

The Vale of Aylesbury Plan



Aylesbury Vale Level 1 Strategic Flood Risk Assessment August 2012

Agreed by the Environment Agency



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Cover Photo: The Fairford Leys Sustainable Drainage Scheme

Photo source: AVDC (2012). Photo taken 7 August 2012.

EXECUTIVE SUMMARY

Introduction to the 2012 Update

- i. The Vale of Aylesbury Plan is being prepared by AVDC as the next development plan for the district covering the plan period 2011-2031. A Strategic Flood Risk Assessment is needed as part of the evidence base behind this new plan to inform policies and proposals at the Pre-Submission stage of this plan in Autumn 2012. Therefore the SFRA Level 1 produced by Royal Haskoning and agreed and published by AVDC in April 2007 has been updated and amended for the preparation of a new development plan. The update has involved consultation with the Environment Agency, Thames Water, Anglian Water, the Bedford Group of Internal Drainage Broads and Buckinghamshire County Council.

Study Objectives

- ii. This Level 1 Strategic Flood Risk Assessment (SFRA) for the Aylesbury Vale District Council (AVDC) has been undertaken to provide a robust assessment of the extent and nature of the risk of flooding and its implications for land use planning. In addition, the SFRA sets the criteria for the submission of planning applications in the future and for guiding subsequent development control decisions. The key objectives of the study are to:
 - Provide a reference and policy document to inform preparation of the Vale of Aylesbury Plan;
 - Ensure that AVDC meets its obligations under the Department of Communities and Local Government's (DCLG's) National Planning Policy Framework and technical guidance on Flood Risk
 - Enable the Environment Agency to agree this as the evidence base for the Vale of Aylesbury Plan and the Water Cycle Strategy
 - Provide a reference and policy document to advise and inform private and commercial developers of their obligations under the NPPF
- iii. An increased scope Level 2 SFRA as per the NPPF and NPPF Technical Guide may be required to facilitate possible application of Exception Test and to address significant flood risk issues within the Vale District, prior to the submission of the emerging Vale of Aylesbury Plan. A more detailed SFRA would have to consider the detailed nature of the flood hazard by building upon the findings of this Level 1 SFRA and by fully taking account of the presence of flood management measures through further detailed hydraulic modeling.

Outputs

- iv. The principal output from the study is a set of maps, which categorises the Vale District into Flood Zones according to the NPPF. It depicts the presence of flood defences where they exist. These maps have been produced adopting a robust assessment to give AVDC sufficient information so as to have an overall view of flood risk areas for strategic planning purposes.

- v. The maps and this accompanying report and guidance will provide a sound framework enabling consistent and sustainable decisions to be made when making future planning decisions. Methods of assessment and limitations of the SFRA outputs, including further recommendations to address them, are also presented. The Level 1 SFRA evaluates the present-day (year 2012) situation and the situation after 50 years time (year 2062) with increased peak flood flows to allow for projected climate change.
- vi. **Figure 1** presents the study area and shows the main rivers as well as the IDB drainage networks within this catchment. The SFRA has considered all sources of flooding within the Vale District, as explained in this report and related figures.

Data Sources

- vii. **Figure 16** and the data register in Appendix E show the extent of data that was made available for the study.

Co-operation

- viii. An SFRA Level 1 was first produced for AVDC by Royal Haskoning UK Ