality scenarios enforced by the Environment Agency. If the WwTW outfalls into an ordinary watercourse within the IDB's district, then consent under the Land Drainage Act is also required from the IDB. These issues must be addressed in the detailed WCS.

5.7.3 The Bedford sewer network has capacity for the planned urban extensions to Bedford. Further investigation is required to determine a long term wastewater treatment strategy for the Marston Vale.

5.7.4 There are sewer capacity issues in most development centres proposed for Mid Beds. Generally, sewerage infrastructure costs will be lower for sites which do not require upgrades through town centre trunk sewers. There is likely to be an opportunity for strategic sewers to serve development in Biggleswade (to south and east) and for the option of transferring flows from the Marston Vale to Bedford WwTW.

5.7.5 The potential for the additional discharge from WwTW to cause an increase in flood risk is discussed further in section 6.15.

# 6 Flood Risk Management

## *6.1 Introduction*

6.1.1 The purpose of the flood risk section of the WCS is to define the flood risk zones, summarise the existing flood risk in the study area, the planned flood risk mitigation measures for the major development sites, and how these will impact flood risk downstream. It also assesses whether these mitigation measures are in alignment with the Marston Vale Surface Waters Plan. For Mid Beds and Bedford Borough, estimates are made for the volumes of storage that would be required for the level of development planned in the draft and adopted core strategies. For Mid Beds, a list of development sites that were submitted for the Mid Beds Site Allocations DPD which are either partly or fully within the flood plain is provided within Appendix E. At the time of writing, a similar list of submitted sites was not available for the Borough Area, however, the scale of new allocations required to meet regional targets is set out in the recently adopted Bedford Borough Core Strategy and Rural Issues Plan. The focus for new allocations is the compact Bedford, Kempston and Northern Marston Vale growth area. A description of the drainage systems and known flood risk issues are discussed for the key service centres in Bedford Borough. The objective of the Councils is to be able to use this information to support the development of Site Allocations DPDs.

## *6.2 Context*

6.2.1 The Marston Vale Surface Waters Plan was prepared by the Surface Waters Group which was formed in 1998 with representation from the Bedford Group of Drainage Boards, Environment Agency, Forest of Marston Vale, Bedford Borough, Mid Beds District and Bedfordshire County Councils. Anglian Water and Renaissance Bedford have subsequently joined the Group. The Surface Waters Plan was published in 2002 and adopted by all the parties of the Group. The Plan's goal is to align development aspirations and surface water management by the provision of strategic and integrated flood risk management assets.

6.2.2 WSP Consultants produced the Stage 2B Strategic Flood Risk Assessment (SFRA) for Mid Beds District Council in September 2007 and the Level 1 SFRA for the areas covered by the Bedford Town Centre Area Action Plan (TCAAP) in 2006, whilst Atkins produced a Level 1 SFRA for the rest of the Borough for Bedford Borough Council in July 2008. These show the areas at risk of flooding and provide an authoritative document for guiding development away from areas of local flood risk. Under PPS25 Local Planning Authorities are also required to:

- Safeguard land from development that is required for current and future flood management e.g. conveyance and storage of flood water and flood defences;
- Reduce flood risk to and from new development through location, layout and design, incorporating appropriate use of sustainable drainage systems (SUDS);
- Use opportunities offered by new development to reduce the causes and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; re-creating the functional floodplain; and set back defences.

6.2.3 This WCS strives to supplement the SFRAs, give advice on SUDS and information which will help the Local Planning Authority meet these requirements by:

- Providing an indication of the amount of storage that might be required for new developments so that flood risk is not increased downstream.

- Providing an indication of the allowable run-off from new development so that flood risk will not be increased downstream.
- Identifying areas where discharge from storage is likely to exacerbate flood risk downstream and evaluating the cumulative effect of discharge from multiple development sites.
- Identifying opportunities for strategic flood risk mitigation that could reduce flood risk to existing development or the catchment.
- Identifying areas where development is likely to restrict future opportunities for reducing flood risk downstream.

6.2.4 This report has taken a broad and generic approach to assessing flood risk and the development sites. When undertaking further analysis of the information and recommendations discussed here, close liaison with all the Operating Authorities (i.e. the Environment Agency, Bedford Group of Drainage Boards and the Local Authorities drainage engineers) is imperative to discuss the localised catchment specific issues. To provide a fully integrated Urban Drainage forum, liaison with Anglian water and the relevant Highway Authority should also take place.

## *6.3 Existing Flood Risk: Overview*

6.3.1 PPS25 classifies the Environment Agency's Flood Map into separate Flood Zones (Zones 1, 2, 3a and 3b) as described in Table 6.1. These Flood Zones represent river and sea flooding without flood defences in place. Further information regarding land use vulnerability classification and appropriate land uses according to specific Flood Zones is available within Annex D of PPS25, to provide direction when applying the Sequential Test.

| Flood Zone | Probability |
|---|---|
| 1 (Low Probability) | Less than a 1 in 1000 (<0.1%) annual probability of river or sea flooding in any year. |
| 2 (Medium Probability) | Between 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year. |
| 3a (High Probability) | A greater than 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. |
| 3b (Functional Floodplain) | Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood |

**Table 6.1: Flood zone definition**

6.3.2 For the purposes of this WCS, reference to fluvial flood risk across the study area has drawn upon findings of the recent SFRAs produced separately for Bedford Borough (Level 1) and Mid Beds District (Stage 2B). Each document is based principally upon the Environment Agency's Flood Map, supplemented by hydraulic modelling data results and more site specific information where applicable and available. Refinement of the baseline information may be made at a later stage of the planning process through revision to each SFRA comprising enhancement of existing hydraulic modelling data and the re-definition of flood outlines including an assessment of climate change impacts and the definition of the functional floodplain. Assumptions made in the SFRAs to date include that all areas at risk of flooding are undefended; the Functional Floodplain has been classed as any area lying within Flood Zone 3, and; the climate change outline is taken to be the same as the current Flood Zone 2 outline.

6.3.3 Three types of floodplain map support this report and their differences in origin are outlined below:

- Environment Agency Flood Zone Maps: These maps indicate areas at risk of flooding from rivers under the 1% (1 in 100 year) event, the sea under the 0.5% (1 in 200 year) event and the extreme 0.1% (1 in 1000 year) event in England and Wales, each without the impact of flood defences. Data to produce the maps has been derived from national generalised modelling, supplemented by good quality local data (modelled or topographic) that satisfies the Agency's criteria. These maps are in the public domain and can readily be viewed online at the Environment Agency website
- Bedford Group of Drainage Boards flood maps for the Elstow Brook: The Brook is the principal watercourse through the Marston Vale and consequently the key source of flood risk to the area. As term consultants to the Drainage Board, Hannah-Reed have undertaken an extensive modelling exercise of the Elstow Brook to generate an indicative floodplain envelope for the 1% (1 in 100 year) and 0.1% (1 in 1000 year) event. Based on detailed topographic input data and hydrodynamic flow routing, these refined floodplain extents reflect detailed local knowledge and should be used in preference to the Agency's Flood Map when appraising flood risk in this local catchment. These maps are available on request from the Drainage Board. The Drainage Board intend to formally submit these and other similar flood maps of their District to the Agency to revise their online Flood Maps in due course.
- Strategic Flood Risk Assessment flood maps: As noted above, the SFRA maps to date typically comprise Environment Agency Flood Map data supplemented by hydraulic modelled data, such as that produced for the Elstow Brook, where available. Future development of SFRAs is likely to incorporate additional modelling exercises of currently unmodelled watercourses and to aid definition of the functional floodplain and potential future climate change impacts at key locations.

## *6.4 Bedford Borough Description*

6.4.1 Covering approximately 1,200 km², the Borough consists of the urban town of Bedford and is surrounded by large pockets of rural land (see Figure 6.1 below). The underlying geology is predominantly Oxford Clay and Kellaways Beds with some small areas of Cornbrash and Great Oolite limestone formations. This geology results in poor infiltration across the majority of the region. The topography of the catchment is generally fairly flat with land rising in the North with lower land to the South. The River Great Ouse is one of the principal watercourses within the Bedford Borough administrative boundary. Passing through the centre of Bedford and many of the surrounding villages, the Great Ouse catchment extends from Northampton in the West to Suffolk in the East. In addition, the River Til, the Riseley and Pertenhall Brooks pose a risk to the North of Bedford. To the East of the Borough and village of Tempsford is the confluence of the Rivers Ivel and Great Ouse. The Great River Ouse and the River Ivel are designated as Main Rivers and the Environment Agency has powers and duties for the main rivers.

6.4.2 The Bedford Group of Drainage Boards is responsible for several watercourses in Bedford Borough and some of these are key watercourses within the area, for example Elstow Brook. These watercourses and ditches are predominantly to the South of the Town Centre and in the rural areas of the Southern part of the Borough.

6.4.3 The Elstow Brook rises from the Greensand ridge near Lidlington within the Mid Beds District and flows through the Marston Vale and into the South of the Borough before discharging into the River Great Ouse near Willington. The Brook is a Category 1A (high risk) watercourse according to the Bedford Group of Drainage Boards' categorisation system and consequently maintenance operations on this watercourse are a priority for the Board as a flood risk mitigation measure.

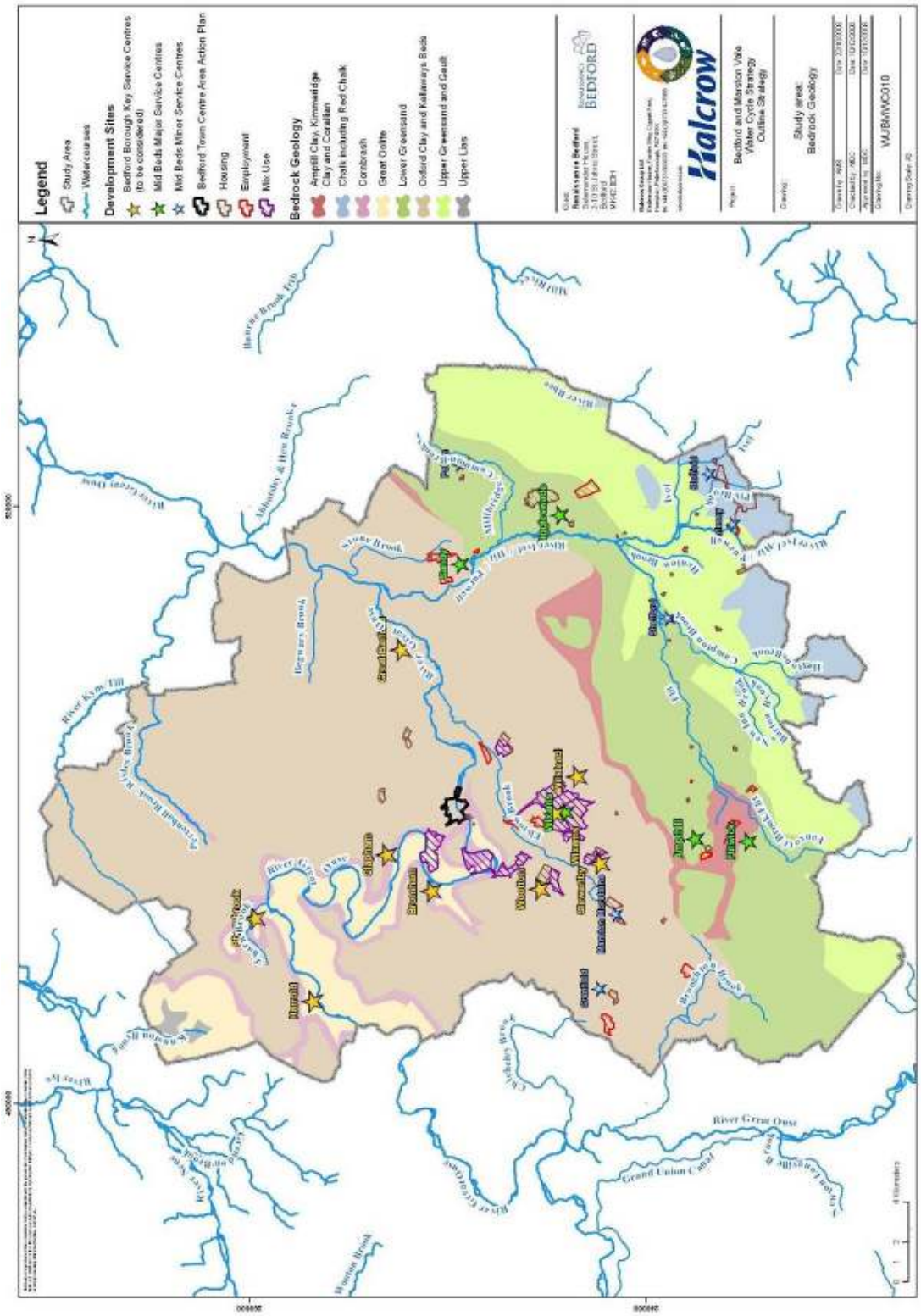



**Figure 6.1: Study area Bedrock geology**

## *6.5 Existing Studies: Bedford Borough*

6.5.1 Several previous studies have been carried out looking at flood risk to the Borough and have been used to inform this WCS. These studies include:

- The Bedford Borough SFRA Level 1 (WSP, 2006) focused specifically on the Town Centre and areas covered by the Bedford Borough Area Action Plan. The emphasis of this report was identifying the sources of flooding and level of flood risk to the key areas of interest, outlining any constraints to development.
- In conjunction with the above, a separate Bedford Borough-wide Level 1 SFRA has been prepared (Atkins, 2008).
- The Marston Vale Surface Waters Plan (Marston Vale Surface Waters Group, 2002) appraises local flood risk within Marston Vale and promotes the role of strategic surface water management solutions.
- Various hydraulic models have been undertaken within the Bedford Borough boundary, as summarised in Table 6.2:

| Model Name | Date | Originator | Watercourse |
|---|---|---|---|
| Bedford S105 | Feb 2003 | EA (Royal Haskoning) | Great Ouse |
| St Neots S105 | Feb 2003 | EA (Royal Haskoning) | Great Ouse |
| Kempston Prefeasibility Study | Oct 1999 | EA (Royal Haskoning) | Great Ouse |
| Milton Keynes Drainage Study | Mar 2000 | EA (Halcrow) | Great Ouse, Ouzel |
| Clapham Prefeasibility Study | Sep 1999 | EA (Royal Haskoning) | Great Ouse |
| Kimbolton Prefeasibility Study | Aug 1999 | EA (Royal Haskoning) | River Kym |
| Olney, Newton Blossomville, Turvey Prefeasibility Study | Aug 2002 | EA (Atkins) | Great Ouse |
| Harrold, Odell, Sharnbrook SOP | Nov 2004 | EA (Atkins) | Great Ouse |
| ARTS2c Bedford Ouse Block | Feb 2006 | EA (Atkins) | Inter alia, Great Ouse, River Kym, Riseley Brook |
| St Neots Flood Defence Scheme PAR | Mar 2008 | EA (Atkins) | Great Ouse |
| Elstow<br>Wixams | 1994 to present | IDB (Hannah-Reed)<br>WSP | Elstow Brook |
| Great Barford | 2004 | IDB (Hannah-Reed) | IDB maintained watercourses B13 and |

| | | | |
|---|---|---|---|
| | | | B7. |
| Updated River Ivel PFS | Dec 2004 | EA | River Ivel |
| Bromham Brook | April 1994 | EA | Bromham Brook |
| Riseley PFS | Feb 2004 | EA | Riseley Brook |
| Pix Brook Flood Zone Improvement Study 07/08 | Jan 2008 | EA | Pix Brook |

**Table 6.2: Hydraulic modelling exercises undertaken for Bedford Borough**

## *6.6 Existing Flood Risk: Bedford Borough*

6.6.1 Development upstream of any of the Borough's Key Service Centres has the potential to exacerbate existing flood risk, however, identifying the locations at particular risk will provide the opportunity to incorporate flood risk mitigation. The Environment Agency Flood Zone Maps are the principal source of flood risk information and indicate 'at risk' areas from Main Rivers. Detailed flood risk maps of the Borough can be found in Appendix A.8 (Maps A – H) of the Bedford Town Centre Area Action Plan SFRA Level 1 (WSP, 2006).

Historic fluvial and surface water flooding to areas outside Key Settlements

6.6.2 Several villages situated to the North of Bedford have experienced flooding along with the Town Centre. In addition to the River Great Ouse, the Borough's Level 1 SFRA indicates that the Kings Ditch, which flows from St Mary's Embankment near County Hall, through a series of culverts and beneath the Dame Alice Harpur School before re-joining the Great Ouse again, is a flood risk source to the town. Historically, this ditch conveyed flood waters along this same route but levels in the Ouse can often prevent outfall of the ditch in times of storm events. Kings Ditch is part Anglian Water Sewer and part IDB adopted watercourse.

6.6.3 The Environment Agency's Flood Zone Map shows the Town Centre lies within High Probability Flood Zone 3, however the urban area in the vicinity of the Kings Ditch is shown to benefit from the presence of flood defences on the River Great Ouse. Some of these defences are formed with demountable barriers. In times of flood, Kings Ditch has a restricted gravity discharge and relies upon temporary pumping. The IDB is proposing that a permanent pumping station be installed, funded by developer contributions.

6.6.4 Key historical flood events that have predominantly affected the Town Centre and areas that are not key service centres are summarised below:

- 1823, 1947 & 1998 – These events affected the Town Centre specifically between County Bridge and Town Bridge. The Kings Ditch flooded at the junction between St Johns Street and Rope Walk. ,
- 1987 – Flooding occurred in Riseley and Yelden
- 1992 – Villages to the North of Bedford including Great Staughton, Pertenhall, Riseley and Turvey had numerous properties flooded when Riseley and Pertenhall Brooks overtopped. Some access roads were also flooded.
- As documented in Section 3.3.7 of the Bedford Borough-wide SFRA, the Bedford Group of Drainage Boards are aware of numerous locations that have experienced instances of historic flooding, however only limited data is available to quantify these events.

Historic groundwater flooding

6.6.5 There are no known records of groundwater flooding within the Borough however there are known areas of particularly waterlogged land which lie to the South East and South West of the town centre.

## *6.7 Evaluation of Development Proposals: Bedford Borough*

6.7.1 The location of the proposed development areas in relation to the watercourses and flood zones are shown in Figure 6.2 and Figure 6.3. The developments can be divided into two areas, the Growth Area and the Rural Policy Area. The Growth Area is Bedford, Kempston and the Northern Marston Vale and includes the Key Service Centres of Wootton and Stewartby. In due course, Wixams will also be a Growth Area Key Service Centre. The Rural Policy Area Key Service Centres are Bromham, Great Barford, Harrold, Clapham, Sharnbrook and Wilstead. The purple hatchings show the development sites that have already been allocated. Some planning permissions have been issued and in other cases negotiations on S106 agreements are significantly progressed

6.7.2 Development has the potential to increase flood risk downstream of all these areas as it increases the impermeable area and hence both the rate and volume of run-off without mitigation. There may also be an increase in the volume of water discharged from sewage treatment works. PPS25 requires that there is no increase in flood risk due to development, and development proposals must include measures to ensure that flood risk downstream is not increased. Typically planning requirements are that storage is provided so that the rate and volume of run-off from development is equivalent to the greenfield rates. However, there is often an opportunity to take a more strategic approach to flood risk management, and such an approach forms the ethos of the Surface Waters Plan. All operating authorities, which include the Environment Agency, Local Authorities, Anglian Water and Bedford Group of Drainage Boards, should be consulted in relation to specific drainage issues associated with development sites and their surrounds.

6.7.3 At the outline planning stage developers must ensure that their proposals include adequate space for flood risk management storage areas including the increased runoff generated from the site. More detailed plans will be required at later stages in the planning process to ensure that run-off is appropriately managed within the site to minimise flood risk to new properties and to ensure safe routing of flood flows to the storage ponds and lakes. The WCS considers the earlier phases of the development process and therefore investigates the high level opportunities and constraints posed by flood risk management.

6.7.4 The approximate storage volumes and allowable run-off rates for Bedford Borough's remaining employment allocation in the Northern Marston Vale have been calculated using the method outlined in the Defra/Environment Agency Flood and Coastal Defence R&D Programme's 'Preliminary rainfall run-off management for developments R&D Technical Report'.

6.7.5 For the calculations it has been assumed that for employment development targets 90% of the whole development site will be impermeable, compared to an assumed 0% prior to development. It is possible that the actual impermeable area will be lower so these calculations should represent conservative estimates of the storage requirements.

6.7.6 The required storage volumes Table 6.5 are broken down into: a) attenuation storage, which is provided to reduce the rate of run-off to the equivalent predevelopment rate of run-off, and: b) long term storage, which is provided to reduce the volume of run-off to the predevelopment run-off volume where necessary. Developers will be required to provide sufficient storage to meet the combined total on the long term and attenuation storage, or mitigation as otherwise agreed with the drainage authority

6.7.7 Water is generally to be released from attenuation storage at greenfield equivalent rates. These rates have been calculated according to the Defra guidance, and are shown in Table 6.6 below. Calculations of run-off are made based on Qbar, which is the run-off that would occur in an event with a 1 in 2 (50%) probability of occurring or being exceeded within a given year.

| Site | Site Area (Ha) | Estimated Attenuated Storage for stand-alone solution ($m^3$) | | | Long Term Storage ($m^3$) |
|---|---|---|---|---|---|
| | | 1yr | 30yr | 100yr | |
| **EMPLOYMENT** | | | | | |
| Northern Marston Vale | 21 | 3,200 | 6,200 | 13,000 | 5,300 |

**Table 6.3: Attenuation storage and long term storage volume estimates for the Bedford Borough employment allocation in the Northern Marston Vale**

| Site | Site area (ha) | QBAR (l/s) | 2yr (l/s) | 30yr (l/s) | 100yr (l/s) |
|---|---|---|---|---|---|
| **EMPLOYMENT** | | | | | |
| Northern Marston Vale | 21 | 130 | 130 | 320 | 450 |

**Table 6.4: Greenfield run-off rates for the Bedford Borough employment allocation in the Northern Marston Vale**

6.7.8 Water from long term storage is either released by infiltration or at a low flow rate compared to the rates of flow in the receiving watercourse. Guidance is that the rate of discharge from long term storage is less than 2 l/s/ha. During design, developers are advised to make an assessment of where releasing water from long term storage is likely to have an adverse effect on flood risk in the receiving watercourse. The extra discharge is considered likely to be significant upon the receiving watercourse if it is comparable to an event which has a 1 in 2 (50%) probability of occurring or being exceeded in a year as past experience shows that this is approximately bank full level for a natural channel.

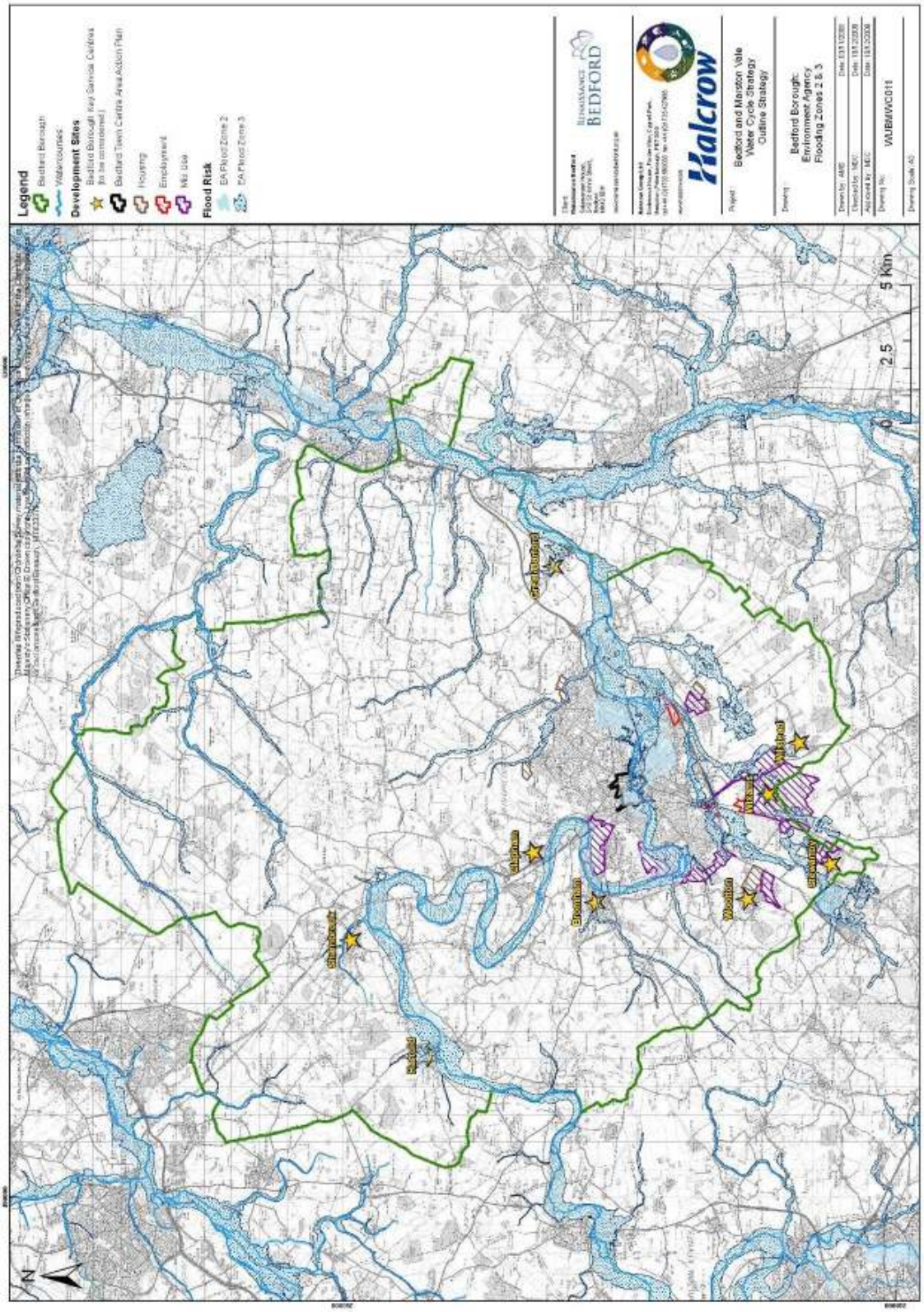



**Figure 6.2: Bedford Borough Environment Agency Flood Zones**

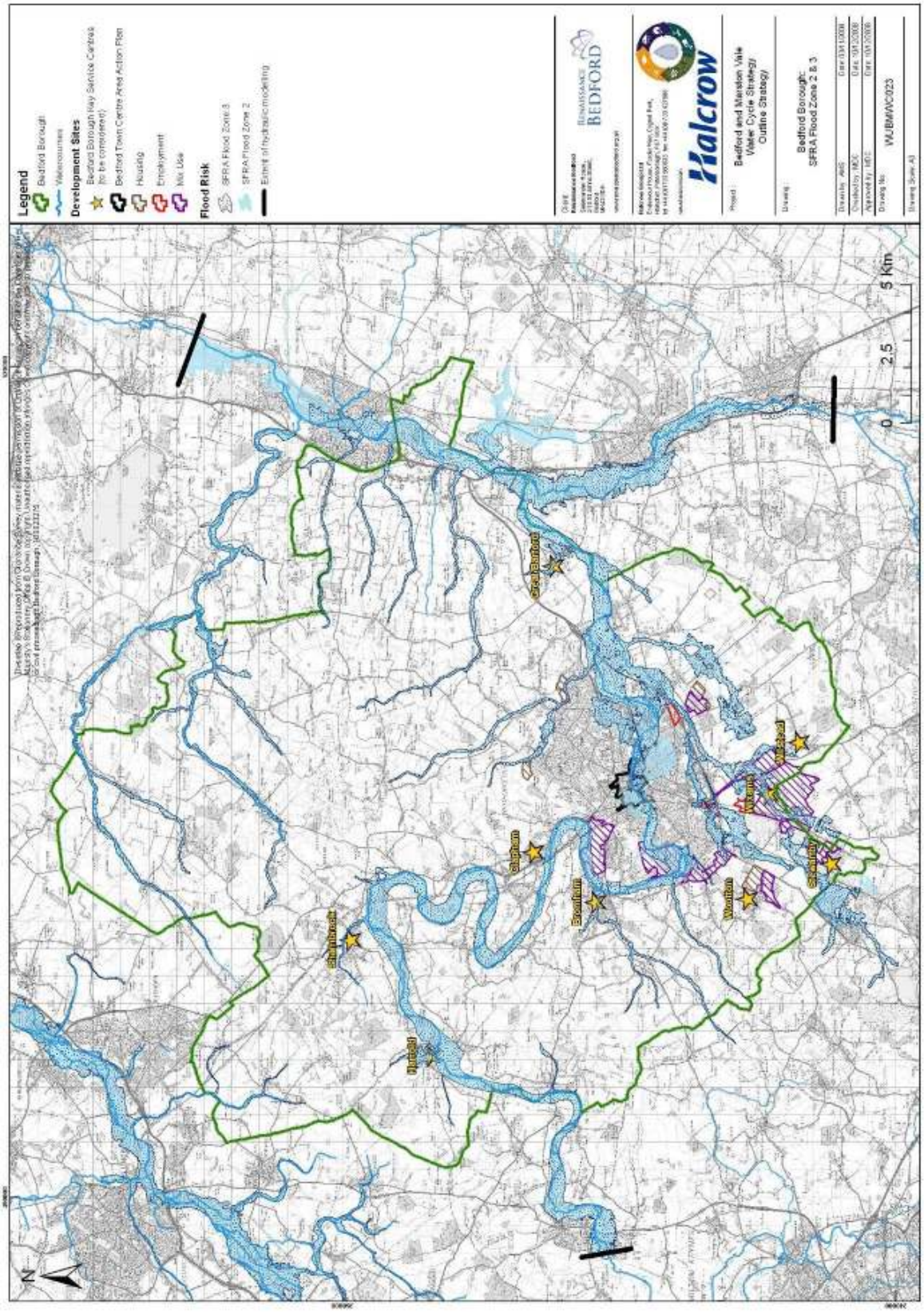



**Figure 6.3: Bedford Borough Strategic Flood Risk Assessment Flood Risk Zones**

6.7.9 As no further housing allocations are needed to support the Bedford Borough Core Strategy, the remainder of this Section includes;

a) A review of the flood risk and proposed surface water drainage solutions to the existing development allocations within Bedford Borough; and

b) a drainage description review of each of the Key Service Centres to aid future direction of calculations and potential strategies.

6.7.10 The principles of the Marston Vale Surface Waters Plan recommend an integrated, holistic approach to both flood risk and surface water run-off mitigation to support development. Consequently through integration there is scope for proposed mitigation measures to be dual-purpose and the following review of the development allocations discusses both these elements.

## *6.8 Drainage solutions for existing development allocations, Bedford Borough*

New Road, Great Barford

6.8.1 This allocation is for 58 residential dwellings to be constructed on land at College Farm and falls within Flood Zone 3. Consequently proposed finished floor levels should be 600mm above the 1 in 100 year level or 600mm above the 1947 River Great Ouse flood level of 20.04m AOD i.e. a minimum of 20.65m AOD.

6.8.2 Surface water drainage will be managed through soakaway drainage constructed above ground water level. There should also be sufficient SUDS arrangements to protect the new dwellings and also protect the existing dwellings around the site perimeter from surface water runoff. In order to implement the proposed drainage solution there will need to be localised ground rising in the South East corner of the site in order to form the swale basin.

Land at Shortstown (Former RAF Site)

6.8.3 This outline planning allocation comprises erection of a residential development of 970 units with associated works, strategic landscaping and open space within Flood Zone 1. Only land north of Harrington Lane (i.e. very northern site extents) falls within the IDB District.

6.8.4 The principle of a dry balancing pond with greenfield equivalent rate discharge to a local watercourse has been agreed. The site of the proposed pond is within the IDB District. The pond will protect the District from increased runoff following development; hence the IDB are likely to consider it for 'adoption'. If however, the pond is to be developed as a wildlife site, these proposals must ensure that the primary purpose of flood storage is not compromised.

Shortstown (Rear of airship sheds)

6.8.5 This outline planning allocation comprises erection of a residential development of 425 units with associated works, strategic landscaping and open space. The site stands outside of the IDB District.

6.8.6 A dry balancing pond is recommended to attenuate surface water runoff to the greenfield rate and should be adopted by a statutory authority in perpetuity. Whilst the proposed pond is not within the IDB District it will protect the District from increased runoff following development; hence the Board may be prepared to consider it for 'adoption'.

Shortstown (Frontier)

6.8.7 The site stands outside of the IDB District within Flood Zone 1, draining to Flood Zone 3. Surface water will be attenuated to the greenfield runoff rate, with the IDB requiring that

final pond volumes be increased to cater for a 1 in 100 year plus climate change probability event. Negotiations are ongoing for the IDB to maintain the dry pond in perpetuity

Land North of Norse Road

6.8.8 This site (allowed on appeal) comprises residential development of 323 dwellings together with a new roundabout junction on Norse Road, a playing field, pavilion, play area, extension to cemetery and landscaping. The majority of the site stands in low risk Flood Zone 1, with a small part falling in Flood Zone 3 of Renhold Brook.

6.8.9 The recommendations of the Flood Risk Assessment (FRA) for this site are:

- All dwellings and buildings be outside the 1 in 100 year flood envelope.
- All finished ground floor levels be a minimum of 600mm above the 1 in 100 year flood event which vary from 26.32m AOD on the upstream boundary to 25.75m AOD at the downstream boundary of the site.

6.8.10 The on-site proposals for development are that surface water runoff be controlled either at source through a SUDS approach or through conventional surface water drainage to three balancing ponds prior to discharge to Renhold Brook. The diversion of the Renhold Brook (watercourse B5 (1)) is a necessary pre-requisite to the design of the access roundabout, subject to the formal consent of the IDB.

North of Brickhill

6.8.11 This permission is for residential development including the provision of a country park, falls predominantly within Flood Zone 1 with a minority within Flood Zone 3 of Watercourse B6. This area is under the IDB, agreement and consent should be obtained from them.

6.8.12 Surface water will be attenuated to the greenfield runoff rate, with the IDB requiring that final pond volumes be increased to cater for a 1 in 100 year plus climate change probability event. Bedford Borough Council plan to maintain the wet ponds in perpetuity.

Land North of Bromham Road

6.8.13 This allocation stands within Flood Zone 3 and the floodplain of the River Great Ouse, but no development has been proposed within Flood Zone 3. A site specific FRA has been agreed with the Environment Agency. Conditions have been proposed to ensure the flood plain is protected and surface water is controlled to ensure no increase in run-off from the site.

Biddenham Loop

6.8.14 The Biddenham Loop allocation encompasses Land at Great Denham, Kingswood Way, Great Denham. The comprehensive development proposals include housing, employment, schools, shops, community facilities, open space, roads and all ancillaries. The site is partially in Flood Zone 3 but no built development is allowed within this area as agreed in the FRA.

6.8.15 Design proposals have been accepted for surface water discharge from the site to be discharged to a large balancing pond, based on impermeable area of 65% of the proposed build site. If the impermeable area is increased then either changes will need to be made to the balancing pond including flow control rates or infiltration methods should be considered within the areas of increased density.

Land West of Kempston

6.8.16 This allocation crosses the watershed between the Elstow Brook and Great Ouse River catchments, with the eastern portion of the site discharging towards the Brook.

6.8.17 The site lies predominantly outside of the floodplain envelopes, although the eastern commercial area does lie within the functional floodplain (pre-mitigation) of the Bott End Extension, a tributary of the Elstow Brook bisecting the site. Flood relief to this area does however form part of the Drainage Board's Master Plan for Developments West of Bedford and through the provision of an online storage reservoir, control structures and notable ground raising, the floodplain has been locally redefined to remove this constraint and provide betterment to the catchment.

6.8.18 At the time of writing, the surface water solution remains unresolved to the Brook catchment. Whilst there is ample provision for the site within the Master Plan, the rights for the conveyance of flows remains a matter of legal debate. It is thought that these legal issues will soon be resolved to allow the strategic solution to be delivered as promoted, thus delivering the maximum hydraulic, amenity and ecological benefits of the scheme that may not feasible with the alternative onsite storage option.

6.8.19 The western portion of the site, within the River Great Ouse catchment, will be attenuated through onsite balancing facilities. As part of the development proposals there are discussions for potential off site flood mitigation works to help alleviate some flood risk to the village of Kempston.

North of Fields Road, Wootton

6.8.20 This land is predominantly outside the floodplain envelope of the Wootton Drain, a tributary of the Elstow Brook, which bisects the proposal site close to its eastern boundary.

6.8.21 Current proposals for the disposal of surface water from the site embrace the principles of the Surface Waters Plan by promoting a strategic solution. It is envisaged that the site will contribute to the Drainage Board's Master Plan for Developments West of Bedford. This will necessitate the construction of an offline flood reservoir facility at Van Dieman's Land (Pond F 16,500m3) and watercourse improvements through the site.

6.8.22 The scale and nature of the facilities in the Master Plan allows them to be considered for 'adoption' by the Drainage Board, and thus their future maintenance and operation are secured in perpetuity.

South of Fields Road, Wootton

6.8.23 The residential allocation lies predominantly outside the floodplain envelopes of the Berry Farm and Wootton Drains, although the commercial area is currently vulnerable to shallow flooding with water conveyed between the two watercourses.

6.8.24 Current options for the disposal of surface water from the site embrace the principles of the Surface Waters Plan by promoting a solution of notable scale that interacts with the natural catchment watercourse. It is envisaged that the site will either contribute to the Drainage Board's Master Plan for Developments West of Bedford, or develop online and offline storage facilities along the Berry Farm Drain.

6.8.25 The Master Plan has been developed to allow contribution from this site within the general provisions of storage identified for the combined Wootton Development and facilities already constructed by their development partners. Nevertheless, the alternative option of providing on site storage has also been shown to provide catchment benefit.

Wixams

6.8.26 The Wixams Site lies predominantly outside of the floodplain envelope of the Medbury Outfall (Watercourse 3(1)) other than areas in the immediate river corridor that can be preserved in the landscape framework, or local urban drainage issues that can be readily addressed. This site is within the Bedford Group of Drainage boards and as such all surface water disposal will need full agreement with the IDB.

6.8.27 Due to the scale of the proposals, the surface water solutions required significant management and the resulting catchment-based approach embrace the principles of the Surface Waters Plan. A combination of watercourse improvements, channel diversions and large strategic flood reservoirs mitigate the flow leaving the site so as not to compound the flood risk downstream. Improvements are currently being implemented with the construction of the site and the A6 diversion.

6.8.28 The scale and nature of the facilities allows them to be considered for 'adoption' by the Drainage Board, and thus their future maintenance and operation are secured in perpetuity.

Britannia Works, Kempston Road

6.8.29 237 flats have been completed on this site, 130 have planning permission, a resolution to grant planning permission subject to a S106 agreement exists for a further 255 flats and it is estimated that 100 units can be delivered from the remainder of the site – a total of 722 units. The site falls within Flood Zone 3, protected by defences, but is outside the IDB District.

6.8.30 The FRA for this site has been agreed and part of the site has been re-contoured into a flood mitigation area to ensure the residential areas are outside Flood Zone 3. The Britannia Road area drains via Anglian Water storm water sewers into the Kings Ditch. Kings Ditch is restricted from discharging in times of flood and any development within the Kings Ditch catchment should therefore contribute to the permanent pumping station proposals.

Land off Cambridge Road

6.8.31 Significant areas of this allocation lie within the floodplain of the Elstow Brook. However, these areas do not form part of the functional floodplain, and proposals have been developed to demonstrate that compensation measures can be appropriately developed within the river corridor of the Elstow Brook to allow ground raising to remove this constraint. This site is within the Bedford Group of Drainage boards and as such all surface water disposal will need full agreement with the IDB.

6.8.32 This in-channel storage (provided in agricultural land upstream of the bridge at Cardington Cross)

Land East of B530

6.8.33 This small site lies outside of the floodplain of the Elstow Brook which passes its Northern boundary.

6.8.34 In promoting the site the developer has pursued the potential for a strategic solution to flood risk and run-off management, and some small scale measures are to be incorporated within the scheme along with the provision of storage on the site.

Land South of Interchange Retail Park

6.8.35 The site lies wholly within the floodplain of the Elstow Brook, but outside of the functional floodplain, but the watercourse traversing the site forms a key drainage path for the catchment. This site is within the Bedford Group of Drainage boards and as such all surface water disposal will need full agreement with the IDB.

6.8.36 It is felt that an on-site solution would not be practicable for the site as it would overly constrain the development potential. However, whilst water issues present a significant constraint on the development, site mitigation based on providing off site flood compensation and continued conveyance, might be feasible.

6.8.37 Proposals have been promoted that would utilise a large storage lagoon to the south of the southern bypass that would sufficiently throttle the conveyance flow through the site to

allow development potential to be realised. A strategic solution of this nature would need to be pursued if the site is to be considered further.

Kempston Hardwick

6.8.38 The site lies outside of the floodplain of local watercourses.

6.8.39 The proposals for the site are thought to utilise the large lakes to the north (Kempston Hardwick Pits) to attenuate surface water flows. These pits are identified in the Surface Waters Plan as an opportunity for providing a flood risk management asset, and therefore their use in this manner is encouraged.

Land North of Wixams beside B530

6.8.40 The site lies outside of the floodplain, but in an area renown for land drainage problems due to the constraints on the capacity of the system following its diversion to accommodate the Southern bypass. This site is within the Bedford Group of Drainage boards and as such all surface water disposal will need full agreement with the IDB.

6.8.41 Little is known about the proposed solution for surface water run-off from the site, but consideration should be given to pursuing the following hierarchy of options in accordance with the principles of the Surface Water Plan:

- The use of the Elstow South lakes as a strategic surface water facility.
- Combining a solution with neighbouring developments (either the Elstow North Landfill site, the Wixams development or the Land South of the Interchange Retail Park, as discussed above (subject to verification of the natural drainage paths).
- An on-site attenuation solution with mitigation or contributions to help resolve the local land drainage issues.

## *6.9 Drainage Description Review of Key Service Centres, Bedford Borough*

6.9.1 Bedford Borough has identified eight Key Service Centres, with Stewartby and Wootton being located within the Bedford Growth Area. Each of these Centres will be discussed below with regards to their drainage, key watercourses and any known flood risks. A detailed map of these areas can be found in Appendix A.1 in the Bedford Borough-wide SFRA.

Stewartby

6.9.2 Stewartby is located at the very South of the Borough boundary. Elstow Brook is the arterial watercourse through this location, which flows in a North-easterly direction. Immediately North of Stewartby the area is designated as being in Flood Zone 3 however, the majority of the area lies within Flood Zone 1. Bedford Borough-wide SFRA states that there is no flood risk in this area therefore future development will not be restricted. This site is within the Bedford Group of Drainage Boards District and as such all methods of surface water disposal will need their full agreement.

6.9.3 Hannah-Reed on behalf of the Bedford Group of Drainage Boards has undertaken an extensive hydraulic modelling exercise of Elstow Brook and results will be included in the Bedford Borough Council SFRA Level 2. Stewartby Lake itself is the site of a former clay pit which has since been designated as an on-line flood balancing reservoir. The Bedford Group of Drainage Boards undertake water level management of the Lake as a strategic asset and key flood risk mitigation measure for the Marston Vale. The original land owner of the Lake has retained drainage rights that allow the discharge of controlled flows to the Lake from the surrounding land. Stewartby reservoir is category D under the Reservoirs Act 1975.

Wootton

6.9.4 Situated between Stewartby and Kempston, Wootton village lies entirely within Flood Zone 1 and, as stated in the Bedford Borough-wide SFRA, is not at risk of any fluvial flooding. Existing land has already been allocated for development and flood risk from the Wootton Drain, a Drainage Board maintained watercourse, can be managed. There is recorded shallow flooding at this site, arising from the Berry Farm Drain. Floodplain issues therefore need to be considered in the proposals for any future development at Wootton. This area is covered by the Bedford Group of Drainage Boards and all methods of surface water disposal will need their full agreement.

Harrold

6.9.5 The principal watercourse here is the River Great Ouse, although the majority of the flood risk is posed by the minor watercourses through the village. There are two lakes situated to the North and East of the village of which one is the site of a country park. Ordnance Survey maps show a number of small backwaters and drainage channels adjacent to this site. Two smaller drainage channels lie to the West of the village. The existing and potential use of these lakes as a flood mitigation function is unknown. The majority of the village is within Flood Zone 3 which should be considered when assessing future development proposals. The Environment Agency are currently undertaking a project to refine the flood zone boundaries in Harrold.

Sharnbrook

6.9.6 The Great Ouse and the Sharn Brook are the key watercourses in this village. The Brook flows along the Northern side of the village into the Ouse, located at the south. Only a very small area of the village is within EA and SFRA Flood Zone 3. There are a series of disused gravel pits that lie to the south of Sharnbrook which have since been filled with water and turned into a nature reserve; these may present an opportunity for strategic storm/flood water management. Flooding occurred to Sharnbrook Road in the 1992 and 1998 flood event.

Bromham

6.9.7 A small part of the village lies within the Flood Zone due to it being situated on the banks of the River Great Ouse. Several other small watercourses influence the hydrology of this village, specifically Bromham Brook. Two flood events during the 1980's caused large amounts of damage to the area; in 1980 when 62 homes and caravans were flooded; and in 1983 when 7 properties were flooded. The 1983 event was assessed to be a 1 in 10 (10%) event.

Clapham

6.9.8 Clapham is situated to the North of Bedford town and lies on the banks of the River Great Ouse. However, only the very southern edge of the village is at risk from flooding from this watercourse and falls within Flood Zone 3; the majority of the settlement stands outside of the floodplain in Flood Zone 1. There are no minor watercourses in the area that would influence flooding in the area. Clapham was seriously affected by flooding from the River Great Ouse during Easter 1998. There have been nine incidents of surface water sewer flooding as stated in the Anglian Water's DG5 register.

Great Barford

6.9.9 Great Barford is to the East of the Town Centre and is again on the banks of the River Great Ouse. There are a number of smaller watercourses that confluence with the Great Ouse to the South of the village. The Drainage Board have identified areas that are at risk from these smaller watercourses with a history of property flooding through the village. These areas are within the EA and SFRA Flood Zones 2 and 3. Two upstream flood storage

reservoirs have recently been constructed to the north of Great Barford, as part of the bypass construction works, and these strategic assets are maintained by the Bedford Group of Drainage Boards to mitigate risk to the village downstream.

Wilstead

6.9.10 Smaller watercourses that come under the powers of the Drainage Board pose the only flood risk to Wilstead, however this is estimated to be very minor. No part of Wilstead falls within the EA or SFRA floodplain and thus Wilstead is entirely within Flood Zone 1. The small watercourses are generally field ditches that flow to the south of Bedford town centre and are tributaries to the Elstow Brook. There is a flood storage reservoir to the south of Wilstead, that reduce the existing flood risk to the village. It is operated by the IDB.

## *6.10 Mid Beds District Council Description*

6.10.1 Approximately 500 km², Mid Beds is a predominantly rural District interspersed by small towns and villages. The Greensand Ridge is the principal topographical feature within the District running from Ampthill to Sandy in a generally North-Easterly direction. Underlain by Lower Chalk in the South East, there are outcrops of Gault, Woburn Sands, West Walton, Ampthill Clay and Oxford Clay formations that run along the North West of the District (see Figure 6.1). The impermeable nature of much of the bedrock suggests there is little potential for infiltration drainage methods to be successfully implemented across the District.

6.10.2 Within Mid Beds, there are three principal watercourses, which are River Ivel, River Great Ouse and River Hiz. River Ivel, rises in Hertfordshire and flows Northwards where it joins the River Great Ouse at Tempsford. River Hiz, flows in a Northerly direction towards Arlesey where it joins the River Ivel at Henlow. River Flit flows North to merge with significant tributaries at Flitwick and Shefford before continuing in a North-Easterly direction as the River Ivel Navigation channel that discharges into the River Ivel at Langford. Where the watercourse is classified as a main river, it is administered by the Environment Agency. Where the watercourse is classified as an Ordinary Watercourse, the Bedford Group of Drainage Boards administers it.

6.10.3 The Pix Brook is also significant in the District and is a main tributary of the River Hiz. There are several smaller watercourses in the District that are maintained by the Bedford Group of Drainage Boards and these will be discussed in more detail in the drainage descriptions.

## *6.11 Existing Studies: Mid Beds District*

6.11.1 Previous studies that have been conducted to consider flood risk within the District include:

- Mid Beds District Council SFRA Stage 1 Report (WSP, 2006) which was an initial review of allocated and proposed development sites alongside existing EA Flood Zone Mapping.
- Mid Beds District Council SFRA Stage 2A (WSP, 2007) which was an assessment of collected data and a review of principal sources of flood risk whilst highlighting limitations to flood risk mapping.
- Mid Beds District Council SFRA Stage 2B Report (WSP, 2007) which assesses the flood risk across the District from all watercourses. This SFRA states that no other relevant feasibility reports have been identified for the District.
- The Marston Vale Surface Waters Plan (Marston Vale Surface Waters Group, 2002) appraises local flood risk within Marston Vale and promotes the role of strategic surface water management solutions.

## *6.12 Existing Flood Risk: Mid Beds District*

Historic fluvial and surface water flood risk

6.12.1 Historically, flooding across the District has predominantly been of fluvial origin. Some sewer flooding has occurred and surface water run-off from new developments is also thought to affect parts of the study area. Historical flood events that have occurred in the District, specifically in the Key Service Centres and those which have been highlighted in the Mid Beds Stage 2B SFRA, are summarised below. The SFRA also states that little information on levels and flows was available for many of these events.

- 1993: Shefford was flooded due to excess overland flow from surrounding agricultural land.
- 1998: The River Ivel caused extensive flooding across Biggleswade.
- 2002: Roads and some rural land in Ampthill were flooded by a small watercourse, Sweet Briar Brook. Elms Close, situated approximately 300m away from the other flooded areas itself flooded due to excess water levels in the highway drainage system. The Pix Brook also caused flooding to a road in Arlesey. Flooding to a school and its access road in Flitwick was caused by problems with highway drainage.
- 2003: The Rivers Ivel and Flit caused flooding to Biggleswade, Sandy and Shefford. Numerous properties were affected in each of these three towns.
- Problems with highway drainage, insufficiently maintained culverts or private watercourses have caused flooding to parts of the following villages, however the date and extents are unknown:
- Sutton Mill Road, Judith Gardens, Manor Way and Brook End, Potton.
- Bedford Road and Station Road, Marston Moretaine.
- Tippet Drive, Shefford.
- Ampthill Road, Flitwick.
- High Street, Lodge Road and Court Road, Cranfield.

The Environment Agency are able to provide the flood outlines and water levels for the 1947 and 1987 flood events if required.

Historic groundwater flooding

6.12.2 There are no known incidents of flooding caused by high groundwater levels within the District however natural springs are known to be prevalent in Cranfield and Ampthill which may pose a localised source of flood risk.

## *6.13 Evaluation of Development Proposals: Mid Beds District*

6.13.1 The locations of the eleven major development areas in relation to the watercourses and flood zones are shown in Figure 6.4 and Figure 6.5.

6.13.2 Development has the potential to increase flood risk downstream of all these areas as it increases the impermeable area and hence both the rate and volume of run-off without mitigation. There may also be an increase in the volume of water discharged from sewage treatment works. PPS25 requires that there is no increase in flood risk due to development, and development proposals must include measures to ensure that flood risk downstream is not increased. Typically planning requirements are that storage is provided so that the rate and volume of run-off from development is equivalent to the greenfield rates. The

Environment Agency and Bedford Group of Drainage Boards should be consulted in relation to specific drainage issues associated with development sites and their surrounds.

6.13.3 At the outline planning stage developers must ensure that their proposals include adequate space for flood risk management storage areas. More detailed plans will be required at later stages in the planning process to ensure that run-off is appropriately managed within the site to minimise flooding risk to new properties and to ensure safe routing of flood flows to the storage ponds and lakes. The WCS considers the earlier phases of the development process and therefore investigates the high level opportunities and constraints posed by flood risk management.

6.13.4 The approximate storage volumes and allowable run-off rates for the major development areas in Mid Beds District have been calculated using the method outlined in the Defra/Environment Agency Flood and Coastal Defence R&D Programme's 'Preliminary rainfall run-off management for developments R&D Technical Report'. This method provides initial estimates of the increase in peak flow and volume of run-off from developments less than 200 ha, and these figures have been used to provide a basis for evaluating the flood risk for each of the developments in the context of the WCS overview.

6.13.5 Two sets of calculations have been undertaken to produce Table 6.5. The first for residential development targets where it is assumed that up to 75% of the whole development site will be impermeable, compared to an assumed 0% prior to development, and the second for employment development targets where it is assumed that 90% of the whole development site will be impermeable, compared to an assumed 0% prior to development. In order to calculate indicative sites areas, it has been assumed that housing sites will be constructed at a density of 40 dwellings per hectare. The third element of Table 6.6 collates the residential and employment estimates together. It is expected that the actual impermeable area will be lower so these should represent conservative estimates of the storage area. More detailed calculations will be required during the master planning of development sites to determine the exact storage requirement s for each development site. In addition adoption of a sustainable drainage strategy can further reduce the impermeable areas for example through adoption of pervious paved areas. Similarly, contribution to off-site solutions may help to reduce the storage and site impacts significantly, and such an approach should be promoted for all development sites.

6.13.6 For each Key Service Centre the identified required storage volumes above are broken down into: a) attenuation storage, which is provided to reduce the rate of run-off to the equivalent predevelopment rate of run-off, and: b) long term storage, which is provided to reduce the volume of run-off to the predevelopment run-off volume where necessary. Developers will be required to provide sufficient storage to meet the combined total on the long term and attenuation storage, or mitigation as otherwise agreed with the drainage authority

6.13.7 Water is generally to be released from attenuation storage at greenfield equivalent rates. These rates have been calculated according to the Defra guidance, and are shown in Table 6.6 below. Calculations of run-off are made based on Qbar, which is the run-off that would occur in an event with a 1 in 2 (50%) probability of occurring or being exceeded within a given year.

6.13.8 It is noted that average run-off rates, based on the topography and geology of local parishes may sometimes be considered acceptable for smaller schemes. The developer should therefore liaise with the drainage authority to agree these criteria at an early stage.

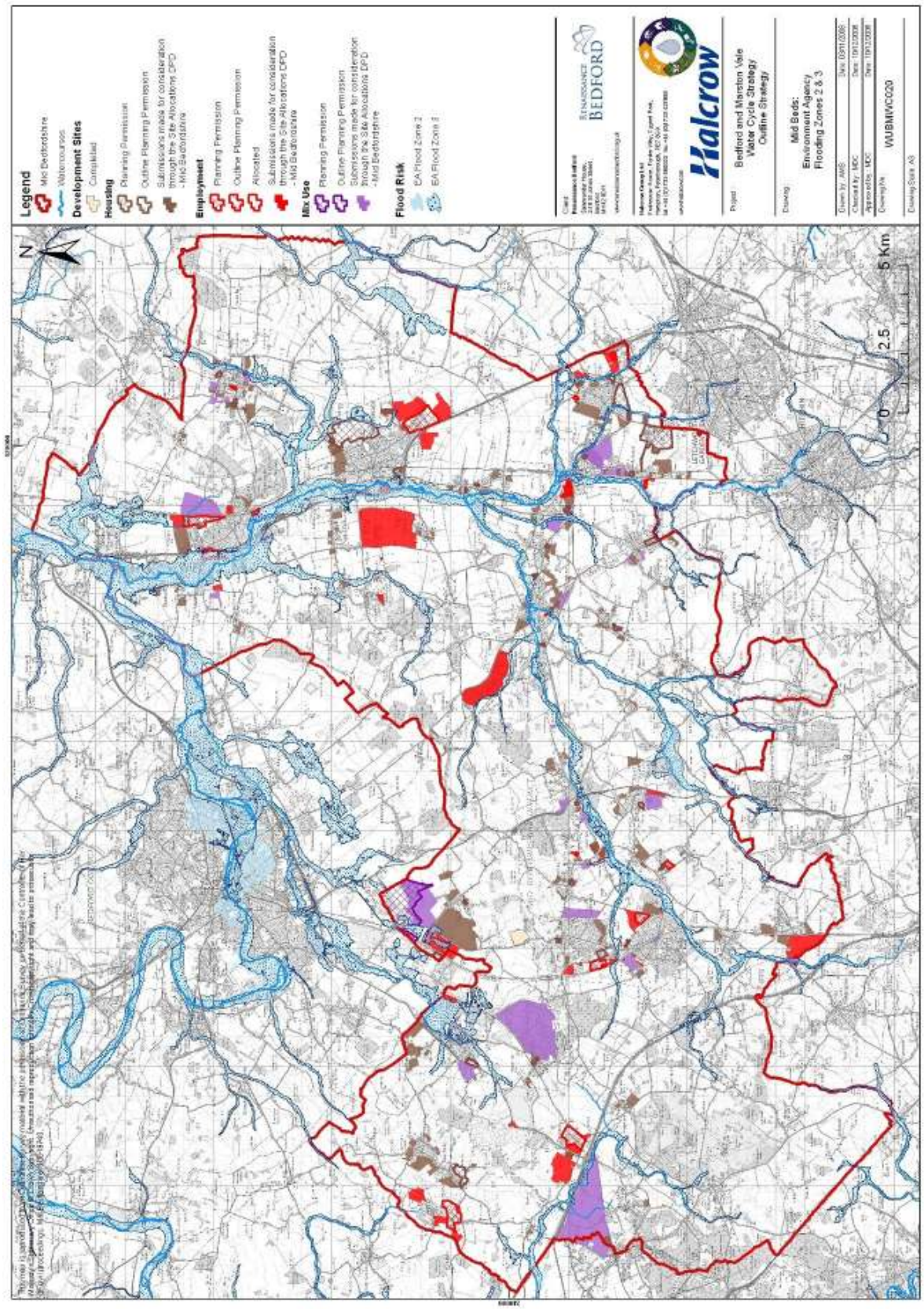



**Figure 6.4: Map of Environment Agency Flood Risk Zones in Mid Beds District**

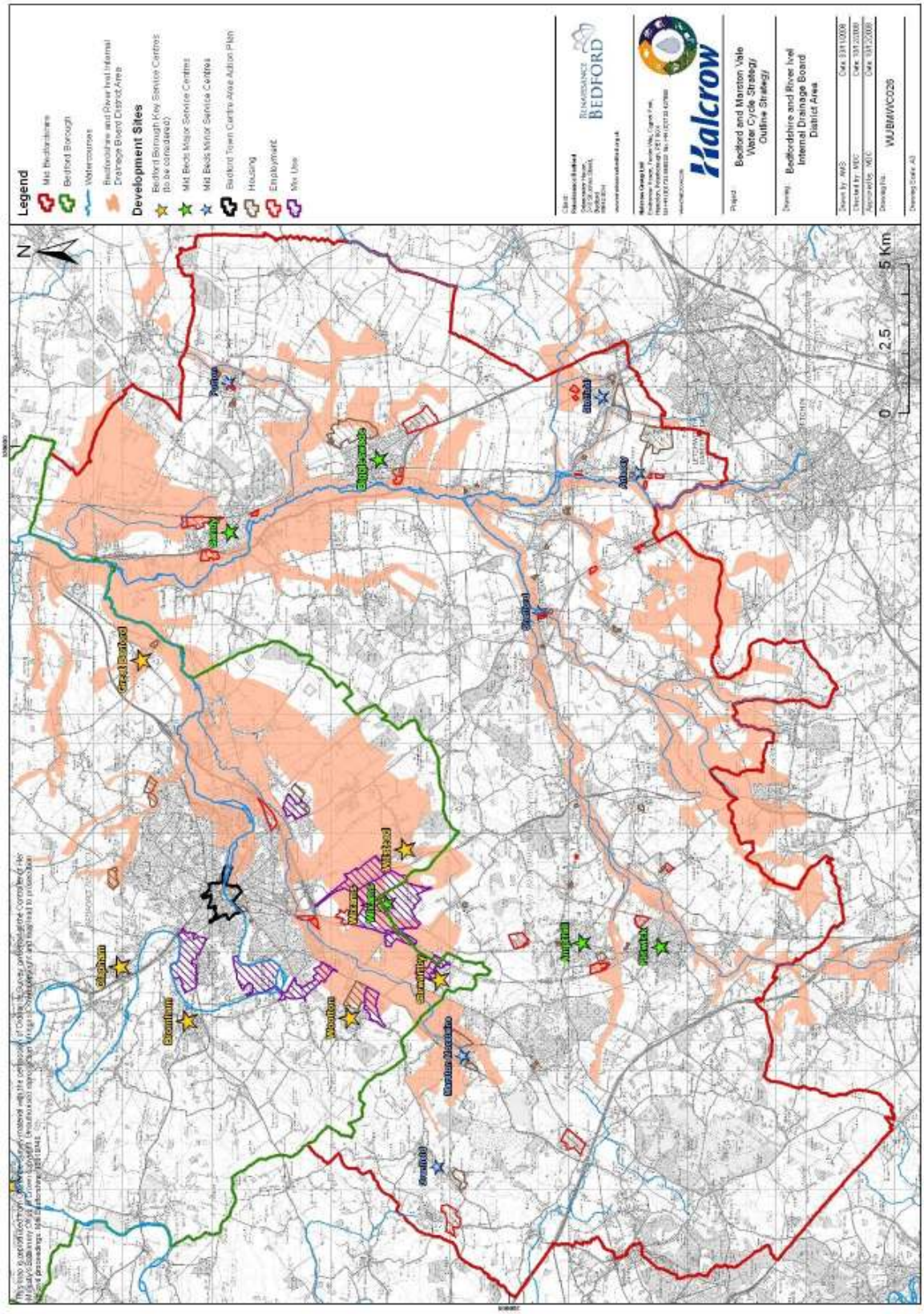



**Figure 6.5: Bedford Group of Drainage Boards District area**

| Site | Site Area * | Estimated Attenuated Storage for stand-alone solution ($m^3$) | | | Long Term Storage |
|---|---|---|---|---|---|
| | (Ha) | 1yr | 30yr | 100yr | ($m^3$) |
| **RESIDENTIAL** | | | | | |
| Biggleswade | 71.8 | 11,000 | 28,000 | 39,000 | 10,000 |
| Sandy | 5.7 | 940 | 2,200 | 2,800 | 1,200 |
| Ampthill | 19.8 | 3,300 | 6,500 | 9,700 | 3,300 |
| Flitwick | 19.7 | 3,400 | 7,600 | 11,000 | 5,600 |
| Wixams | 81.3 | 13,000 | 27,000 | 40,000 | 12,000 |
| Arlesey | 25.7 | 4,200 | 8,500 | 13,000 | 4,200 |
| Cranfield | 16.2 | 2,700 | 5,400 | 8,000 | 2,700 |
| Marston Moretaine | 14.8 | 2,400 | 5,700 | 8,000 | 2,100 |
| Potton | 7.1 | 1,200 | 2,300 | 3,500 | 1,200 |
| Shefford | 11.6 | 2,000 | 4,500 | 6,800 | 3,300 |
| Stotfold | 38.1 | 6,700 | 15,000 | 22,000 | 8,100 |
| **EMPLOYMENT** | | | | | |
| Biggleswade | 33.7 | 5,100 | 10,000 | 21,000 | 8,600 |
| Sandy | 13.6 | 2,400 | 5,200 | 7,900 | 4,600 |
| Ampthill/Flitwick | 16.1 | 2,400 | 4,900 | 9,900 | 4,600 |
| Arlesey/Stotfold/Fairfield | 21.3 | 3,700 | 8,200 | 12,000 | 7,200 |
| Northern Marston Vale | 47.8 | 7,200 | 14,000 | 29,000 | 12,000 |
| Cranfield | 11.3 | 1,700 | 3,400 | 6,900 | 3,200 |
| Potton | 2.2 | 320 | 650 | 1,300 | 610 |
| Shefford | 4.0 | 690 | 1,500 | 2,400 | 1,700 |
| **COMBINED TOTAL** | | | | | |
| Biggleswade | 105.4 | 17,000 | 38,000 | 60,000 | 19,000 |
| Sandy | 19.3 | 3,300 | 7,400 | 11,000 | 5,800 |
| Ampthill/Flitwick | 55.5 | 9,100 | 19,000 | 31,000 | 13,000 |
| Arlesey/Stotfold/Fairfield | 85.0 | 15,000 | 31,000 | 47,000 | 20,000 |
| Northern Marston Vale | 47.8 | 7,200 | 14,000 | 29,000 | 12,000 |
| Marston Moretaine | 14.8 | 2,400 | 5,700 | 8,000 | 2,100 |
| Cranfield | 27.5 | 4,400 | 8,800 | 15,000 | 5,900 |
| Potton | 9.2 | 1,500 | 3,000 | 4,800 | 1,800 |
| Shefford | 15.6 | 2,700 | 6,000 | 9,200 | 5,000 |
| Wixams | 81.3 | 13,000 | 27,000 | 40,000 | 12,000 |

**Table 6.5: Attenuation storage and long term storage volume estimates for the areas of planned development in Mid Beds District**

*Site area calculated assuming a housing density of 40 dwellings per hectare.

| Site | Site area (ha) | QBAR (l/s) | 2yr (l/s) | 30yr (l/s) | 100yr (l/s) |
|---|---|---|---|---|---|
| **RESIDENTIAL** | | | | | |
| Biggleswade | 71.8 | 300 | 200 | 600 | 1000 |
| Sandy | 5.7 | 100 | 100 | 300 | 500 |
| Ampthill | 19.8 | 200 | 200 | 600 | 900 |
| Flitwick | 19.7 | 0 | 0 | 100 | 100 |
| Wixams | 81.3 | 300 | 200 | 600 | 900 |
| Arlesey | 25.7 | 200 | 200 | 200 | 600 |
| Cranfield | 16.2 | 300 | 200 | 600 | 900 |
| Marston Moretaine | 14.8 | 300 | 300 | 800 | 1,200 |
| Potton | 7.1 | 200 | 200 | 600 | 900 |
| Shefford | 11.6 | 0 | 0 | 100 | 100 |
| Stotfold | 38.1 | 100 | 100 | 300 | 400 |
| | | | | | |
| **EMPLOYMENT** | | | | | |
| Biggleswade | 33.7 | 300 | 300 | 700 | 1,000 |
| Sandy | 13.6 | 100 | 100 | 300 | 400 |
| Ampthill/Flitwick | 16.1 | 300 | 200 | 600 | 900 |
| Arlesey/Stotfold/Fairfield | 21.3 | 100 | 100 | 300 | 400 |
| Northern Marston Vale | 47.8 | 300 | 300 | 700 | 1,000 |
| Cranfield | 11.3 | 300 | 200 | 600 | 1,000 |
| Potton | 2.2 | 300 | 200 | 600 | 900 |
| Shefford | 4.0 | 0 | 0 | 100 | 100 |

**Table 6.6: Greenfield run-off rates for the proposed Key Growth Settlements**

6.13.9 Water from long term storage is either released by infiltration or at a low flow rate compared to the rates of flow in the receiving watercourse. Guidance is that the rate of discharge from long term storage is less than 2 l/s/ha. During design, developers are advised to make an assessment of where releasing water from long term storage is likely to have an adverse effect on flood risk in the receiving watercourse. The extra discharge is considered likely to be significant upon the receiving watercourse if it is comparable to an event which has a 1 in 2 (50%) probability of occurring or being exceeded in a year as past experience shows that this is approximately bank full level for a natural channel.

## *6.14 Drainage Description of Key Service Centres: Mid Beds District*

6.14.1 Detailed descriptions of the geology of each of these locations can be found in Appendix H of this report and Section 8 within the Mid Beds SFRA Stage 2B report.

Major Service Centres

Biggleswade

6.14.2 Biggleswade is situated with its Western side on the banks of the River Ivel. The Potton Brook has a tributary that flows on the Eastern side of the town and is an allocated IDB watercourse. The Ivel is the main risk of flooding to this town and from the Mid Beds SFRA model properties on the far western edge of the town lie in the 1 in 100 year flood zone. The tributary of the Potton Brook is within the EA Flood Zone 3a however no properties are located in this particular zone. Sewer flooding occurred in Boddington Gardens, located on the far east of the town.

Sandy

6.14.3 Sandy is located to the North of Biggleswade, on the North West of the district. The River Ivel flows along the east side of the town and is the main source of fluvial flooding to the area. Based on the SFRA model, there are numerous farm buildings that lie within the 1 in 100 year Flood Zone along with the northern part of the small village of Beeston. There are three minor watercourses that are under the IDBs maintenance; one on either side of the Ivel and one to the North of the town.

Flitwick

6.14.4 The main watercourse in Flitwick is the River Flit which is IDB adopted. Rising in Luton, it flows northwards into the River Ivel Navigation then joining the River Ivel. There is a separate IDB watercourse that flows between Ampthill and Flitwick where it joins the Flit to the North West of the town. A section of the River Flit has been modelled by Hannah Reed and the south east of the town is within the 1 in100 year Flood Outline.

Ampthill

6.14.5 Situated to the north of Flitwick and the South East of Marston Moretaine, there are no prominent watercourses that flow through the town. However, as mentioned previously, the IDB have an adopted watercourse that flows to the south of the town and is highlighted as being within the EA Flood Zone 3.

Wixams

6.14.6 This location has no major watercourses running through the town however there is an IDB adopted watercourse that splits into two channels at the North of the site and flow along the West and East Side. As this is a new town, there is no information on historical flooding.

Minor Service Centres

Potton

6.14.7 Potton Brook is the key watercourse in this minor service centre, which is situated in between Biggleswade and Sandy, slightly to the North East. This flows along the East side of the village and this is within the EA Flood Zone 3a. A higher section of ground separates Potton and Sandy however the village sits at an elevation of 35mAOD with ground levels generally falling towards the River Ivel in a South Westerly direction.

Shefford

6.14.8 Shefford is located in the middle of the Mid Beds District. There is a significant amount of flood risk to the town of Shefford due to the River Flit flowing through the North where it merges with the River Ivel Navigation. The confluence of the River Hiz also lies in Shefford. Parts of the Flit and Hiz are Main River and part Ordinary watercourse. Another IDB drain joins with the River Flit at the east of the village. The SFRA model indicates that much of the village is within the 1 in100 year flood outline. The 2003 event saw properties flooded that lie on the edge of the EA Flood Zone 2. Shefford has also experienced flooding due to overland flow from surrounding fields and OS maps indicate that there are numerous field drains in the North of the village.

Cranfield

6.14.9 Cranfield is situated on a plateau with an elevation of 110mAOD, in the North West of the District. There are no watercourses within Cranfield that pose a flood risk.

Stotfold

6.14.10 Located in the very South East of the District, to the east of Arlesey, the River Ivel is the significant watercourse in this village. Flowing along the East side of the village, only a small number of properties are at risk from flooding according to the EA Flood Zone 3. There is a ditch that runs along the east side of the A1 through the village of Radwell and this joins the River Ivel to the North of Stotfold at Ivel Mill. Along with a smaller drainage channel, this area also lies within the EA Flood Zone 3.

6.14.11 To the South East of the village, the Pix Brook flows in a North Easterly direction and properties located on the Eastern side of a residential area off Hitchin Road lie just within the EA Flood Zone 3. This zone continues along the watercourse and a small portion of the village at the junction of Brook Street and Hitchin Road being at some flood risk.

Arlesey

6.14.12 Arlesey is a narrow village that follows the course of the River Hiz however a railway line separates the residential areas and the river with a significant embankment on either side of it. The Pix Brook, as detailed in the Stotfold description, flows alongside the River Hiz in the North of the village before joining the River Ivel on the outskirts of Henlow. A disused clay pit to the south of the village is now the site of a landfill indicating poor infiltration; therefore Sustainable Urban Drainage Systems would not be viable in this village. More detail on this can be found within the SFRA Stage 2B.

Marston Moretaine

6.14.13 Located on the border of Mid Beds District and Bedford Borough, Elstow Brook is the significant watercourse within Marston Moretaine, with two small field drains flowing in from the West of the village. Stewartby Lake, a flood balancing reservoir separates Marston Moretaine and Stewartby and is owned by the Forest of Marston Vale and is controlled with a sluice gate managed and operated by the IDB under the Reservoirs Act. There is a country park at on the east of the village that has a series of wetlands. The SFRA states that an area of Bedford Road often floods due to poor maintenance of a vegetation screen.

## *6.15 Flood risk from wastewater treatment works*

6.15.1 This section aims to quantify the volume of additional effluent discharge from the Wastewater Treatment Works (WwTWs) due to growth and how this compares to the existing flow in the watercourse during a flood event. This assessment is undertaken to support the principle of PPS25, which requires that development should not increase flood risk.

> PPS25 (Annex E)
>
> Any organisation or person proposing development must consider whether that development will not add to and where practicable reduce flood risk.
>
> At all stages of the planning process, the minimum requirements for flood risk assessments are that they should consider and quantify the different types of flooding (whether from natural and human sources [such as wastewater treatment works] and including joint and cumulative effects) and identify flood risk reduction measures.....;

6.15.2 For the six WwTWs assessed in this WCS, the results from previous studies have been used to quantify the percentage increase in peak flow for various flood events. This assessment was based on the Environmental Capacity Study undertaken by Halcrow for AWS (October 2008) which used a 1 in 2 year flood event and also on the East of England Capacity Study by Halcrow for the Environment Agency, which assessed the 20 and 75 year flood events in the receiving watercourses. The percentage increase in peak flow due to the projected increase in WwTW effluent discharge is shown in Table 6.7.

| | | | | | Peak Flows (m3/s) | | % flow Increase to watercourse due to additional wastewater effluent | | |
|---|---|---|---|---|---|---|---|---|---|
| Wastewater Treatment Works | Growth | cDWF (m3/s) | | | Watercourse | | | | |
| | % incr PE | 2006 | 2021 | Inc-rease | 20 year | 75 year | 2 year | 20 year | 75 year |
| Bedford | 16.59% | 0.39 | 0.48 | 0.09 | 180.5 | 224.1 | 0.16% | 0.05% | 0.04% |
| Biggleswade | 25.07% | 0.05 | 0.06 | 0.01 | 41.7 | 56.1 | 0.15% | 0.02% | 0.01% |
| Clophill | 14.92% | No available information | | | | | | | |
| Marston Moretaine | 32.25% | 0.02 | 0.03 | 0.01 | 0.4 | 0.6 | 0.33% | TBC | TBC |
| Poppyhill | 62.04% | 0.04 | 0.05 | 0.01 | 7.2 | 10.4 | 0.24% | 0.15% | 0.10% |
| Potton | 8.22% | No available information | | | | | | | |

**Table 6.7: Effluent discharge increase to receiving watercourses**

**incr PE = increase in population equivalent, CDWF = Consented Dry Weather Flow**

**Percentage increases in growth and flow values are taken from the Environmental Capacity Study (October 2008)**

6.15.3 At this stage, there may be opportunities to meet the PPS25 statements to reduce flood risk where this appropriate. The WCS mechanism provides an opportunity to reach agreement between all parties in order to facilitate sustainable growth. Sufficient time should be allowed within the detailed study to address this issue and obtain agreement from the Environment Agency, Water Companies and the local planning authority partners of the study. To give this discussion context, the volumes of storage that would be required to mitigate the additional WwTW discharge for the duration of the 1 in 100 year flood event had been calculated using FEH methods (using the critical storm duration for each location and the Re-FEH rainfall runoff method) and are summarised in Table 6.8.

| Wastewater Treatment Works | Watercourse | Discharge point grid reference | Duration of critical 100 year hydrograph | | Storage needed |
|---|---|---|---|---|---|
| | | | Hours | Days | m3 |
| Bedford | River Great Ouse | TL 08504949 | 155 | 6.46 | 48,300 |
| Biggleswade | River Ivel | TL 18904680 | 70 | 2.92 | 1,900 |
| Clophill | River Flit | Used 509250 238094 | 42 | 1.75 | Not modelled |
| Marston Moretaine | Marston Brook | TL 00084214 | 27 | 1.13 | 500 |
| Poppyhill | River Ivel | TL 18453864 | 42 | 1.75 | 1,700 |
| Potton | Sutton Brook | Used 522259 248642 | 45 | 1.88 | Not modelled |

**Table 6.8: Compensation storage volume required due to increase in wastewater treatment effluent discharge**

6.15.4 Options should be included in the detailed WCS to ensure the additional risk is mitigated by suitable solutions either spatial or strategic.

6.15.5 The WCS must consider that any works to a WwTW adjacent to a Main River are highly likely to require a Flood Defence Consent from the Environment Agency. The appropriate Internal Drainage Board will need to be consulted for works to any WwTW sites on IDB main drains.

6.15.6 The base flows for WwTWs may increase as a result of development if mitigation is not provided. Assessment at outline report stage has not determined this issue as insurmountable and thus requiring material change to the proposed spatial plan. However the next phase of the WCS needs to quantify such risks and propose appropriate mitigation measures. These will need to be prescribed in sufficient detail to:

- Produce outline costs;
- Identify associated land use linkages to feedback into the spatial planning process, and;
- Allow later phases of the WCS to determine an implementation mechanism including funding and agreements for delivering the necessary works. If either the Core Strategy allocation sites for development or sites come forward in advance of the WCS then this implementation mechanism needs to be clearly agreed. Developers will be required to submit Flood Risk Assessments in accordance with PPS25 to demonstrate how the development will ensure risk is not increased including discharge to watercourses.

## *6.16 Conclusion*

6.16.1 This section summarises the existing flood risk in the study area, the planned flood risk mitigation measures for the major development sites in Bedford and how these will impact flood risk downstream and whether there are in alignment with the Marston Vale Surface waters Plan. This section identifies the amounts of storage that may be required for the levels of development planned across Mid Beds.

6.16.2 Generally, the flood risk mitigation measures for the major developments around Bedford are in alignment with the Surface Waters Plan and the IDB has indicated that it would be prepared to adopt many of these schemes that contribute towards its master plan. Level 1 SFRA has been undertaken and Level 2 is going to be carried in line with the procedures.

# 7 SUDS and Surface Water Management

## *7.1 Introduction*

7.1.1 The purpose of this section is to:

- Provide an introduction to the uses of Sustainable Drainage Systems (SUDS);
- Summarise the type of SUDS that could be selected for flood risk mitigation;
- Summarise the geological environmental of the study area;
- Discuss the maintenance and adoption of SUDS;
- Present the Marston Vale Case Study.

## *7.2 Sustainable Drainage Systems*

7.2.1 The application of suitable Sustainable Drainage Systems (SUDS) to minimise environmental impacts of development plays a significant role in sustainable development. The ideal SUDS option for a development site will vary in each situation, depending upon:

- The geological, topographical and hydro geological characteristics of the site.
- The goals of the Local Planning Authority and the developer.
- The requirements of the Environment Agency and Internal Drainage Board (where applicable).
- Willingness of an appropriate body to maintain the facilities in perpetuity.

7.2.2 SUDS solutions may be selected and implemented to achieve many environmental objectives including:

- Flood risk mitigation through managing run-off arising from development.
- On-site pollution control arising from surface water run-off.
- Reducing pollutant infiltration into groundwater.
- Maintaining recharge to groundwater.
- Providing natural amenity and green spaces within development.
- Maintaining or restoring natural flow regimes of a receiving watercourse.

Flood risk mitigation

7.2.3 One of the primary applications of SUDS with respect to PPS25 is mitigation against flood risk arising from increased run-off generation from impermeable surfacing. Smaller-scale preventative measures such as porous pavements for infiltration, green roofs, or rainwater harvesting can contribute to this mitigation, but the wider benefits of larger-scale attenuation or filtration ponds, or wetlands, should not be overlooked when considering SUDS. In all solutions the ability to maintain the facility remains fundamental.

7.2.4 The Code for Sustainable Homes requires that peak run-off rates and annual volumes of run-off are no greater than the previous conditions for the development site. As Mid Beds

District's and Bedford Borough's strategic growth sites are, in the majority, on previously undeveloped land, careful planning of flood risk mitigation will be required within the planning process. CIRIA C697 also quotes that brownfield development should aim to replicated Greenfield runoff rates in recognition that old design standards are less than current standards and did not allow for climate change and to provide betterment

7.2.5 It is the developer's responsibility to undertake the analysis required to provide the evidence base to prove that flood risk will not be exacerbated to both the site itself and the neighbouring area as a result of their development. This should be included within the planning application. Appendix F provides a process for a Local Planning Authority to assess the requirements of a developer's submission in relation to flood risk.

7.2.6 The Marston Vale Surface Waters Plan (see case study below) promotes the benefits of taking a strategic and integrated approach to flood risk and storm water management. Adopting these principles the IDB have promoted a number of strategies in the area for Flood Mitigation. These strategies demonstrate the benefits of scale and help to avoid piecemeal solutions and the difficulties associated with ongoing maintenance of SUDS. These schemes provide a model for the successful delivery of sustainable solutions.

On-site pollution control

Use of SUDS for pollutant control is another possible application. The EA will generally advise if pollution control SUDS are required for a specific development site. Table 7.1 is adapted from (CIRIA, C697) and provides an indication of the pollutant removal potential of various SUDS methods.

Reducing pollutant infiltration

7.2.7 Securing the protection of vulnerable aquifers is an important consideration, particularly in areas of key abstractions. The presence of sensitive aquifers may constrain the opportunities and choice of feasible SUDS solutions at a specific location.

7.2.8 The majority of Bromham and Southern Clapham are located within the Outer Source Protection Zone as defined by the Environment Agency (see Figure 7.1). This categorisation may mean the proposed development may be restricted in the use of infiltration drainage methods. The remaining strategic growth settlements in Mid Beds District and Bedford Borough are not within a Source Protection Zone and are therefore unlikely to be restricted in the use of infiltration drainage although the impacts on any underlying aquifers will need to be considered.

Maintaining recharge to groundwater

7.2.9 Where possible, minimising the impacts on natural environmental processes should be the objective of sustainable development. In the natural environment, rainfall will infiltrate the soil and recharge the underlying groundwater. This process should be imitated where practicable within development as required within Building Regulations, Part H.

7.2.10 There may be constraints to implementing infiltration SUDS such as limited soil permeability and land contamination, and the feasibility of this approach can only clearly be determined through conducting ground investigation works on site. These surveys should be requested within the planning application submissions in support of the SUDS strategy. The 'Developer Checklist' in Appendix G provides an indication of what information should be requested.

| SUDS group | Technique | Water quality treatment potential | | | | | Hydraulic control | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total suspended solids removal | Heavy metals removal | Nutrient (phosphorous, nitrogen) removal | Bacteria removal (*) | Capacity to treat fine suspended sediments and dissolved pollutants | Runoff volume reduction | 0.5 (1/2 yr) | Suitability for flow rate control (probability) 0.1 – 0.3 (10/30 yr) | 0.01 (100 yr) |
| Retention | Retention pond | H | M | M | M | H | L | H | H | H |
| | Subsurface storage | L | L | L | L | L | L | H | H | H |
| Wetland | Shallow wetland | H | M | H | M | H | L | H | M | L |
| | Extended detention wetland | H | M | H | M | H | L | H | M | L |
| | Pond / wetland | H | M | H | M | H | L | H | M | L |
| | Pocket wetland | H | M | H | M | H | L | H | M | L |
| | Submerged gravel wetland | H | M | H | M | H | L | H | M | L |
| | Wetland channel | H | M | H | M | H | L | H | M | L |
| Infiltration | Infiltration trench | H | H | H | M | H | H | H | H | L |
| | Infiltration basin | H | H | H | M | H | H | H | H | H |
| | Soakaway | H | H | H | M | H | H | H | H | L |
| Filtration | Surface sand filter | H | H | H | M | H | L | H | M | L |
| | Sub-surface sand filter | H | H | H | M | H | L | H | M | L |
| | Perimeter sand filter | H | H | H | M | H | L | H | M | L |
| | Bioretention/filter strips | H | H | H | M | H | L | H | M | L |
| | Filter trench | H | H | H | M | H | L | H | H | L |
| Detention | Detention basin | M | M | L | L | L | L | H | H | H |
| Open channels | Conveyance swale | H | M | M | M | H | M | H | H | H |
| | Enhanced dry swale | H | H | H | M | H | M | H | H | H |
| | Enhanced wet swale | H | H | M | H | H | L | H | H | H |
| Source control | Green roof | n/a | n/a | n/a | n/a | H | H | H | H | L |
| | Rain water harvesting | M | L | L | L | n/a | M | M | H | L |
| | Permeable pavement | H | H | H | H | H | H | H | H | L |

* limited data available

n/a: non applicable

H = high potential
M = medium potential
L = low potential

**Table 7.1: Pollutant removal potential of SUDS**

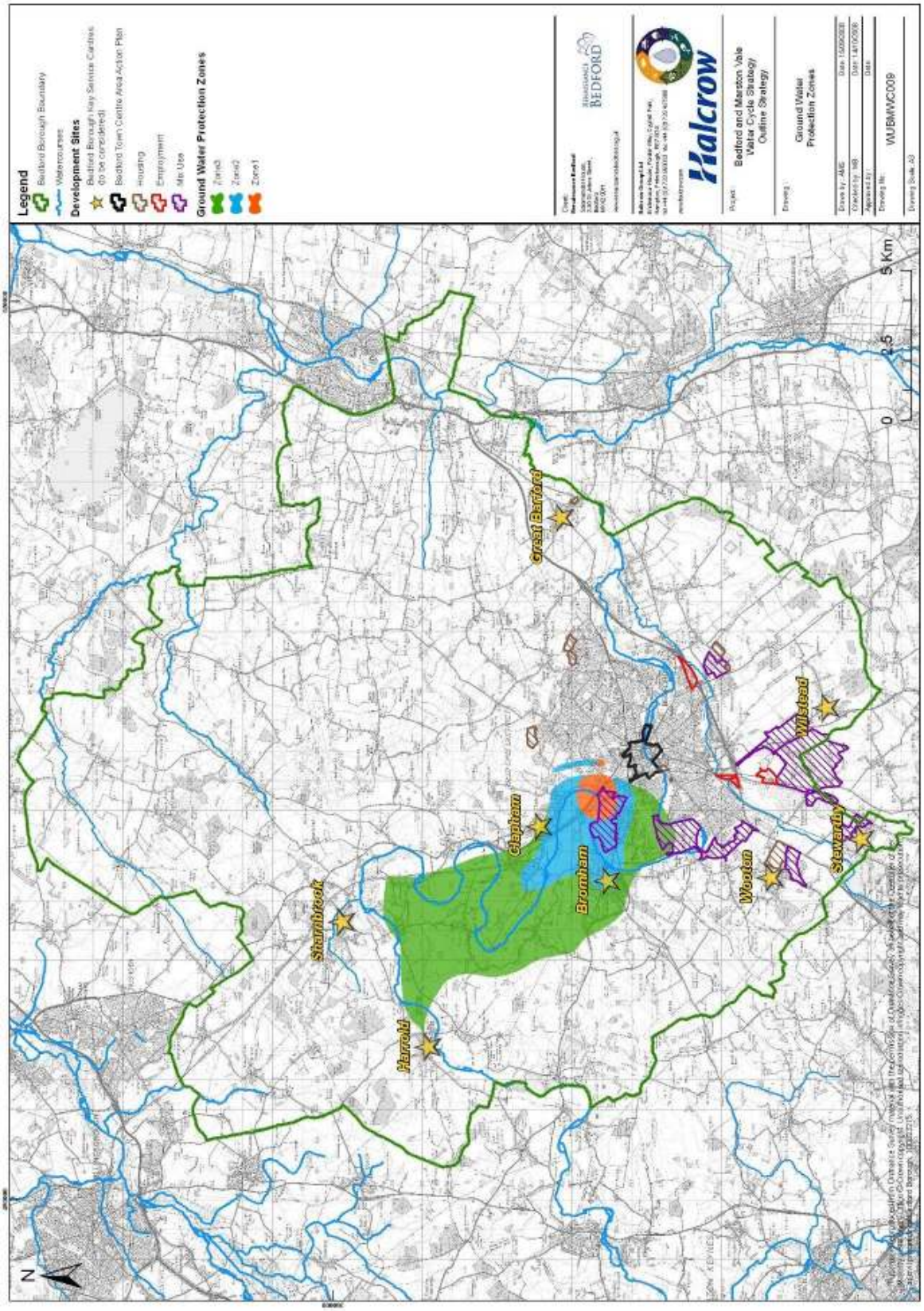



**Figure 7.1: Groundwater source protection zones**

Providing natural amenity

7.2.11 Local policies within both Mid Beds District and Bedford Borough create a strong emphasis on public amenity, protecting and maintaining green space, and the provision of recreational open space within new residential development in accordance with the Councils' standards. SUDS measures should be planned carefully at the master planning stage of development to achieve these goals whilst still providing adequate provision for maintenance.

7.2.12 SUDS measures provide an effective ecological opportunity to enhance existing habitats, or to compensate for encroachment on natural habitat elsewhere within the development site, but these benefits are best achieved in larger scale solutions. It is imperative that these benefits do not constrain the primary function of the flood mitigation and surface water management facilities.

Maintaining or restoring natural flow regimes of a receiving watercourse

7.2.13 SUDS measure, whether of an attenuation or infiltration nature, are designed to slow the rate of run-off generated from the introduction of impermeable surfacing during development. Attenuation of run-off rates back to Greenfield (pre-development) allowable rates will replicate the existing hydrological regime. Infiltration based alternatives, where feasible, will contribute to baseflow quantities within the receiving watercourse.

7.2.14 Unattenuated discharge from developments may sometimes be permissible where contribution is made to a strategic scheme. These schemes will normally include strategic flood storage or infrastructure improvements that benefit the catchment as a whole.

Integrated urban drainage

7.2.15 The role of SUDS should be considered in the wider context of effective surface water management delivered through an inclusive, coherent and holistic approach. Components of the whole drainage system include roads, sewers, infiltration and attenuation based SUDS together with receiving watercourses. Each element plays a role in conveying and managing surface water so that it limits flood risk locally and at downstream locations.

## *7.3 Selecting Suitable Sustainable Drainage Systems*

7.3.1 This WCS aims to provide a high level indication of what SUDS may be suitable for each settlement earmarked for potential development based upon underlying geology, source protection zones, aquifer characteristics, proximity to large water bodies and potential for a strategic approach. Detailed site geological surveys and appraisals should be undertaken by developers as required, as a part of the planning application process to define the most suitable SUDS options. Requirements for developers are listed in the Developer Checklist in Appendix G.

7.3.2 An important factor in determining if infiltration techniques are used is the depth to groundwater. Generally where the groundwater is less than 5m below the ground surface there is very limited potential for the pollutants to be dispersed, absorbed or otherwise neutralised before they enter the groundwater. Therefore the depth to groundwater and in particular the seasonal maximum must be known. From this information the degree of risk assessment can be determined. For shallow groundwater the risk assessment should be detailed.

7.3.3 Where the geology does not permit infiltration then the volume of detention storage required at a site will increase as little run-off can be lost to ground. This is also the case where small scale source control elements do not contribute, e.g. permeable paved driveways/paths, as the major attenuation elements then need to store the full volume of run-off.

7.3.4 For sustainable drainage to be most effective a site specific tailored series of elements for the run-off to pass through should be implemented. This is known as the treatment or management train (see Figure 7.2 below):

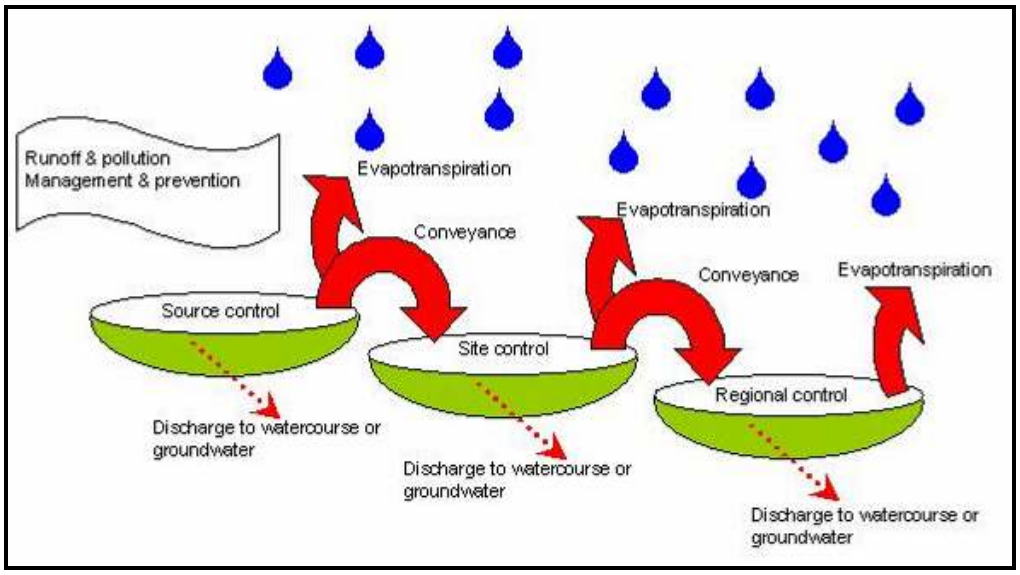



**Figure 7.2: The SUDS treatment (or management) train (www.ciria.org)**

Source control

7.3.5 Small-scale SUDS elements should be introduced at house or street level to provide the quickest and most localised response to managing run-off generation. The most typical element comprises a soakaway (ground conditions permitting) however it should be noted that soakaways are only normally designed to attenuate run-off for up to a 10% (1 in 10 year) return period event. Building Regulations require an assessment to be made to determine if soakaways can be utilised.

7.3.6 Alternatives include rainwater harvesting measures that are aligned with the Code for Sustainable Homes and the ideals of a WCS to avoid moving treated potable water and surface water run-off in opposite directions. Equally, green roofs work on any site and also act to enhance air quality and reduce the heat rise associated with property construction, but such measures have a limited impact in reducing run-off.

7.3.7 It must be emphasised and recognised however that whilst source control measures play a valuable role in run-off management, their contributions are comparatively minor and their success relies heavily upon appropriate maintenance and management – typically by the private property owner at the domestic dwelling scale, who may potentially be unfamiliar with the location, design and performance of such measures.

Site control

7.3.8 To better manage run-off quantities and thereby provide more substantial flood risk mitigation, an overall site strategy is required for each development. Typically surface features such as ponds, or sub-surface features such as crate storage are required to effectively attenuate the vast majority of run-off, in particular the quantities arising under large storm events where smaller-scale source control measures are constrained or inadequate. However, maintenance of an underground crate system can be problematic, which should be considered when assessing the whole life of the development.

Regional control

7.3.9 In the past an isolated approach would have been taken to development, presenting surface water drainage solutions in a piecemeal fashion comprised of source control and/or smaller-scale site control measures with little regard for effective management and long-term maintenance. The Developments West of Bedford Master Plan principles in the Marston Vale however have allowed surface water management and flood risk to be assessed and mitigated at a strategic level, benefiting both the developers, in terms of increased developable land and limited maintenance liability, and the public through reduced flood risk and environmental and amenity enhancement.

7.3.10 In accordance with the principles of the Government's 'Making Space for Water' strategy published in 2004, design of a large-scale, strategic solution enables the Operating Authority under PPS25 to fully utilise their Byelaws in ensuring protection of floodplain from development and the provision of adequate maintenance access to ensure assets function as designed for the benefit of future communities. Detailed design of strategic solutions offers opportunities to include contingency through providing surplus capacity to mitigate future climate change impacts and exceedance scenario events, coupled with diversion mechanisms for activation under unforeseen emergency scenarios.

7.3.11 As indicated by Figure 7.2 above, successful, efficient management of surface water run-off and associated flood risk mitigation relies upon the accurate design, implementation and long-term maintenance of all elements in composite.

## *7.4 Geological Environment*

7.4.1 Geological conditions have significant bearing upon the preferred surface water drainage solution for a development site and correct implementation of that solution is essential in providing flood risk mitigation to a site.

7.4.2 The underlying geology conditions for each key settlement within Mid Beds District and Bedford Borough are described below, with a supporting indication of feasibility for infiltration drainage.

7.4.3 Data has been collated from the Bedford Group of Drainage Boards GIS database and the Stage 2b Strategic Flood Risk Assessment produced by WSP Consultants for Mid Beds District Council. See Appendix H of the Stage 2b SFRA for visual representation of the feasibility for infiltration drainage at each key settlement in the District.

Bedford Borough Summary

7.4.4 The bedrock in Bedford Borough is generally the Oxford Clay Formation, with smaller areas of the Oolite Limestone Formation and Kellaways Formation in the centre of the district (See Figure 6.1).

7.4.5 There are no trends in the location of superficial deposits as Glacial Till and Glaciofluvial Deposits are widespread and common, with Alluvium deposits concentrated along the watercourses in the Borough. Detailed Geology of the Key Service Centres and the type of SUDS suitable for this geology can be found in Appendix H.

Mid Beds District Summary

7.4.6 The bedrock geology in the District has some general trends with the Woburn Sands Formation running from West to East through the centre of the District beneath Ampthill, Flitwick, Shefford, Biggleswade and Potton. To the North West of the District the bedrock is the Oxford Clay Formation and to the South East is the Lower Chalk Formation.

7.4.7 The distribution of the superficial deposits in the District is more variable. Areas adjacent to the River Flit and River Ivel have Alluvium deposits, with the remaining Glaciofluvial

deposits including Sands and Gravels, Glacial Till and Head deposits found throughout the settlements are listed in Appendix H.

## *7.5 SUDS Maintenance and Adoption*

7.5.1 Currently, no standard framework exists for adoption and maintenance of SUDS infrastructure, however in the DEFRA publication 'Making Space for Water' (2004) it is advised that a long term adoption strategy is crucial for the success of SUDS measures. This implies the involvement of "durable, accountable organisations that can be expected to have the financial capacity to meet their responsibilities in the longer term".

7.5.2 The planning, design, construction and initial maintenance of SUDS are the responsibility of the developer. The 'Interim Code of Practice for Sustainable Drainage Systems' developed by the National SUDS Working Group (2004) states that an adopting authority will require the SUDS to be developed to an appropriate standard, and that they are in an acceptable condition at handover. A developer must also provide a comprehensive owners manual, covering annual maintenance tasks as well as long-term remedial solutions. For indicative costs associated with maintenance of specific SUDS infrastructure see Appendix I.

7.5.3 The adoption situation is currently under review by the government which recognises that adoption and maintenance have been obstacles to the widespread introduction of SUDS. The document Improving Surface Water Drainage, published by DEFRA in February 2008, sets out some alternatives that may be introduced in the future. A summary of responses to the consultation on Improving Surface Water Drainage was published in September 2008 by Defra.

Adoption bodies

7.5.4 There are five options for the adoption and maintenance of elements of sustainable drainage assets within the Mid-Bedfordshire and Bedford Borough.

These are:

- Bedford Group of Internal Drainage Boards
- Unitary Authorities (which tier of local authority still to be determined, e.g. Borough Council or other). From April 2009 Bedford will become a unitary authority and Mid Beds will merge with South Beds District Council to become the unitary authority Central Bedfordshire whilst Bedfordshire County Council dissolves.
- Sewerage undertakers
- Local Highways Authority
- New specialist drainage undertakings or companies

Bedford Group of Internal Drainage Boards

7.5.5 Currently, the Bedford Group of Drainage Boards have adopted, and are therefore responsible for the maintenance of, 46 strategic assets across their three Internal Drainage Districts. Typically the Board are willing to adopt a suitable, strategic asset that falls within a District's geographic boundary for a 30 year funded agreement duration, with assets outside the District boundary that generate a direct flood protection benefit to the District for a 50 year funded agreement duration. The Board will only consider adoption of assets that benefit the flood protection standards of the Districts; they cannot be seen to 'facilitate development' alone.

7.5.6 In several instances, the Board have demonstrated a good working relationship with a partnership body to share the maintenance responsibilities. This is where the Board concentrates on flood risk management and water level control operations. The partner

body, (typically a charitable trust or public authority with landscape and amenity management responsibilities) addresses landscape maintenance associated with preservation of public open space e.g. working with the Milton Keynes Park Trust in Milton Keynes and the Marston Vale Trust.

7.5.7 The Board will develop a commuted sum to fund their operations, based on the specific maintenance inputs required for a facility. These will be most effective where the benefits of scale are present, where sums in the order of £2.50 to £10.00 per cubic metre of storage are achievable. The commuted sums are generally payable through a private, bespoke agreement between the developer and the Board. But should ideally be linked into the planners Section 106 agreements

Local Authorities

7.5.8 In Northampton a number of SUDS features have been incorporated into design undertaken by English Partnerships (now part of the Homes and Communities Agency). The adoption of these elements is still not finalised. The most likely option being considered is that the local council will manage the maintenance work that is necessary. The council will be provided with appropriate funding under Section 106 of the Town and Country Planning Act and will then arrange for a suitably qualified contractor, e.g. the Land Restoration Trust to undertake the actual work. This is partly made possible by the fact that there is a need to maintain an entire Country Park as well.

Sewerage Undertakers/ Water Company

7.5.9 At present the local water company may adopt SUDS elements that are in compliance with Sewers for Adoption (SFA) 6th Edition where the storage capacity does not exceed that required to attenuate storms any larger than a 1 in 30 year storm. The key clauses are:

- Part 1 – General
- Clause 1.14 covers flow attenuation and details the design parameters to be achieved. It also excludes any above ground items
- Clause 1.19 which relates to Sustainable Drainage Systems (SUDS)
- Part 2 – Design
- Clause 2.13 Hydraulic Design - Surface Water on Site
- Clause 2.14 Hydraulic Design – Protection against Flooding, which relates to sewer flow capacity and defines the 1 in 30 year no flood level of protection
- Clause 2.15 Control of Surface Water Discharges, which relates to PPS25 and the need to provide a sustainable solution

7.5.10 Historically there has been a recognised reluctance for Water Authorities to adopt the 'softer' green infrastructure elements of SUDS options and therefore adoption has typically concentrated upon hard, structural elements alone. Anglian Water however will be imminently publishing a new policy on their adoption of SUDS which could have significant bearing upon the design and implementation of surface water drainage strategies for forthcoming developments in both Mid Beds and Bedford Borough.

7.5.11 Generally the more technical elements or where there is an inherent safety risk due to confined spaces should be adopted and maintained by the sewerage undertakers as they possess the skills required to appropriately manage these residual risks if they cannot be designed out.

Local Highways Authority

7.5.12 The Highway Authority will adopt engineered grassed channels that are similar to swales and

vegetated wetlands, so long as both are in accordance with the provisions of Design Manual for Roads and Bridges (DMRB).

7.5.13 Generally the design of such elements for the Highway Authority should follow the DMRB Volume 3 Section 2 Drainage. Particular reference should be made to HA119 Grassed Surface Water Channels for Highway Run-off and HA103 Vegetated Drainage Systems for Highway Run-off.

New specialist drainage undertakings or companies

7.5.14 A type of specialist company that is already operating in the UK is a Multi Utility Services Company (MUSCO). Two examples of where such companies are used are the Multi Utility Joint Venture and the Ebbsfleet New Town.

Multi Utility Joint Venture (MUJV)

7.5.15 This is a company established for maintenance and operation of SUDS on the Allenby-Connaught development for Aspire Defence Limited, with the ultimate client being the Ministry of Defence (MOD).

7.5.16 MUJV is made up of a part of Thames Water (which has now become Veolia Water) and EDF Energy and was formed to service the works required to modernise and operate 9 garrisons for the MOD. The arrangement relates to water and electricity supplies plus foul and surface water drainage provision.

7.5.17 Work during the construction phase includes terminating services as required, modifying the existing network to suit refurbishment works and provision of a suitable new network to service all building and areas. MUJV is responsible for operating and maintaining all of the services for a period of 35 years following completion. Some parts of the SUDS network, such as the ponds and swales, are maintained by Aspire Defence Limited whilst the soakaways, some of which include large volumes of infiltration, are the responsibility of MUJV. The contract only operates within private areas operated by the MOD and ownership of the water infrastructure rests with the MOD.

Ebbsfleet New Town

7.5.18 Ebbsfleet New Town is a new development where a large number of properties are being built adjacent to Ebbsfleet International Rail Station. A MUSCO has been formed between Thames Water (now Veolia Water) and EDF Energy for the provision of services to this site.

7.5.19 This company provides complete new water, drainage and electricity infrastructure as required by the site layout. The MUSCO will be responsible for procuring all bulk utility supplies and delivering these to each property.

Adoption summary

7.5.20 The adopting organisation should be a public authority (or water company) with statutory powers. It is possible that for different elements of the SUDS network there will be a preferred adopting authority due to specialist skills. For example sewerage undertakers would be more capable of maintaining a below ground structure that provided attenuation and allowed infiltration. The Internal Drainage Board is experienced in hydraulic management of strategic pond facility, supported by a charitable trust to undertake maintenance of the adjacent public open space. Smaller SUDS assets are more suited to the current skills and capabilities of a local authority. New specialist drainage companies may bring flexibility and concentrated focus on maintenance of the SUDS assets, but must demonstrate appropriate skill and engineering knowledge through operation.

7.5.21 The use of management or wildlife trusts for adoption should be treated with caution. PPS25 identifies the importance of there being an accountable body to adopt, and the objectives of

the trust must not conflict with the primary function of the facilities being offered for adoption.

7.5.22 It would be most effective within the projected development areas of Mid-Bedfordshire District and Bedford Borough for there to be locally agreed solutions detailing the organisation most appropriate to take on responsibility for the adoption and management of SUDS.

7.5.23 The most advanced strategy to date is the Surface Waters Plan devised for the Marston Vale area, where the Internal Drainage Board have been proactive in the design and adoption of strategic surface water assets, sometimes in partnership with the Forest of Marston Vale charitable trust. Through potential expansion of the detailed Master plan strategy for Developments West of Bedford to incorporate Kempston-Hardwick lakes, and indeed the proposed revision of the Surface Waters Plan to provide higher level direction, an opportunity exists to extend the principles of the Surface Water Plan across the geographic extents of this Study Area.

7.5.24 Forthcoming publication of the Government's Floods and Water Bill is likely to generate significant impact upon the future roles and responsibilities of SUDS adoption bodies.

## *7.6 Marston Vale Case Study*

7.6.1 Marston Vale spans an area of 16,000 hectares from the South-West of Bedford to the edge of Milton Keynes and demonstrates a landscape shaped by an industrial heritage of brick-making. The A421 and the Bedford to Bletchley railway line are the key transport corridors through the Vale and serve existing settlements including: Wootton; Stewartby; Upper and Lower Shelton; Marston Moretaine; Lidlington, and; Brogborough.

7.6.2 The Marston Vale Surface Waters Group ('the Group') was formed in 1997 on the initiative of the Bedfordshire and River Ivel Internal Drainage Board and the Marston Vale Trust with the aim of aligning development aspirations with flood risk management within the Vale. In 2002 the Group published the Marston Vale Surface Waters Plan ('the Plan'), promoting the benefits of large-scale, strategic sustainable urban drainage systems rather than piecemeal alternative solutions.

7.6.3 The ethos of the Group, as emphasised through the policies of their Plan, is the need for proactive, integrated planning between Local Authorities, Drainage Authorities and key stakeholders to produce an optimal, sustainable solution to surface water run-off generation and thereby facilitate development targets. The Group recognise that a surface water management plan is an especially important tool in addressing hydrological issues across Council administrative boundaries.

7.6.4 The Internal Drainage Board have embraced the principles of the Plan through the promotion of a strategic surface water strategy for Developments West of Bedford ('the Master Plan'), and assisting developers in delivering an integrated solution.

7.6.5 The Group and their outputs demonstrate an early, working example of integrated urban drainage management (IUDM); a concept further developed and defined through the recent Defra-funded Integrated Urban Drainage Pilot studies. In 2006 the Marston Vale and its associated Surface Waters Plan was selected to be one of the fifteen pilot projects across England. Led by the Internal Drainage Board with the support of Hannah-Reed, the Forest of Marston Vale pilot study addressed the following three objectives:

1) To determine the impact of the Surface Waters Plan upon the planning process to date;

2) To collate lessons learnt from implementation of the Master Plan, and;

3) To consider the potential expansion of the benefits of the Master Plan and how the principles could generate a model for translation in other catchments.

A brief summary of the pilot study findings is outlined below.

7.6.6 Extensive consultation found the Surface Waters Plan to have been well received and recognised for the merits of a holistic, strategic approach. The document is regarded to be technically and hydrologically sound, yet hindered by insufficient appreciation of commercial aspects within its content and a lack of evolvement to fit with emerging planning legislation.

7.6.7 Three Local Planning Authorities traverse the Vale, demonstrating significant variation in the extent of promotion of the Plan and this issue is subject to further change through evolution of a Unitary Authority in Spring 2009. Private developers have widely implemented the Plan, whether through multiple parties sharing contributions to a surface water asset in implementing the Master Plan, or as a sole master developer designing a stand-alone strategic solution for future incorporation within extensive development proposals (Wixams).

7.6.8 Implementation of large-scale strategic surface water assets between multiple parties has scope to bring long-term benefit to all, however recent experience of implementing the Master Plan indicates allocation of funding responsibilities and the riparian rights of land ownership have proved legally intricate. Protracted negotiations introduced significant uncertainty over scheme implementation.

7.6.9 The pilot study generated five potential foresights to deliver strategic solutions in the future, listed below in order of perceived potential achievability rather than effectiveness:

(i) Heads of Terms should be signed in advance between developer parties to establish a legal basis of what is to be delivered, by whom, the funding, land contributions and deed of grant of drainage rights.

(ii) Agreement should be made under Section 106 of the Town and Country Planning Act 1990 between the Local Planning Authority and the Developer to implement strategic sustainable drainage systems to secure benefit to the wider community.

(iii) The new Community Infrastructure Levy introduced by the Department for Communities and Local Government in the Planning Bill of 24 January 2008 should be adopted by Local Planning Authorities and incorporate an allowance for the provision of strategic surface water solutions as a vehicle to provide a funding source upfront.

(iv) Compulsory Purchase Order and delivery powers for Internal Drainage Boards should be extended to allow use to facilitate development where a strategic solution is identified that will benefit the catchment as a whole. Powers are currently restricted to resolving known drainage problems only.

(v) Upfront funding to be provided by a third party development delivery vehicle equipped with the ability to hold funds (e.g. English Partnerships) and costs subsequently divided amongst beneficiaries.

7.6.10 The above list should be considered in programming the efficient delivery of strategic assets in the future in the Bedford area and beyond.

7.6.11 The 15 pilot studies concluded in April 2008, culminating in publication of the final report in June 2008. Findings recommended that in areas of high need a surface water management plan (SWMP) is developed under the leadership of the Local Authority to ensure that the actions of all other stakeholders (developers, water companies, Environment Agency, Internal Drainage Board) are aligned. One driver for SWMP is new development and therefore closely linked to surface water management aspects of WCS. Consequently, Surface Water Management Plan Guidance is due to be published by DEFRA in autumn 2008. A

second round of pilot study projects will be established to test and evaluate this forthcoming guidance.

7.6.12 In response to the Marston Vale pilot study findings, the forthcoming Surface Water Management Plan guidance, the potential eco-town development and evolving Local Development Frameworks, work will commence on a revision of the Marston Vale Surface Waters Plan in December 2008.

7.6.13 The provision of a strategically planned and properly maintained series of SUDS is central to good IUDM. This report provides guidance on how this can be provided for new development in both Mid-Bedfordshire District and Bedford Borough. The report also discusses upgrades to existing pubic sewers that are being driven by growth but also current levels of service which are below agreed levels. Another aspect is the proper consideration of exceedance flows within developments which occur once the design capacity of normal sewers or drainage (1 in 30 years) is exceeded. For new development in and around Bedford the developer should demonstrate that exceedance flow routes have been identified and integrated within their plans so that property is protected from surface water flooding for up to the 1% (1 in 100 years) return period events. This often necessitates planning the provision of green space to store excess flows, the design of highways to retain flows and/or the raising of building thresholds to reduce flood consequences in flow pathways. Proprietary software tools now allow flood pathways to be identified with relative ease. Full technical guidance on how to manage exceedance flows is specified in CIRIA Report C635 'Designing for exceedance in urban drainage – good practice'.

## *7.7 Conclusion*

7.7.1 One of the primary applications of SUDS with respect to PPS25 is mitigation against flood risk arising from increased run-off generation from impermeable surfacing.

7.7.2 Currently, no standard framework exists for adoption and maintenance of SUDS infrastructure, however in the DEFRA publication 'Making Space for Water' (2004) it is advised that a long term adoption strategy is crucial for the success of SUDS measures. This implies the involvement of "durable, accountable organisations that can be expected to have the financial capacity to meet their responsibilities in the longer term". The adoption situation is currently under review by the government which recognises that adoption and maintenance have been obstacles to the widespread introduction of SUDS.

7.7.3 The Marston Vale Surface Waters Group ('the Group') was formed in 1997 on the initiative of the Bedfordshire and River Ivel Internal Drainage Board and the Marston Vale Trust (a charitable trust) with the aim of aligning development aspirations with flood risk management within the Vale.

7.7.4 Currently, the Bedford Group of Drainage Boards have adopted, and are therefore responsible for the maintenance of, 46 strategic assets across their three Internal Drainage Districts. Typically the Board are willing to adopt a suitable, strategic asset that falls within a District's geographic boundary for a 30 year funded agreement duration, with assets outside the District boundary that generate a direct flood protection benefit to the District for a 50 year funded agreement duration. The Board will only consider adoption of assets that benefit the flood protection standards of the Districts; they cannot be seen to 'facilitate development' alone.

7.7.5 The suitability of the types of SUDS that could be utilised within Bedford Borough and Mid Beds has been assessed within this section. The majority of Bromham and Southern Clapham are located within the Outer Source Protection Zone as defined by the Environment Agency which may mean the proposed development may be restricted in the use of infiltration drainage methods. The remaining strategic growth settlements in Mid Beds District and Bedford Borough are not within a Source Protection Zone and are therefore unlikely to be restricted in the use of infiltration drainage.

# 8 Ecological Constraints and Opportunities

## *8.1 Introduction*

8.1.1 A key objective of a WCS is to ensure that town and country planning makes best use of environmental capacity, adapts to environmental constraints and makes best use of environmental opportunities relating to the water environment. Key to this is the consideration of potential constraints, opportunities, risks and benefits relating to ecology, nature conservation and biodiversity.

8.1.2 This section considers the potential changes in the water cycle that may arise from planned development in Bedford Borough, Mid Beds District and the Bedford and Marston Vale development area, and presents a high-level appraisal of the related constraints, opportunities, risks and benefits to/for the key water and wetland ecological features of the area.

8.1.3 The primary objectives of this appraisal are to:

- Describe the key water and wetland features sensitive to potential changes in the water environment that could constrain or be affected (positively or negatively) by the implementation of actions recommended by this WCS.
- Identify the risks, benefits and opportunities relating the key water and wetland features arising from the conclusions and recommendations of this WCS.

## *8.2 Approach*

Scope of this appraisal

8.2.1 This ecological appraisal is designed to identify potential constraints, opportunities, and risks to/for key water and wetland features within the study area as a result of the proposed changes to the water cycle (as identified in Section 8.8.)

8.2.2 The appraisal has both informed and considered the conclusions and recommendations of the following aspects of this WCS:

- Drainage and flood risk management requirements to manage surface water run-off;
- Water resources exploitation and protection to meet an increased demand for potable water;
- Water quality protection related to an increased demand for wastewater treatment and disposal;
- Significant new water supply infrastructure;
- Significant new sewerage infrastructure (specifically the proposed Marston Moretaine to Bedford Sewer).

8.2.3 There is no statutory basis for this ecological appraisal. It is intended to complement, but not replace, the full consideration of ecological issues required during the statutory environmental assessment of proposals arising from the Local Development Framework process – including Strategic Environmental Assessments (SEA), Sustainability Appraisals (SA) and any 'Appropriate Assessment' requirements under the Conservation (Natural Habitats&c.) Regulations 1994, as amended – and any subsequent, more detailed, Environmental Impact Assessments (EIA) required for specific developments.

8.2.4 In addition, this appraisal has been informed by, but does not replace, statutory ecological assessments undertaken by external parties in support of various aspects of the water cycle, for example the Environment Agency's Upper Ouse and Bedford Ouse Catchment Abstraction Management Strategy (CAMS), the draft Great Ouse Catchment Flood Management Plan (CFMP), and consented discharges and abstractions.

## *8.3 Methodology*

8.3.1 The study area covers the districts of Bedford Borough and Mid Beds, the Bedford and Marston Vale development area. All internationally, or nationally significant water / wetland ecological sites have been identified. Additional focus on locally significant features – Local nature Reserves (LNR), County Wildlife Sites (CWS) and protected and notable species associated with water and wetland features has been made for the development footprints and the River Ivel, River Hiz, River Great Ouse, Elstow Brook, the River Flit and their tributaries.

8.3.2 The appraisal was undertaken in parallel with the other aspects of the WCS and involved the following process:

- Review of all water and wetland features present within the study area and identification of those relevant to this appraisal –the 'key water and wetland features'. Information was obtained from the sources described in Section 8.2.2. Details of designated sites (international, European, national and regional/local) within the study area were reviewed to determine the presence of water and wetland features. Sites identified as not having water or wetland features within them were not considered further. See Section 8.6.11 for further details.
- Determination of the importance of the key water and wetland features as international, national or local based on: presence of nature conservation designations; qualification under the UK Biodiversity Action Plan (BAP); and/or wildlife conservation legislation (e.g. EU Habitats Directive, EU Freshwater Fisheries Directive, Wildlife & Countryside Act 1981, as amended)
- Display of the collated information for the key water and wetland features on a GIS mapping platform (see Figure 8.1 and Figure 8.2).
- Identification of policy and legislative requirements relevant to the water and wetland ecology of the study area, for example, likely improvements in the ecological status of rivers and lakes under the EU Water Framework Directive.
- Assessment of the sensitivity of the key water and wetland features to potential hazards resulting from changes to the water cycle and identification of relevant constraints on the implementation of these changes.
- Identification of the likely risks to the key water and wetland features resulting from changes to relevant aspects of the water cycle (e.g. change to hydrology, decrease in water quality) and, where relevant, recommendations on how these might be managed.
- Identification of likely opportunities for improvement of the key water and wetland features resulting from changes to relevant aspects of the water cycle and, where relevant, recommendations on taking these forward.

## *8.4 Information sources and mapping*

8.4.1 The information used for the ecological appraisal was compiled from the published and web-based information sources shown in Table 8.1.

| | |
|---|---|
| **Ecological data** | • Environment Agency<br>• Bedfordshire and Luton Biodiversity Recording and Monitoring Centre<br>• Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough Wildlife Trust<br>• Natural England<br>• UK BAP website: www.ukbap.org.uk<br>• MAGIC (Multi-Agency Geographic Information for the Countryside) website: www.magic.gov.uk<br>• The Bedfordshire Bird Report (2006), The Bedfordshire Naturalist |
| **Related plans** | • Forthcoming Water Framework Directive (WFD) objectives and measures under the Anglian River Basin District Management Plan<br>• Environment Agency Upper Ouse and Bedford Ouse Catchment Abstraction Management Strategy (CAMS)<br>• Draft Summary Plan: Environment Agency Great Ouse Catchment Flood Management Plan (CFMP)<br>• UK Biodiversity Action Plan (BAP)<br>• Bedfordshire and Luton BAP<br>• Water and Wetlands BAP (Bedfordshire and Luton)<br>• Planning Policy Statement (PPS) 9: Biodiversity and Geological Conservation<br>• PPS25: Development and Flood Risk<br>• Framework for the Bedford River Valley Park (2008)<br>• Bedfordshire and Luton Strategic Green Infrastructure Plan (2007)<br>• Marston Vale: Preliminary WCS (2008) by PBA<br>• The Wetland Vision, A 50-Year Vision for Wetlands: England's Wetland Landscape. |

**Table 8.1: Information sources used for ecological appraisal**

8.4.2 The collated information for the identified key water and wetland features was entered into a GIS mapping platform. To ensure clarity on the maps, the following decisions were made:

- Designated sites (international, national and local) without water and wetland features were not displayed.
- Due to the large number of local designated sites, only local sites along the River Ivel, River Hiz, River Great Ouse, Elstow Brook, the River Flit and their tributaries, and within 1km of the development areas were displayed.
- Where conservation designations overlap, e.g. local, national and international, only the highest rank was displayed on the maps.
- No GIS information was available for ditch and pond habitats.
- Key areas of species distributions are identified on Figure 8.1 and Figure 8.2 Where the distribution of species are scattered these are detailed in Appendix J.

8.4.3 The data used during this ecological appraisal will be dependent on the surveys undertaken therefore, considering this limitation, where the presence on water and wetland features are not displayed, this does not suggest absence of these features.

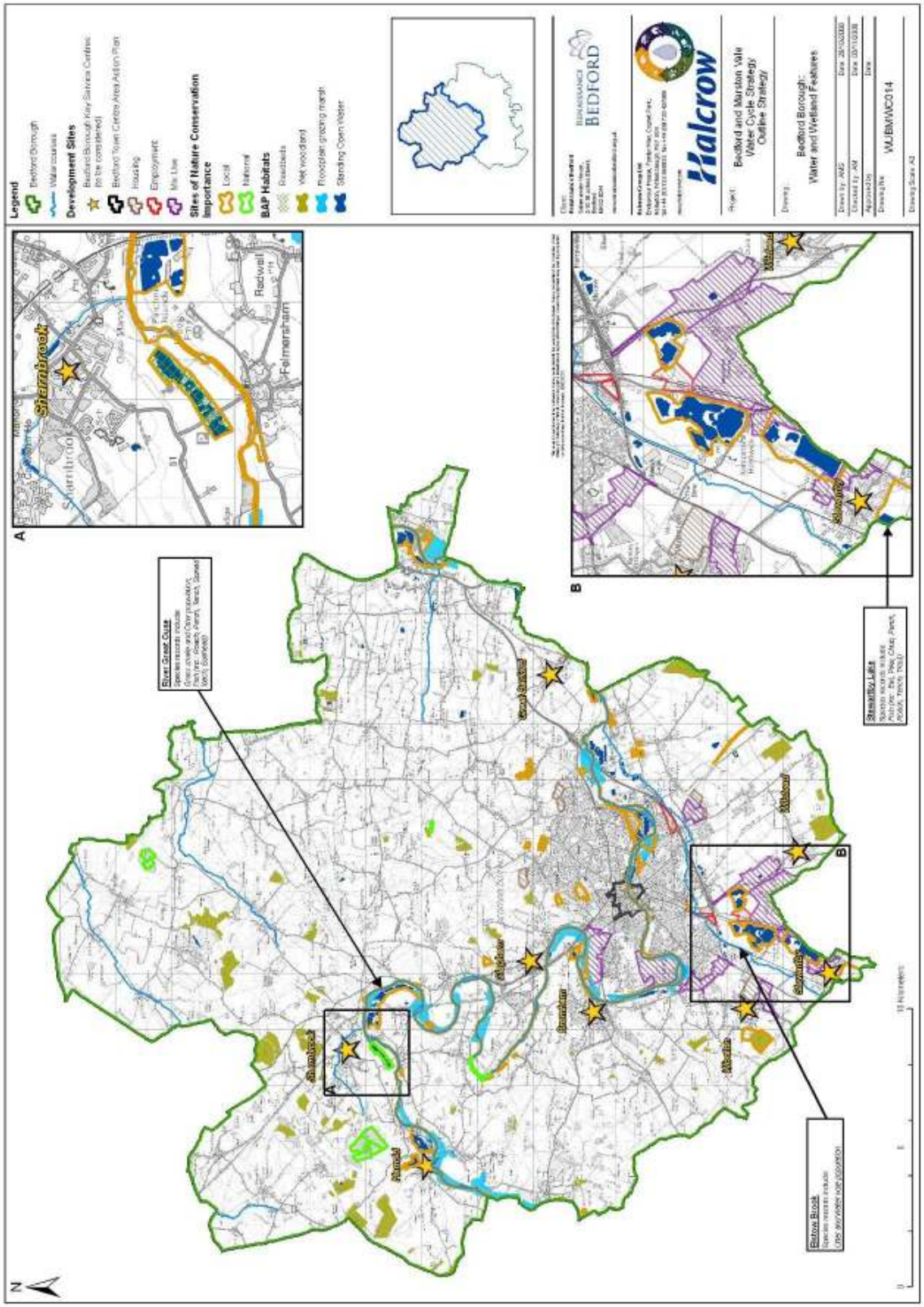



**Figure 8.1: Bedford Borough Water Related Ecology**

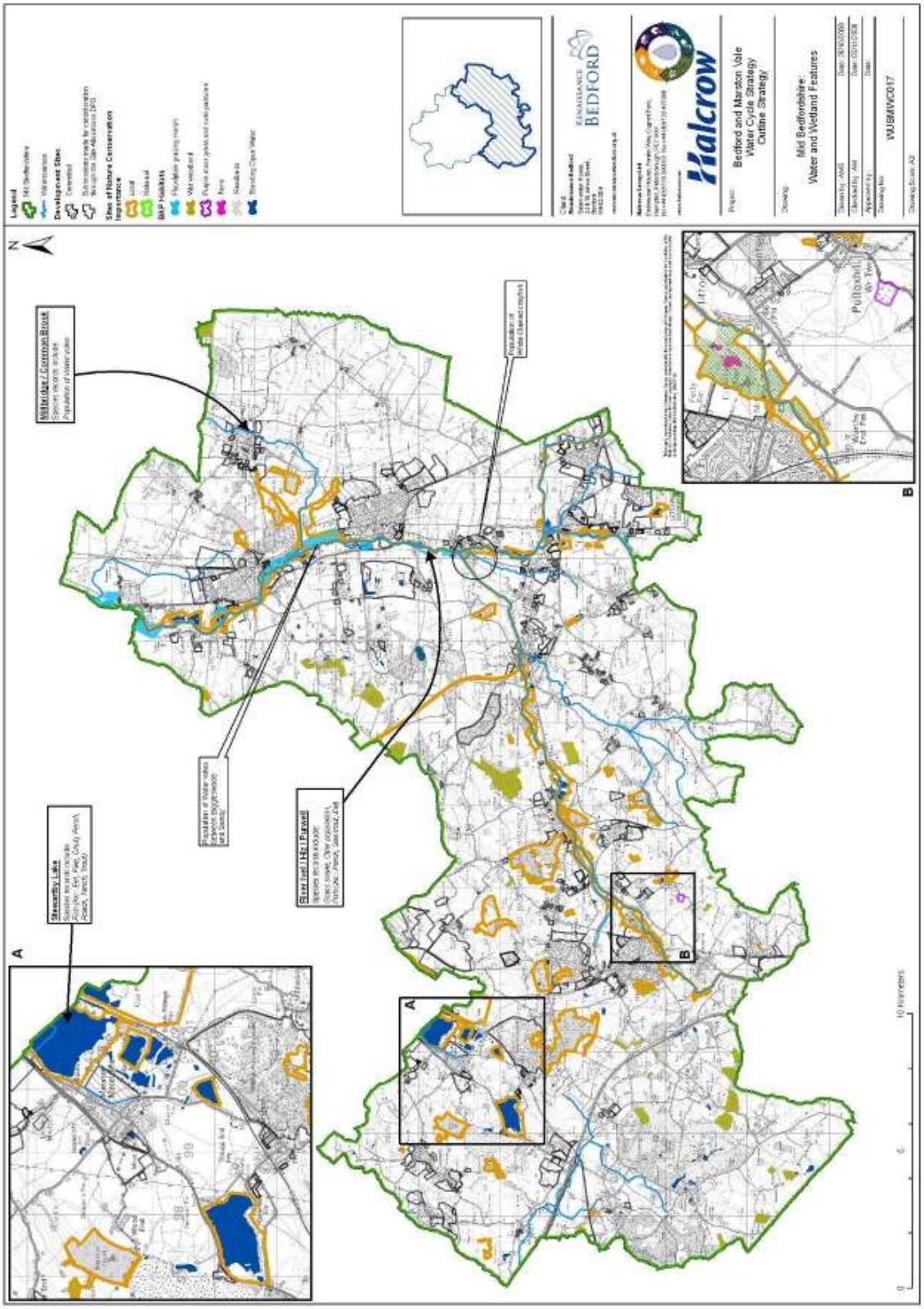



**Figure 8.2 Mid Beds Water Related Ecology**

## *8.5 The Study Area Context*

8.5.1 The study lies within the boundaries of four Natural Areas[4]; West Anglian Plain, Yardley-Whittlewood Ridge, Bedfordshire Greensand Ridge, and Chilterns. Arable land and agriculturally improved pasture make up the majority of the habitats present. They comprise features such as hedgerows, mature trees, ponds, small watercourses and rough grassland. Key wetland and water habitats present across the study area include:

- Standing and flowing open waters;
- Swamp;
- Marsh;
- Wet woodland;
- Mire; and,
- Flood meadow.

8.5.2 Conservation objectives for these habitats and their associated species have been set within the Natural Area profiles. Habitat objectives cover the restoration and maintenance of water quality and quantity, appropriate management of habitats adjacent to open water, traditional management of marshes, flood meadows and mires, and the re-establishment of natural river dynamics. Species objectives include the assessment and maintenance of white-clawed crayfish *Austropotamobius pallipes* distribution, and watercourse management to support otter *Lutra lutra*, and water vole *Arvicolla terrestris*.

8.5.3 In the study area there are numerous designated sites covering two levels of conservation importance:

- National: Sites of Special Scientific Interest (SSSIs) – designated under the Wildlife and Countryside Act 1981 (as amended). (e.g. Felmerhsam Pits SSSI, Wavendon Heath Ponds SSSI).
- Local/Regional: County Wildlife Sites (CWS) – designated by principal local authorities and receive protection under planning policy (e.g. River Great Ouse CWS, River Ivel and Hiz CWS). Local Nature Reserves (LNR) - designated by principal local authorities under Section 21 of the National Parks and Access to the Countryside Act 1949 (e.g. Hill Rise LNR).

8.5.4 Outside of the study area, although hydrologically linked to the study area through surface water for example the River Great Ouse, there are four internationally designated sites:

- Ouse Washes SAC, Portholme SAC and The Wash SAC – designated under the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive').
- The Ouse Washes SPA – designated under the 'Council Directive 79/409/EEC on the conservation of wild bird (the 'Birds Directive').

8.5.5 In addition to designated sites, there are habitats and species within the study area which are targeted for action under the UK Biodiversity Action Plan (BAP). BAPs identify key 'priority' species and habitats that are considered to be under threat, either on a local or national basis, and set out a plan of action to protect and enhance them. BAPs are set at both a national and local level. UK BAP priority habitats present within the study area and relevant to the WCS include: floodplain grazing marsh; wet woodland; fens; standing open water; and reed beds. Relevant UK BAP priority species within the study area include: water vole; otter; grass snake *Natrix natrix*; white-clawed crayfish; great crested newt *Triturus*

[4] Natural Areas are biogeographic zones that allow for the identification of habitats and species that are both important nationally and distinctive locally, and for appropriate nature conservation objectives to be set.

*cristatus*, brown trout/sea trout *Salmo trutta*, eel *Anguilla anguilla*; and spined loach *Cobitis taenia*. Figure 8.1 and Figure 8.2 illustrates the distribution of the UK BAP habitats and key populations of species across the study area.

## *8.6 Related Policies, Plans and Proposals*

8.6.1 There are key policies/plans/proposals relating to maintaining and enhancing water habitats and species, and the creation of new habitats and waterways, which are forward mentioned.

Water Framework Directive (WFD) (2000/60/EC

8.6.2 This sets environmental objectives for rivers and other types of water bodies such as lakes and ground water to achieve good ecological status (which requires appropriate chemical and physical conditions) by 2015 and ensure no deterioration of water quality. The objectives and measures for the study area are outlined in the Anglian River Basin District Management Plan. The WFD will be the main driver to place tighter constraints on levels of ammonia and phosphate in discharge from wastewater treatment works to reduce levels in the receiving water courses.

Freshwater Fisheries Directive (78/659/EEC) adopted in 1978 and updated in 2006 (2006/44/EC)

8.6.3 The Directive is concerned with the protection and improvement of fresh waters in order to sustain fish life. Designated stretches are divided into two categories of water: those suitable for salmonids (salmon, trout and grayling); and, those suitable for cyprinids (carp, tench, bream, roach, chub and minnows). For designated waters the Directive sets physical and chemical water quality objectives. Within the study area there is a diverse range of fisheries habitats, with stretches of the River Great Ouse, River Flit, River Hiz and Elstow Brook being designated under the Directive as suitable for cyprinid species. In addition, a stretch of the Ivel Navigation and the River Ivel is designated under the Directive as suitable for salmonid species.

Environment Agency Upper Ouse and Bedford Ouse Catchment Abstraction Management Strategy (CAMS)

8.6.4 Water demands in the study area include surface water abstractions for public water supply, industry and agriculture. The Environment Agency classifies the River Flit, River Ivel and Bedford Ouse as "no water available" for surface water, and ground water resources as "over abstracted". The main ground water abstractions are from gravel aquifers in the Ouse Valley (Woburn Sands and the Bedfordshire Oolite).

The Bedford and Luton Strategic Green Infrastructure Plan

8.6.5 The Bedford and Luton Strategic Green Infrastructure Plan identifies key areas for wetland habitat enhancement and creation along the River Ivel, River Hiz, River Purwell, Ivel Navigation, Elstow Brook, Campton Brook, River Flit and River Great Ouse. These identified areas are part of the strategic opportunity mapping which has the aim of creating a biodiversity rich tapestry within the Bedford and Luton areas.

Rowing Lake and Bedford River Valley Park

8.6.6 The Marston Vale Trust are proposing to create the Bedford River Valley Park (BRVP), a 868 hectare regional park to the east of Bedford, primarily situated on the River Great Ouse floodplain. The aim of the BRVP is to restore the floodplain and create areas of wetland and wet woodland. It is anticipated by Marston Vale Trust that these wetlands could be supported by treated waste water from the Bedford WwTW.

8.6.7 As part of the BRVP, a new rowing lake has been proposed and was granted planning permission in 2006. The rowing lake will stretch from the South Eastern edge of the Bedford

WwTW to just North of Willington. The construction of the rowing lake will require that Elstow Brook be re-aligned and broadened, meaning that a replacement brook 1.65km long will be required. Elstow Brook is currently the primary outfall from a large catchment including West of Bedford and Wixams, and is heavily modified channel with a primary function of flood risk management. The replacement brook will continue to have a primary function of flood risk management, and will incorporate meanders, pools and riffles. In addition, occasional steep banks will be incorporated to provide nesting opportunities for birds such as kingfisher and sand martin, and gentler bank sections to provide opportunities for water voles.

Bedford and Milton Keynes Waterway

8.6.8 The Bedford and Milton Keynes Waterways Trust are proposing to construct 24km of waterway to connect the Grand Union Canal in Milton Keynes with the Great Ouse in Kempston, Bedford. Outline Planning Permission has been granted for the first stage of the Waterway in Milton Keynes. The route within Bedfordshire has yet to be finalised, but it is proposed that the canal will run from Milton Keynes, under the M1, over Brogborough Hill, through Marston Vale, into Brogborough Lake before entering Stewartby Lake, then under the A421 travelling North – Eastwards towards Wootton and Kempston, joining to the River Great Ouse at Kempston.

Planning Policy Statement 9 (PPS9) and circular 06/05: Biodiversity and Geological Conservation (2005)

8.6.9 PPS9 sets out policies on protection of biodiversity and geological conservation through the planning system. The broad aim is that development should have minimal impacts on biodiversity and geological conservation interests and enhance them where possible. Appropriate weight should be attached to the need to protect international and national designated sites.

Features considered in the appraisal

8.6.10 The study area includes a number of different water and wetland habitats, which are considered to be sensitive to potential changes in the water cycle.

8.6.11 The specific features considered in the appraisal (see Figure 8.1 and Figure 8.2 for their distribution) included:

- The River Ivel (and its minor tributaries), which rises at Ivel Springs in North Hertfordshire and flows in a northerly direction past Biggleswade and Sandy before it meets the River Great Ouse at Tempsford;
- The River Hiz (and its minor tributaries), which rises South of Charlton and flows through Hitchin where it meets the River Oughton and the River Purwell, and joins the River Ivel near to Henlow.
- The River Great Ouse (and its minor tributaries), which rises in Northamptonshire, and flows in a North-Eastern direction towards Kings Lynn through Bedford, Huntingdon, Ely, Downham Market.
- The River Flit (and its minor tributaries), which flows through Flitwick, Clophill, Chicksands and Shefford before joining the River Ivel at Langford.
- Standing open water bodies within the study area (including disused quarry pits);
- Wetland areas (in particular floodplain wetlands);
- Ditches (scattered distribution);
- Ponds (scattered distribution);
- Species associated with these habitats (e.g. water vole, otter, grass snake, white-clawed

crayfish, eel, sea trout, spined loach and wading birds).

8.6.12 The water and wetland features listed above have varying levels of conservation importance; some or part of the features may be within a designated site boundary, and may be classified as a priority habitat or species under the UK BAP. For example, wetland habitats such as fen would have national importance in Flitwick Moor SSSI and ditches have local conservation importance when located within Stewartby Lakes CWS. See Appendix J for further detail.

## *8.7 Water and wetland features and their sensitivity to water cycle hazards*

8.7.1 The sensitivities of key water and wetland features in the study area are considered below:

- Change in hydrology e.g. changes to ground, surface and flood water levels: All features are considered to be sensitive to changes in hydrology as they are dependent on water to maintain the quality of the habitats for their associated species. Rivers and streams are sensitive to reductions in river flow or levels through surface or ground water abstraction which has the potential to impact on water voles, fish and white-clawed crayfish. Wet woodland, floodplain grazing marsh and fen habitats are sensitive to changes in flooding frequency, duration and extent. Flood risk management proposals, such as in-channel storage, have the potential to reduce the flood water levels during flood events. This has the potential to reduce the quality of these habitats and also to impact associated species, such as nesting lapwings, through the reduction of suitable nesting habitat. Increased flood water levels and increased frequency of flooding of rivers has the potential to impact water vole populations through increased flooding of their river habitats. Water voles are particularly vulnerable to disturbance during the breeding season. Increased flooding of habitats such as floodplain grazing marsh has the potential to disturb bird populations during the breeding season as nesting habitats would be flooded.
- Decrease in water quality e.g. increased nutrient levels, contamination: A decrease in water quality from WwTW has the potential to impact certain riverine species directly (including sea trout, and white-clawed crayfish) or indirectly, e.g. by impacting the food sources of species such as water voles and grass snakes.
- Physical habitat loss e.g. direct loss from the footprint of proposed development areas: Habitats such as ponds, ditches and floodplain grazing marsh, and the species they support, will be vulnerable if present within the proposed footprints of the development areas and associated infrastructure, including compensatory flood storage sites.
- Change in channel morphology e.g. erosion from additional flows, flood defence structures: Changes in channel morphology from flood risk management proposals and increased flows from waste water treatment discharges have the potential to impact river channel morphology. This could potentially result in impacts on aquatic vegetation through erosion and on fish populations through the prevention of fish passage through flow control structures.

## *8.8 Risks and Opportunities*

8.8.1 The risks and opportunities related to key water and wetland feature are assessed below, based on their sensitivity to water cycle hazards and the probability of the hazard occurring. The assumptions made throughout the assessment are outlined first, then the risks and then the opportunities.

Assumptions made

Water resources

8.8.2 No additional groundwater abstractions have been recommended as part of this WCS, and as

such are not considered in this ecological appraisal. Additional surface water will be supported within the Anglian Water's existing abstraction licences.

8.8.3 Flood risk management - Flood alleviation options for the key service centres (Stewartby, Wootton, Harrold, Sharnbrook, Bromham, Clapham, Great Barford, Wilstead) have not been defined in this WCS and therefore no options for flood alleviation in these areas have been considered as part of this ecological risk assessment. As no further housing allocations are required in these key service centres to support the Bedford Core Strategy, no further consideration is required within the detailed study.

Information on the flood alleviation options for the following developments was outstanding at the time of this ecological assessment and has therefore not been considered at this stage and will be considered within the detailed study:

- New Road, Great Barford
- Land at Shortstown
- Land north of Norse Road
- Norse Road
- North of Brickhill
- Land north of Bromham Road
- Biddenham Loop
- Shortstown (Frontier)
- Brittania Works, Kempston Road
- Land at Wotton Broadmead/Stewartby
- Austin Canons, Kempston

Information on the effect of releasing water from long term storage, potentially causing an adverse effect on flood risk in the receiving watercourses, was also outstanding at the time of this ecological risk assessment and has therefore not been assessed. This will be included within the detailed study.

Water supply

8.8.4 The ecological risks associated with improvement and addition of new pipes to the current water supply network will be localised and have not been considered during this appraisal. They will be addressed by Anglian Water through the EIA process.

Wastewater treatment

8.8.5 Increased development is likely to lead to an increase in the volume of treated water that will be discharged from the existing WwTWs into watercourses. This increase in volume has been modelled for Bedford, Biggleswade, Marston Mortaine, Poppyhill , Clophill and Potton WwTWs.

The water quality assessment in Section 5.3 has identified the changes required to the wastewater discharge consents in order to prevent deterioration of current water quality. None of these changes are beyond the levels currently achievable by the use of the best available technology, and it has therefore been assumed, as part of this appraisal, that all the WwTWs will be required to discharge to their consented water quality standards and that there will not be a decrease in water quality compared with current water quality. Discharge consents are regulated by the Environment Agency to protect the water quality of receiving watercourses. Effluent discharges from wastewater treatment will be required to meet the water quality requirements (no deterioration) of the WFD by 2015.

8.8.6 Undertaking the upgrade works at Bedford will result in a temporary overload of the remaining treatment units until the upgrade is completed. Further discussion between the Environment Agency and AWS is required in order to agree a methodology of how the upgrade can be undertaken to avoid detriment to water quality downstream of the WwTW. It is important that a methodology is agreed as soon as possible to prevent delay to the upgrade of Bedford WwTW.

Sewerage infrastructure

8.8.7 The ecological risks associated with minor upgrades to the sewer network have not been addressed during this appraisal as the risks are localised.

Risks to ecologically sensitive features from water cycle hazards

8.8.8 Risks discussed in this section are related to the affect of the proposed water cycle changes upon the water and wetland habitats and associated species within the study area.

8.8.9 Water resources (abstraction)

8.8.10 Increased abstraction from the local reservoir to the south-east of Flitwick has the potential to lower water levels within the reservoir. However, this abstraction is consented by the Environment Agency, and is therefore not considered to be a risk to the water and wetland features within the reservoir.

Flood risk management

8.8.11 Utilising Kempston Hardwick Pits and Elstow South Lakes for flood attenuation would lead to the increased flooding of these waterbodies. However, the duration, extent and frequency of the likely flooding is not known at this time. Increased flooding has the potential to impact associated bird species (such as mute swan, great crested grebe, and sedge warbler) on the margins of the water should the flood event coincide with the breeding season. Additionally, depending on the duration and extent of the flooding, there is a risk of loss of marginal BAP priority habitats such as marshy grassland. The potential for the increased intensity and frequency of flooding due to development and the ecological risk will be considered within the detailed study.

8.8.12 Watercourse improvements and in-channel storage (likely to require widening) are proposed as part of the flood alleviation for individual development areas (see section 10.4). Although the details of these improvements are not known at this time, there is a risk of loss of river and bankside habitats from these proposals, but also opportunities. Associated species such as fish, invertebrates and water voles may be at risk from the works.

8.8.13 Although information on the effect of releasing water from long term storage on the flood risk of the receiving watercourses was not available during this ecological risk assessment, should there be increased flooding of the River Great Ouse, this may displace fish, including large carp, from gravel pits adjacent to the Bedford Ouse into the main river. The loss of carp into running water is of particular concern, where they have the ability to out-compete the natural riverine species (Upper Ouse and Bedford Ouse CAMS). It is the responsibility of developers to ensure that they do not increase flood risk as a result of development.

Wastewater treatment

8.8.14 An increase in discharge from the WwTW (from increased development) has the potential to increase flow levels and decrease water quality in the receiving watercourses. The receiving watercourses of the nine identified WwTW most likely to have increased demand from proposed development are the River Great Ouse, River Flit, River Ivel, Marston Brook, Sutton Brook, Henlow Brook, and Running Waters. The increase in flow from the WwTW into the receiving watercourses has been modelled and is discussed in Chapter 6. Of the watercourses modelled, Marston Brook is expected to have the most significant flow increase

as a result of the proposed growth.

8.8.15 The River Great Ouse and River Ivel are of good biological and chemical quality. The River Flit, close to Clophill WwTW, is of good biological quality and fairly good chemical quality. Henlow Brook, close to Clifton WwTW, is of fairly good chemical quality. Running Waters, close to Potton WwTW, is of good biological quality and has fair chemical quality. However, the main water quality issue for this catchment concerns eutrophication and nutrient loading of phosphorous.

8.8.16 The Waterways and Wetland Action Plan, Bedford and Luton LBAP has highlighted eutrophication as an issue and outlines a target for reducing eutrophication of river waters by introducing phosphorous stripping at wastewater treatment works at Clifton, Biggleswade, Sandy, Flitwick and Poppyhill. In addition, a section of the River Great Ouse between Ouzel and Welney is designated as Eutrophic Sensitive Area under the Urban Wastewater Directive.

8.8.17 A number of WwTW (Bedford, Clifton, Sandy, Clophill, Marston Moretaine, and Potton) have been identified as needing to increase their consented water discharge volumes in response to the demand from increased development. Further investigation is required to determine the potential effect on water quality in the receiving watercourses through increased eutrophication. A decrease in water quality in the River Great Ouse (Bedford WwTW) may be a risk to sensitive fish species such as bullhead and spined loach. A decrease in water quality in Running Waters (Potton WwTW), Henlow Brook (Clifton WwTW), and River Ivel (Sandy WwTW) may be a risk to sensitive species such as white-clawed crayfish. However, this should be prevented by the review of the discharge consent by the Environment Agency.

8.8.18 Any new discharge consents or changes to existing consents will need to be assessed in accordance with the Habitats Regulations 1994 to ensure that features within European protected sites such as spined loach or alluvial flood meadows within Ouse Washes SAC and Portholme SAC retrospectively are not at risk from any decreases in water quality.

8.8.19 Waste water from Marston Moretaine WwTW discharges to Marston Brook, which flows almost immediately into Stewartby Lake. Any increase in flow along Marston Brook due to increased development may pose risk to otter and water shrew *Neomys fodiens* populations. Stewartby Lake is a designated Cyprinid Fishery under the Freshwater Fish Directive, but is known to suffer from algal blooms. Any change in water quality, may pose a risk of increased algal blooms and associated risks for aquatic species and their predators.

8.8.20 A decrease in water quality in the River Ivel (Biggleswade WwTW) and Henlow Brook (Poppyhill WwTW) may be a risk to sensitive species sensitive such as white-clawed crayfish (at Clifton). A stretch of the River Ivel between Girtford and Tempsford (downstream of Biggleswade and Sandy WwTW) is designated under the Freshwater Fisheries Directive (78/659/EEC) (2006/44/EC) as suitable for salmonid species (brown trout/sea trout), which are sensitive to changes in water quality. However, there is capacity within the discharge consents at Biggleswade and Poppyhill WwTWs, and therefore increased discharge levels within the limits set by the consent should not cause a decrease in water quality. and any subsequent impacts on salmonid species and white-clawed crayfish. Additional flow data is required for Sandy WwTW before the risk of increased discharge levels on salmonid species can be determined. This risk will be investigated within the detailed study.

Development footprint

8.8.21 The footprints of the proposed developments at East Ampthill, Broom, Wixham, Henlow, Bromham, West of Kempston, Biggleswade, Sandy, Potton have the potential for direct loss of open water, river and floodplain grazing marsh habitats, and species associated with these habitats such as water voles, otters and breeding/wintering waterbirds. Other habitats such as ditches and ponds may also be present within the footprints of these and other

development areas. The potential loss of pond and ditch habitats may lead to subsequent risks to aquatic invertebrates, fish, and amphibians (including great crested newts if present).

8.8.22 The river, stream and floodplain grazing marsh habitats are located within the floodplain and Planning Policy Statement 25 (PPS25) states that it aims to *"ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall"*. Additionally, PPS9 states that "*Plan policies and planning decisions should aim to maintain, and enhance, restore or add to biodiversity and geological conservation interests"*. Providing these statements are considered throughout the planning process in relation to these development areas, the risk to all identified habitats and associated species should be reduced.

Potential ecological opportunities/benefits arising from the WCS

8.8.23 Opportunities discussed in this section are aimed at either increasing the quality and extent of existing habitats or the creation of wetland habitats where the changes in the water cycle may create suitable conditions. These opportunities reflect UK BAP targets for priority water and wetland features, and the conservation objectives outlined in the Natural Area profiles for the study area.

Flood risk management

8.8.24 Flood attenuation and surface water management (e.g. Sustainable Drainage Systems (SUDs)) as part of the proposed development areas has the potential to provide habitat creation opportunities, including ponds, lakes, wet woodland, ditches, wet grassland, and reedbeds, whilst having a primary function of flood risk management. These habitats can form part of Green Infrastructure[5] planning for the developments and can be incorporated into multi functional spaces such as parks, as well as part of green corridors and specifically designated areas for nature conservation (where human disturbance is limited). Key considerations for habitat creation would be the creation of habitat mosaics, connectivity of these habitats across the development and achieving a balance between maintaining good ecological status of water and wetland features (and associated species) and human lifestyle benefits (e.g. recreation and angling facilities) provided by Green Infrastructure.

8.8.25 There may be localised river restoration opportunities within the development areas where watercourse improvements and in-channel storage have been recommended in this WCS such as at Wootton, Land off Cambridge Road and the Wixams development areas. In particular, increasing in-channel storage presents an opportunity to improve the river corridor habitats by, for example, setting back flood storage structures to provide primary and secondary channel structures. The watercourses in these areas may also benefit from river restoration opportunities, such as removal of flood and navigational structures, which will return rivers to historical natural flows. This would allow unrestricted passage within the river systems for fish and otters.

8.8.26 Depending on flooding extent, duration, and frequency there may be habitat creation opportunities at Kempston Pits and Elstow Pits which are proposed to be used for flood alleviation.

Wastewater treatment

8.8.27 The WFD will impose tighter constraints on the levels of ammonia and phosphate within

[5] Green infrastructure is the physical environment within and between our cities, towns and villages. It is a network of multi-functional open spaces, including formal parks, gardens, woodlands, green corridors, waterways, street trees and open countryside. It comprises all environmental resources, and thus a green infrastructure approach also contributes towards sustainable resource management. (www.greeninfrastructure.eu)

discharges from WwTW, resulting in improved water quality in the receiving water course. This will help to achieve the objective of achieving good ecological status (via improved chemical status) by 2015 set by the WFD, although such improvements will be a requirement anyway independent of .the WCS.

8.8.28 There may be the potential to create reedbed habitat within the Bedford River Valley Park which could received effluent from the adjacent Bedford WwTW when it is upgraded to accommodate the planned levels of growth. Additionally, reedbed habitat could be used as if a new WwTW is proposed in the vicinity of Marston Moretaine and Stewartby.

8.8.29 The increase in discharges from WwTW into the River Ivel, River Flit and River Great Ouse has the potential to increase summer flows and water levels, helping to alleviate reduced flow concerns (Upper Ouse and Bedford Ouse CAMS).

Development footprint

8.8.30 Open water and grazing marsh habitats are located within the footprints of the East Ampthill, Broom, Wixam, Henlow, Bromham, east of Kempston, Biggleswade, Sandy and the Eco-town development areas. Careful design of the development areas and the management of surface water (e.g. through the use of SUDs) could be used to increase the quality and extent of these habitats.

## *8.9 Potential ecological opportunities/benefits arising from regional proposals*

Rowing Lake and Bedford River Valley Park

8.9.1 The creation of a replacement brook for Elstow Brook as part of the construction of the rowing lake presents opportunities for habitat creation. Meanders, riffles and pools can be created to mimic a natural channel. Occasional steep banks could be created to provide nesting opportunities for birds such as kingfisher and sand martin. Gentler sections could be provided to enable water vole populations to establish. Reedbeds and marsh land could be created as part of the creation of the brook.

Bedford and Milton Keynes Waterway

8.9.2 The creation of the Bedford and Milton Keynes Waterway poses opportunities for habitat creation including reedbeds, and marsh. There may also be opportunities to create a natural channel, with meanders, pool and riffles, which would also provide subsequent benefits to otters and water voles.

## *8.10 Conclusions*

8.10.1 Table 8.2 summaries where potential risks to water and wetland features and opportunities for the features have been identified (for further detail see Appendix J). The risks and opportunities identified were based upon the assumptions made in Section 8.8.2 i.e.: that no additional groundwater abstractions have been recommended and; that works to the current water supply network are likely to have only localised effects and are not considered in this appraisal.

8.10.2 It is recommended that:

- Where risks, habitat benefits and opportunities are identified as part of the proposed development areas, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and green infrastructure.
- The organisations listed in the Water and Wetland BAP continue to work towards achieving the actions and targets identified by the Water and Wetland BAP Group.
- AWS work closely with the EA to agree necessary WwTW discharge consents to meet

WFD water quality targets..

- The detailed study assesses the impact of any flood mitigation measures, the phased release of flood storage water and any changes in the intensity or frequency of flooding upon the water related ecology.
- When flow data for Sandy WwTW is available, the impact of development upon the River Ivel, which is designated under the Freshwater Fisheries Directive, should be assessed.
- At the detailed study stage, further ecological assessment in relation to the potential ecological risks and opportunities associated with the water cycle strategy actions should be carried out.
- Any new discharge consents or changes to existing consents will need to be assessed in accordance with the Habitats Regulations 1994 to ensure that features within European protected sites are not at risk from any decreases in water quality.

| | Water Resources | Flood risk management | | Waste water treatment | Sewer capacity | Development footprint | |
|---|---|---|---|---|---|---|---|
| **Standing open water –lakes and margins** | R | R | O | O | R | R | O |
| **Rivers and Streams** | No risks/ opportunities | R | O | O | R | R | |
| **Wet Woodland** | No risks/ opportunities | O | | No risks/ opportunities | No risks/ opportunities | No risks/ opportunities | |
| **Marshy grassland** | R | O | | No risks/ opportunities | No risks/ opportunities | R | O |
| **Reed bed and swamp** | No risks/ opportunities | R | O | O | No risks/ opportunities | R | O |
| **Ditches** | No risks/ opportunities | O | | No risks/ opportunities | R | R | O |
| **Fen** | No risks/ opportunities | No risks/ opportunities | | No risks/ opportunities | No risks/ opportunities | No risks/ opportunities | |
| **Ponds** | No risks/ opportunities | O | | O | R | R | O |
| **Purple Moor Rush Grassland and Rush Pastures** | No risks/ opportunities | No risks/ opportunities | | No risks/ opportunities | No risks/ opportunities | No risks/ opportunities | |

**Table 8.2: Summary of risks (R) and opportunities (O) on water and wetland features arising from the WCS**

# 9 Marston Vale Eco-Town Scenario

## *9.1 Withdrawal of eco-town proposal*

9.1.1 As at 6th February 2009, O&H announced that they were withdrawing from the eco-town process in favour of pursuing an application through the normal planning process. This section of the report is retained for use when considering future development within the Marston Vale.

## *9.2 Introduction*

9.2.1 The Marston Vale spans an area of 16,000 hectares from the South-West of Bedford to the edge of Milton Keynes and demonstrates a landscape shaped by an industrial heritage of brick-making. The A421 and the Bedford to Bletchley railway line are the key transport corridors through the Vale and serve existing settlements including: Wootton, Stewartby, Upper and Lower Shelton, Marston Moretaine, Lidlington and Brogborough.

9.2.2 In addition to the development planned within the LDF, an eco-town has been proposed in the Marston Vale. Table 9.1 below documents the history of the eco-town publications by Communities and Local Government with respect to the potential Marston Vale eco-town.

| Date | Eco-town publication |
|---|---|
| July 2007 | Eco-town prospectus produced by Communities and Local Government |
| August 2007 | Potential Marston Vale eco-town announced |
| April 2008 | Living in a green Future made available for public consultation. |
| November 2008 | Eco-town Planning Policy Statement (PPS) and Sustainability Appraisal published for public consultation (closes February 2009). The eco-town PPS names Marston Vale as one of the remaining potential eco-town locations being considered. |

**Table 9.1: Eco-town publication history**

9.2.3 This section provides information about the impact of the proposed eco-town in the Marston Vale upon the WCS over and above the development identified in the Local Development Frameworks.

## *9.3 Surface water management*

9.3.1 The eco-town development will be required to comply with the requirements of the Marston Vale Surface Waters Plan. Work will commence on a revision of the Surface Waters Plan in December 2008 in response to;

- The Forest of Marston Vale pilot study findings;
- The forthcoming Surface Water Management Plan guidance;
- The potential eco-town development; and
- Evolving Local Development Frameworks.

## *9.4 Wastewater and Water Quality*

9.4.1 The eco-town which could provide up to 15,000 new dwellings and a wastewater load of 32,000 population equivalent (based upon a dwelling occupancy rate of 2.1). There is also a development planned within the Marston Vale which will yield an additional load equivalent to over 10,000 in terms of population equivalent. It has been assumed there a potential need for treatment facilities for approximately 42,000 population equivalent.

9.4.2 When considering the long term wastewater strategy for the Marston Vale, there is a benefit in considering alternative options for the wastewater currently treated at Marston Moretaine WwTW and Stewartby WwTW. Therefore the two options considered are shown in Table 9.2 below;

| Option | Scenario | Population Equivalent |
|---|---|---|
| 1 | Marston Vale development + Eco-town | 42,000 |
| 2 | Marston Vale development + Eco-town + Load from Marston Moretaine and Stewartby WwTWs | 56,000 |

**Table 9.2: Population equivalent for different scenarios**

9.4.3 Even though the precise location of the development or developments is not yet known, in the context of the identified Marston Vale Area, wastewater treatment could be considered at the following locations;

- Marston Moretaine WwTW
- Stewartby WwTW
- Bedford WwTW
- New Treatment facility in the Marston Vale.

Marston Moretaine WwTW

9.4.4 Anglian Waters' short-term strategy is to extend Marston Moretaine WwTW to accommodate short-term growth in the catchment. However, due to site congestion and the encroachment of ongoing development, significant extension of the treatment works would be constrained in terms of accommodating wastewater from the eco-town.

Stewartby WwTW

9.4.5 This is a small treatment works on a congested site. Realistically, it could not be extended to accommodate this additional load, and complete replacement of the works, including purchase of additional land and provision of a new discharge consent would be required. The timescale for constructing a replacement works would be in the order of 10-15 years. The following table shows the consented discharge limits and the available headroom at the works.

9.4.6 Stewartby has the water quality requirements and available headroom based upon AWS data is shown in Table 9.3

| WwTW | Consented Limits | | | | Current DWF ($m^3$/day) | Available Headroom (Dwellings) |
|---|---|---|---|---|---|---|
| | BOD (mg/l) | SS (mg/l) | Ammonia (mg/l) | DWF ($m^3$/day) | | |
| Stewartby | 25 | 50 | 15 | 290 | 193 | 293 |

**Table 9.3: Discharge consents set by Environment Agency. BOD = Biological Oxygen Demand, DWF = Dry Weather Flow, SS = Suspended Solids.**

Bedford WwTW

9.4.7 Bedford WwTW has limited free capacity to accommodate any additional load at the present time. However, extensions are being progressed to accommodate the committed and projected growth within the catchment, which is equivalent to 20% of the present load. The additional load from the Marston Vale would add a further 30%, requiring extensions of the existing treatment works of up to 50%. This additional load would increase the extent of improvements required and would also bring forward the timing of a new discharge consent (which is already required to support the growth of Bedford), which would have implications for the future quality discharge consent conditions (Table 9.4). The WFD Phosporus standards in the watercourse are unacheiveable, purely by changing the WwTW discharge consent because of upstream water quality issues. Therefore it is not possible to address this by amendment of the treatment works discharge consent alone. Achieving good status will require a range of measures which will need to be proportional to the impact of both point and diffuse sources of phosphate.

| Option | Current Consent | | Indicative consent to meet RQO Standards | | Indicative consent to meet WFD Standards | |
|---|---|---|---|---|---|---|
| | BOD 95%ile consent (mg/) | Ammonia 95%ile consent (mg/l) | BOD 95%ile consent (mg/) | Ammonia 95%ile consent (mg/l) | BOD 95%ile consent (mg/) | Ammonia 95%ile consent (mg/l) |
| 1 | 20 | 7 | 37 | 10 | 26 | 5 |
| 2 | 20 | 7 | 36 | 10 | 25 | 4 |

**Table 9.4: Comparison of Current consent and indicative requirements to meet standards at Bedford WwTW**

New Wastewater Treatment Works in the Marston Vale

9.4.8 The location of a new treatment facility would be dependent upon the location of any future development sites. Any new works boundary would need to be situated a minimum of 400m from any development to comply with the cordon sanitaire. On the strength of present knowledge it would be situated in the vicinity of Stewartby and Marston Moretaine, and would ideally be designed with a view to receive the flow presently served by these works to avoid operational issues associated with low flows during early construction phase of the Ecotown.

9.4.9 The suitability of a new wastewater treatment works in the Marston Vale will be dependent on the environmental capacity of the receiving watercourse to accept the additional flows without detriment to the water quality. A water quality assessment has been undertaken within this WCS and is detailed below. This assesses the impact upon the discharge consent for the existing Marston Moretaine WwTW (Table 9-4) and for the potential new Marston Vale WwTW (Table 9-5). For these options the consent at a new Marston Vale WwTW is assumed to be set against WFD targets.

| Option | Current Consent | | Indicative consent to meet 'no deterioration' of planned water quality | | | Indicative consent to meet WFD standards | | | Indicative consent to meet assumed RQO Standards | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BOD 95%ile (mg/l) | Amm 95%ile (mg/l) | BOD 95%ile (mg/l) | Amm 95%ile (mg/l) | Phos-phorus mean (mg/l) | BOD 95%ile (mg/l) | Amm 95%ile (mg/l) | Phos-phorus mean (mg/l) | BOD 95%ile (mg/l) | Amm 95%ile (mg/l) |
| 1 | 20 | 10 | 14 | 16 | 3.6 | 10 | 2 | 0.17 | 15 | 6 |

**Table 9.5: Scenarios for Marston Moretaine WwTW if a new WwTW is built in Marston Vale**

9.4.10 The impact on Stewartby WwTW situated further downstream on the Elstow Brook was also assessed and found not to be greatly affected by the discharges upstream and would therefore not require any tightening of consents.

The modelling results have indicated that the feasibility of constructing a new wastewater treatment works in the Marston Vale may be restricted by water quality constraints. This is because to ensure no deterioration in water quality, the standard of treatment required is beyond that currently achievable by using the best available technology (BAT). The required consents for the new Marston Vale WwTW for the two scenarios are illustrated in Table 9-6 and the values highlighted in red indicate that the value is beyond BAT.

9.4.11 The Environment Agency policy for 'no deterioration' states that if it is not technically feasible to discharge at the limit needed to achieve no deterioration, or if the cost of doing so would be disproportionate to the benefits, it would consider allowing 10% deterioration. Where this fails to provide a practical sustainable solution, the Environment Agency will consider the use of BATNEEC. However, there must be no planned deterioration beyond the River Quality Objective boundary of the receiving or downstream river stretch.

9.4.12 Statutory WFD limits will still apply, but issues of proportionate cost and overall sustainability would need to be taken into account for limits set to meet WFD standards. Resolving these issues may require flows to be transferred to Bedford WwTW, however an assessment of what is the most sustainable solution will be required.

| Option | Indicative consent to meet 'no deterioration' of planned water quality | | | Indicative consent to meet assumed RQO standards | | Indicative consent to meet WFD standards | | |
|---|---|---|---|---|---|---|---|---|
| | **BOD** 95%ile (mg/l) | **Amm** 95%ile (mg/l) | **Phos-phorus** mean (mg/l) | **BOD** 95%ile (mg/l) | **Amm** 95%ile (mg/l) | **BOD** 95%ile (mg/l) | **Amm** 95%ile (mg/l) | **Phos-phorus** mean (mg/l) |
| 1 | 1.5 | 0.17 | 0.16 | 11 | 3 | 7 | 0.7 | 0.16 |
| 2 | 1.4 | 0.16 | 0.16 | 10 | 3 | 7 | 0.6 | 0.16 |

**Table 9.6: Indicative consent requirements for the Marston Vale WwTW**

9.4.13 The Best Available Technology (BAT) levels set by the Environment Agency are 5mg/l for BOD, 1mg/l for ammonia (both 95%iles) and 1mg/l for phosphate (annual average mean).

9.4.14 This water quality assessment for the potential new Marston Vale WwTW has been assessed against the River Quality Objective (assumed RE3 as this reach is unclassified) and Water Framework Directive (high ecological status) standards. The Marston Vale WwTW was assessed against high ecological status for WFD because the current water quality hits the high ecological status targets, and the WFD status should remain the same with the new WwTW. .

## *9.5 Sewer Network requirements*

9.5.1 The existing "Southern Orbital Sewer" which conveys flows from surrounding villages to Bedford WwTW is not believed to have sufficient capacity to accommodate flows from the Marston Vale. It is likely that a new gravity sewer, approximately 14 km long with some pumping requirements, would be required to convey this flow to Bedford WwTW, which may prove unsustainable. This will be investigated in more detail in the next stage of the WCS.

9.5.2 The estimated sewerage and treatment costs of treating these flows at Bedford WwTW is provided in Table 9.7.

| Scenario | Population | Sewer Cost (Formula A) | Pumping Cost | Treatment Cost | Total Cost |
|---|---|---|---|---|---|
| | | £K | £K | £K | £K |
| 1. Marston Vale only | 10,000 | 11,000 | 500 | 3,500 | 15,000 |
| 2. Marston Vale+ Marston Moretaine | 20,000 | 14,000 | 1,000 | 6,500 | 21,500 |
| 3. Eco town only | 32,000 | 14,500 | 1,500 | 10,500 | 26,500 |
| 4. Eco town + Marston Vale | 42,000 | 16,000 | 2,000 | 14,000 | 32,000 |
| 5. Ecotown +Marston Vale +Marston | 56,000 | 16,000 | 2,000 | 17,000 | 35,000 |

**Table 9.7: Marston Vale outline sewerage and treatment costs at Bedford WwTW (based on UK water industry standard costs)**

## *9.6 Water Resources and Water Supply*

9.6.1 This section considers water resource requirements to supply the potential eco-town, the viability of achieving water neutrally (to comply with the draft eco-town PPS) and the water supply upgrades required to support the potential eco-town.

**Water neutrality definition:**

For every new development, total water use across the wider area after the development must be equal to or less than total water use across the wider area before the development.

Environment Agency, water neutrality high level guidance fact sheet

9.6.2 Figure 9.1 below shows the projected increase in water resources required to support the eco-town and the development rates identified in the Local Development Frameworks. The rates of development have been extrapolated to the year 2031 to align with AWS Water Resource Management Plan. In order to indicate water neutrality, the line on Figure 9.1 should be horizontal.

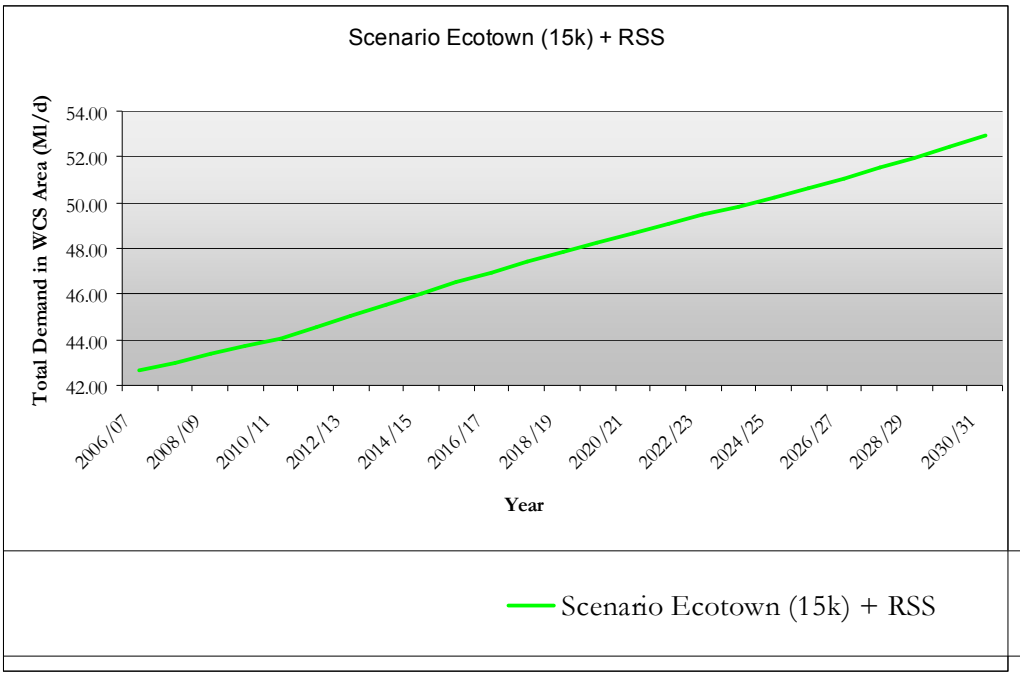



**Figure 9.1: Anticipated water resource demand for eco-town and LDF development**

9.6.3 Within this water resource scenario, it has been assumed that the eco-town would be constructed evenly over a 20 year period from 2011, which represents an additional 750 properties per year. It has been assumed that Code for Sustainable Homes Level 4 applies to the properties within the eco-town from 2011 to 2016, and that Level 6 applies beyond 2016. It has also been assumed that all development constructed to meet the Local Development Framework requirements will meet the requirements of the East of England Plan for the reduction in water consumption. These reductions are 8% for existing homes and 25% for all new homes.

9.6.4 This assessment shows water neutrality cannot be achieved simply by implementing the Code for Sustainable Homes for the eco-town and by complying with the East of England Plan requirements to reduce water consumption within Bedford Borough and Mid Beds District. Therefore in order to identify the requirements to achieve water neutrality, the following should be investigated;

- Review of the assumptions within this WCS;
- Assessment of the effect of more ambitious reductions in water consumption within Bedford Borough and Mid Beds District;
- Consider the ability to achieve water neutraility over a wider area (i.e. the AWS Ruthamford Water Resource Zone)

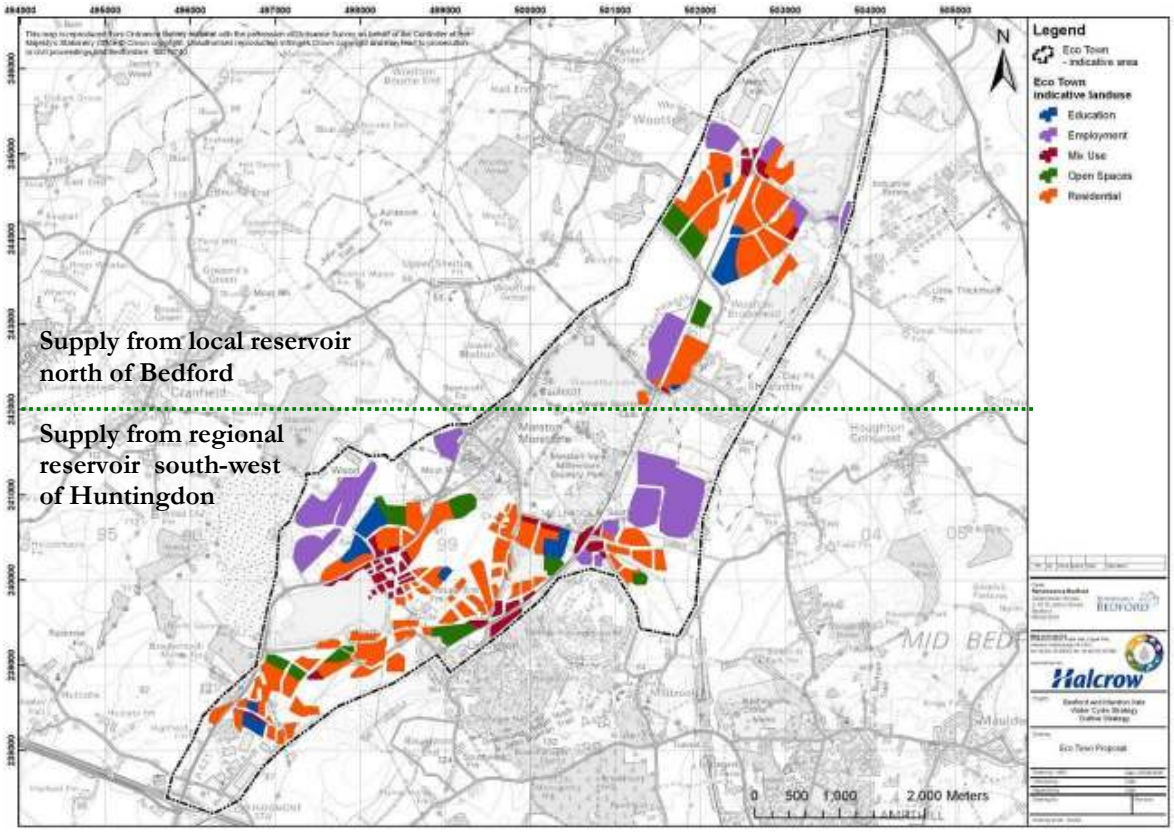
Infrastructure requirements to support growth

9.6.5 Supplying the proposed eco-town will require the duplication of the existing Ampthill to Woburn Sands gravity trunk main from the storage reservoir north of Ampthill, to the

assumed point of connection near Lidlington. The number of dwellings will determine the size of the strategic main required.

9.6.6 The dwellings in the Northern half of the site in the vicinity of Wootton will be supplied by reinforcements to the Bedford ring main, with fluoridated supply coming from the local Bedford reservoir.. The Southern half of the proposed eco-town will be supplied from the trunk main linking the regional reservoir to the south-west of Huntingdon to Milton Keynes via storage reservoir to the north of Ampthill (Figure 9.2). This will require a new strategic main from the reservoir near Ampthill to the development site.

**Figure 9.2: Eco-town water supply strategy**




9.7.4 For the lakes located within the Marston Vale Growth Area, it is recommended that a Water Level Management Plan is developed in consultation with key organisations such as the local IDB and Environment Agency to ensure the long-term integrity of the water and wetland features associated with the lakes. To help achieve this aim, "the Marston Vale Surface Water Group is established to develop an integrated and co-ordinated approach to water management within the Vale" *Water and Wetland BAP, Bedford and Luton*.

9.7.5 Any potential sewer from Marston Vale to Bedford WwTW is likely to run in close proximity to locally important water bodies (Priority BAP habitats), such as Stewartby Lake and Priory Country Park lakes, and the River Great Ouse (a UK BAP Priority habitat) creating a potential risk of habitat loss. Consideration of habitats should be made if the preferred option is to treat eco-town wastewater flows at Bedford WwTW.

## *9.8 Conclusions*

9.8.1 The eco-town will be required to comply with the Marston Vale Surface Waters Plan, a revision of which is expected to commence in December 2008. It is recommended that a Water Level Management Plan is developed in consultation with key organisations such as

the local IDB and Environment Agency to ensure the long-term integrity of the water and wetland features associated with the lakes.

9.8.2 There is insufficient treatment capacity available within the Marston Vale to accommodate the eco-town and the existing treatment works in close proximity are not suited to expansion. The potential for a new treatment works in the Marston Vale could be limited by water quality constraints and will be reliant upon the actual water quality scenarios enforced by the Environment Agency. Further investigation into the water quality constraints and wastewater treatment is required for the Marston Vale. If this constraint cannot be removed, an alternative solution will be required, such as a new strategic sewer to connect to Bedford WwTW. The Bedford Orbital Sewer is not believed to have capacity to accommodate the wastewater flows from the eco-town.

9.8.3 The proposed eco-town at Marston Vale is able to be supplied from the regional WTW to the south-west of Huntingdon. Further investigation is required to identify how water neutrality can be achieved in order to comply with the draft eco-town PPS.

# 10 Conclusions and recommendations

## *10.1 Planning*

10.1.1 The Planning section presents a review of key planning and economic development policies at national, regional and local levels. These policy documents provide the framework which will shape future growth patterns. In turn the WCS will form an important part of the evidence base for the Local Development Frameworks, so this section also identifies major development areas and their planning status. This section provides the context to understand the spatial distribution of future growth in housing, employment, social/community facilities and other development in order to ensure that water infrastructure is provided in a timely manner and to ensure there is no damage to the water environment.

## *10.2 Flood Risk Management.*

10.2.1 The purpose of the flood risk section of the WCS is to define the flood risk zones, summarise the existing flood risk in the study area, the planned flood risk mitigation measures for the major development sites, and how these will impact flood risk downstream. It also assesses whether these mitigation measures are in alignment with the Marston Vale Surface Waters Plan. For Mid Beds, a list of development sites that were submitted for the Mid Beds Site Allocations DPD which are either partly or fully within the flood plain is provided within Appendix E. At the time of writing, a similar list of submitted sites was not available for the Borough Area, however, the scale of new allocations required to meet regional targets is set out in the recently adopted Bedford Borough Core Strategy and Rural Issues Plan. The focus for new allocations is the compact Bedford, Kempston, Northern Marston Vale growth area. A description of the drainage systems and known flood risk issues for the key service centres in Bedford Borough is provided. The objective of the Councils is to be able to use this information to support the development of Site Allocations DPDs.

10.2.2 Generally, the flood risk mitigation measures for the major developments around Bedford are in alignment with the Surface Waters Plan and the IDB has indicated that it would be prepared to adopt many of these schemes that contribute towards its master plan. Level 1 SFRA has been undertaken and Level 2 is going to be carried out in line with the procedures.

10.2.3 The EA has suggested there will be a need to mitigate flood risk which is posed by the increase in discharge flows to existing watercourses by Wastewater Treatment Works. The approach to achieving this eg through increased attenuation of surface water provision, would need to be agreed as a policy decision between the EA and AWS. An indication of possible storage volume has been identified for the growth area.

## *10.3 Sustainable Drainage Systems and Surface Water management*

10.3.1 The groundwater and SUDS section of the WCS summarises the suitability of using the various types of SUDS within the study area and how they can be used for flood risk mitigation, for preventing water pollution and managing water quality. A properly maintained system of SUDS is central to good integrated urban drainage management. One of the primary applications of SUDS with respect to PPS25 is mitigation against flood risk arising from increased run-off generation from impermeable surfacing.

10.3.2 Currently, no standard framework exists for adoption and maintenance of SUDS infrastructure, however in the DEFRA publication 'Making Space for Water' (2004) it is advised that a long term adoption strategy is crucial for the success of SUDS measures. This implies the involvement of "durable, accountable organisations that can be expected to have

the financial capacity to meet their responsibilities in the longer term". The adoption situation is currently under review by the government which recognises that adoption and maintenance have been obstacles to the widespread introduction of SUDS.

10.3.3 The Marston Vale Surface Waters Group ('the Group') was formed in 1997 on the initiative of the Bedfordshire and River Ivel Internal Drainage Board and the Marston Vale Trust with the aim of aligning development aspirations with flood risk management within the Vale.

10.3.4 Currently, the Bedford Group of Drainage Boards have adopted, and are therefore responsible for the maintenance of, 46 strategic flood risk management assets across their three Internal Drainage Districts. Typically the Board are willing to adopt a suitable, strategic asset that falls within a District's geographic boundary for a 30 year funded agreement duration, with assets outside the District boundary that generate a direct flood protection benefit to the District for a 50 year funded agreement duration. The Board will only consider adoption of assets that benefit the flood protection standards of the Districts; they cannot be seen to 'facilitate development' alone.

10.3.5 The suitability of the types of SUDS that could be utilised within Bedford Borough and Mid Beds has been assessed within the SUDS and surface water section. The Eastern majority of Bromham and Southern Clapham are located within the Outer Source Protection Zone as defined by the Environment Agency which may mean the proposed development may be restricted in the use of infiltration drainage methods. The remaining strategic growth settlements in Mid Beds District and Bedford Borough are not within a Source Protection Zone and are therefore unlikely to be restricted in the use of infiltration drainage.

## *10.4 Foul Drainage, Wastewater Treatment and Water Quality*

10.4.1 The purpose of the wastewater section is to identify the available wastewater treatment and sewer capacity and what strategic upgrades or local improvements are required to accommodate development. The objective of the Councils is to be able to use this information in the preparation of Site Allocations DPDs. Within Bedford Borough, the target housing provision is largely made up from committed sites which have a right to connect to the sewer network, however there is an outstanding employment allocation of 21ha.

10.4.2 The existing major wastewater treatment works, Bedford WwTW will require upgrades to treat flows from the planned LDF growth. Anglian Water Services Ltd (AWS) have included a growth scheme for this WwTW scheduled to take place early in Asset Management Period 5 (AMP5, 2010-2015). AWS is aware of the urgency of the situation, since undertaking the works will result in a temporary overload of the remaining treatment units until the upgrade is completed and an increased risk of water quality consent failure. Previous enquiries have concluded that AWS would be restricted in terms of purchasing additional land to expand Bedford WwTW because the adjacent land to the site is allocated for the River Valley Park. This purchase of additional land would allow both the continued use of existing assets and enable more sustainable (but higher footprint) process treatment to be used.

10.4.3 It is expected that the Bedford Southern Orbital Trunk sewer can accommodate additional discharge from the proposed LDF developments within Bedford. AWS has identified the sewer upgrade requirements to support the developments, North of Brickhill, Bedford; North of Nose Road, Bedford and Norse Road, Bedford to allow connection to Castle Mill Terminal Pumping Station.

10.4.4 To inform the production of the Mid Beds Site Allocations DPD, AWS has provided a list of wastewater constraints for each site under consideration. This information is summarised within the full WCS report. Within Mid Beds, the existing wastewater infrastructure for many of the settlements likely to receive growth is operating close to flow consent capacity. Further studies are to be undertaken by AWS in the majority of settlements to establish where infrastructure reinforcements are required to support the proposed growth.

10.4.5 AWS is planning to upgrade Marston Moretaine WwTWs in AMP5 to accommodate the planned levels of growth. The wastewater treatment works at Flitwick and Poppyhill are thought to have capacity to accept flows from the planned growth. Further investigation of flows is required for Marston Moretaine and Potton WwTWs. Revised flow consents are expected to be required in the medium term for Clophill, Clifton and Sandy WwTWs. Reduction in trade flows in Biggleswade means that no flow consent revision is expected to be required in AMP5. However, in the medium to long term, an increase may be needed.

10.4.6 It is unlikely to be feasible to upgrade Marston Moretaine WwTW or Stewartby WwTW works to accommodate the proposed eco-town development due to insufficient space within the existing site boundary and constraints to planning. Either a new WwTW or diversion of flows to Bedford WwTW will need to be considered in greater detail in the detailed study. Initial indications are that the potential for a new treatment works in the Marston Vale could be limited by water quality constraints and will be reliant upon the actual water quality scenarios enforced by the Environment Agency. Further investigation into the water quality constraints and wastewater treatment to develop a long term strategy is required within the detailed WCS for the Northern Marston Vale (irrespective of whether the eco-town is progressed).

## *10.5 Water Resources and Supply*

10.5.1 The purpose of the water resources and supply section of the WCS is to identify whether sufficient water resource is available to support the planned level of growth, whether a reduction of water consumption will eliminate the need for additional water resources and what upgrades are required to supply this resource to where it is needed.

10.5.2 The East of England Plan identifies a target reduction of 25% per capita water consumption for new housing (and 8% for existing housing) as a minimum to ease water stress with the aim of achieving water neutrality across the East of England region.

**Water neutrality definition:**

For every new development, total water use across the wider area [East of England Region] after the development must be equal to or less than total water use across the wider area before the development.

Environment Agency, water neutrality high level guidance fact sheet

10.5.3 The impact of implementing this reduction in consumption is considered within this WCS and its affect upon the water resource requirements are discussed. No consideration of achieving water efficiency in existing houses has been commissioned at this point. If these water efficiency targets are achieved, it will not be sufficient to achieve water neutrality purely within the study area and therefore more ambitious water efficiency measures would be required to achieve this at the local level. The practicalities of achieving this should be considered within the detailed WCS.

10.5.4 The study area lies within Anglian Water's Ruthamford zone and is a water stressed area. AWS has a long term deficit of water resources in the Ruthamford water resource zone and it has identified the upgrades required to support growth, such as the recommissioning of Foxcote reservoir and Pulloxhill WTW in its draft Water Resources Management Plan 08.

10.5.5 The study area is supplied from two main WTW, a regional one south-west of Huntingdon and the local Bedford Ouse WTW and by a number of smaller localised borehole supplies. A number of the more localised borehole supplies are reaching capacity and development in these areas will be supported by an increased import from the regional reservoir. The proposed eco-town at Marston Vale is also able to be supplied from this storage supply if required.

10.5.6 AWS have identified the upgrades required to ensure that there are no constraints in terms of infrastructure requirements for the Bedford area. AWS is at an advanced stage of planning infrastructure for the proposed growth. In Mid Beds, local water supply network improvements will be required in Cranfield, Stotfold, Arlesey and Marston Moretaine.

## *10.6 Ecological Constraints and Opportunities*

10.6.1 The purpose of the ecology section is to summarise where potential risks and opportunities exist to water and wetland features with respect to the planned and future development.

10.6.2 The WCS contains a GIS database in order to identify the sites of nature conservation importance and Biodiversity Action Plan (BAP) habitats. This has allowed an evaluation of the risks and opportunities to ecology if the capacity of the water services infrastructure is increased to support growth (Table 10.1). This dataset will be of benefit when considering the implementation of the strategy and when considering upgrades to the water services infrastructure.

10.6.3 It is recommended that:

- Where risks, habitat benefits and opportunities are identified as part of the proposed development areas, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and green infrastructure.
- The organisations listed in the Water and Wetland BAP continue to work towards achieving the actions and targets identified by the Water and Wetland BAP Group.
- Anticipated WFD water quality standards are adopted by AWS for all relevant WwTWs as soon as possible so that anticipated benefits to water and wetland features can be achieved as soon as possible.
- For the lakes located within the Marston Vale Growth Area, it is recommended that a Water Level Management Plan is developed in consultation with key organisations such as the local IDB and Environment Agency to ensure the long-term integrity of the water and wetland features associated with the lakes. To help achieve this same aim, "the Marston Vale Surface Water Group is established to develop an integrated and co-ordinated approach to water management within the Vale" *Water and Wetland BAP, Bedford and Luton.*

| | Water Resources | Flood risk management | | Waste water treatment | Sewer capacity | Development footprint | |
|---|---|---|---|---|---|---|---|
| **Standing open water –lakes and margins** | R | R | O | O | R | R | O |
| **Rivers and Streams** | No risks/ opportunities | R | O | O | R | R | |
| **Wet Woodland** | No risks/ opportunities | O | | No risks/ opportunities | No risks/ opportunities | No risks/ opportunities | |
| **Marshy grassland** | R | O | | No risks/ opportunities | No risks/ opportunities | R | O |
| **Reed bed and swamp** | No risks/ opportunities | R | O | O | No risks/ opportunities | R | O |
| **Ditches** | No risks/ opportunities | O | | No risks/ opportunities | R | R | O |
| **Fen** | No risks/ opportunities | No risks/ opportunities | | No risks/ opportunities | No risks/ opportunities | No risks/ opportunities | |
| **Ponds** | No risks/ opportunities | O | | O | R | R | O |
| **Purple Moor Rush Grassland and Rush Pastures** | No risks/ opportunities | No risks/ opportunities | | No risks/ opportunities | No risks/ opportunities | No risks/ opportunities | |

**Table 10.1: Summary of risks (R) and opportunities (O) on water and wetland features arising from the WCS**

## *10.7 Developer Checklist*

10.7.1 The key tool for assessing whether developments comply with the principles of this Outline Strategy is the Developer Checklist. This summarises best practice with respect to the Water Cycle, bringing together Environment Agency guidance and the recommendations of this Outline Strategy into a simple checklist. This can be used to guide Developers in the assumptions to make and the data to be provided.

## *10.8 Infrastructure Timeline*

10.8.1 The strategic infrastructure required to support the level of housing and employment development identified in the Local Development Frameworks is summarised in the infrastructure timeline in Figure 10-1. This timeline is plotted against the projected housing completion rates, but includes appropriate allowances for employment sites. Employment flows have been calculated from land use types in accordance with AWS design guidance. This timeline has been used to assign actions to the project stakeholders to help ensure that this infrastructure is provided in association with development. (See Table 10-2).

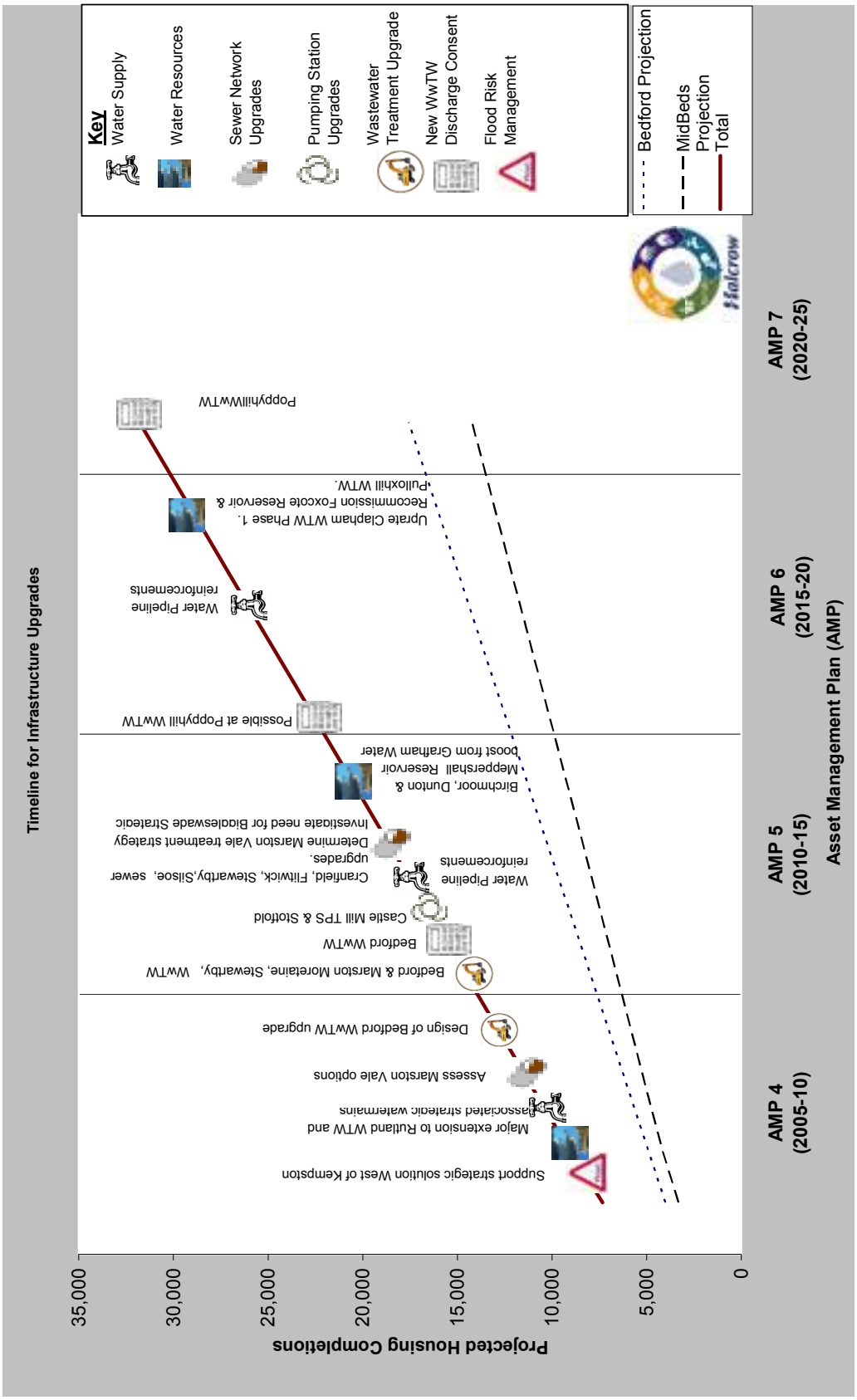



**Figure 10.1: Infrastructure timeline**

| Item | Action | Stakeholders responsible | Timeline |
|---|---|---|---|
| 1 | Support the strategic flood risk management solution to West of Kempston | EA, developer, LPA and AWS | **AMP4 (2005-10)** |
| 2 | Major upgrade to Rutland WwTW and associated water main reinforcements | AWS & developer | |
| 3 | Assess Marston Vale sewer options | AWS, EA and LPA | |
| 4 | Design of Bedford WwTW upgrade | AWS | |
| | | | |
| 5 | Upgrade Bedford WwTW | AWS | **AMP5 (2010-15)** |
| 6 | Revise Bedford WwTW discharge consent. | EA | |
| | Review WwTW flow data at Marston Moretaine, Clifton, Sandy, Clophill and Potton. | | |
| 7 | Determine Marston Vale treatment options | AWS, EA, LPA & developer | |
| 8 | Upgrade Marston Moretaine WwTW | AWS | |
| 9 | Upgrade Castle Mill foul Terminal Pumping Station | AWS | |
| 10 | Investigate Stotfold foul Pumping Station upgrade | AWS | |
| 11 | Water pipeline reinforcements | AWS & developer | |
| 12 | Cranfield, Flitwick and Stewartby sewer upgrades | AWS & developer | |
| 13 | Upgrade and boost Birchmoor reservoir capacity from Grafham Water | AWS | |
| 14 | Upgrade and boost Dunton reservoir capacity from Grafham Water | AWS | |
| 15 | Upgrade and boost Meppershall reservoir capacity from Grafham Water | AWS | |
| | | | |
| 16 | Potential to revise discharge consent at Poppyhill WwTW | AWS & EA | **AMP6 (2015-20)** |
| 17 | Upgrade Poppyhill WwTW | AWS | |
| 18 | Water pipeline reinforcements | AWS | |
| 19 | Uprate Clapham WTW | AWS | |
| 20 | Recommission Foxcote Reservoir | AWS | |
| 21 | Recommission Pulloxhill WTW | AWS | |

**Table 10.2: Stakeholder action timeline to address the infrastructure timeline**

# 11 Detailed WCS Scope

11.1.1 The recommendations for a the Detailed WCS for the Bedford and Marston Vale Growth Area has been based upon the WCS Guidance written on behalf of the Environment Agency.

11.1.2 The detailed strategy will:

- Look at the boundary of the outline WCS and confirm that this spatial area is appropriate for the detailed WCS;
- Ensure that growth and development does not compromise compliance with the Water Framework Directive, and is consistent with the spirit of the draft River Basin Management Plan;
    - Review the draft river basin management plan and provide a WCS partnership response to the EA consultation on the river basin management plan before June 2009;
    - Ensure that the standards and assumptions used in modelling and assessment are not contradictory to the standards, objectives and actions of the draft River Basin Management plan;
- Complete any detailed assessments identified in this outline study, i.e.;
    - Refine and re-examine assumptions made in the water quality modelling for identifying discharge consent standards;
    - Discussion with the Environment Agency to determine the likely water quality implications for a new treatment works within the Marston Vale, and to determine how exactly the 'no deterioration' criteria would be applied to the discharge consent;
    - Development of a long term wastewater treatment strategy for Marston Vale including a comparison of the water quality impacts of upgrading Marston Moretaine WwTW against the financial and carbon cost of transferring flows to Bedford WwTW;
    - Identification of the actual required reinforcements in the Biggleswade sewerage network;
    - Detailed investigation into the actual required reinforcements and upgrades in the water supply network for Mid Beds;
    - Identify potential flood risk mitigation measures and potential storage locations across Mid Beds;
    - Implications for future development at Flitwick in light of WFD 3 mg/l ammonia;
    - Agreed policy with respect to offset impact of flood risk from increased WwTW discharges.
    - quantify the increase in flood risk from wastewater treatment works, propose appropriate mitigation measures, produce outline costs and an implementation mechanism including funding and agreements for delivering the necessary works;
    - identify associated land use linkages of flood risk mitigation measures to provide feedback into the spatial planning process.

- Establish minimum design standards to be applied to new developments to ensure a sustainable and integrated WCS i.e.;

    - investigation into the effect of water efficiency targets required to achieve water neutrality (including the additional effect of the potential eco-town)
    - consideration of the revised Surface Water Management Plan to ensure a coordinated approach.

- Carry out a sustainability assessment of development options and water cycle infrastructure, i.e.;

    - Develop and agree WCS sustainability objectives
    - Assess development scenarios and water cycle infrastructure options against the objectives to identify the most sustainable WCS
    - Produce and look at Carbon costs of the proposed solutions;
    - The sustainability appraisal should also appraise the benefits of ecological opportunities and the multi-use benefits of integrating the WCS with green infrastructure (GI).

- Provide a detailed framework for the sustainable provision of infrastructure including a timeline of requirements (the WCS) i.e.;

    - Detailed infrastructure timeline;
    - Infrastructure cost estimate;
    - Listing actions required by all WCS stakeholders to achieve water neutrality.

- Help ensure that water cycle infrastructure will be funded and implemented;

    - Identification Section 106 contributions for flood risk mitigation measures, or requirements for adoption of mitigation schemes by the Bedford Group of Internal Drainage Boards

- Inform supplementary planning documents (SPDs);

- Assess growth scenarios to inform the review of East of England Plan (to 2031)

- Develop guiding principles for the preparation of the Surface Water Management Plan;

- Provide the basis for a financial mechanism for developer contributions, or a 'reasonable prospect' of infrastructure provision to link planning conditions.

11.1.3 The detailed study will include a definitive timeline, building upon the information contained within the outline WCS timeline. This will set out when the identified problems are likely to occur, and which systems need to be in place to ensure that they do not restrict development.

# A Appendices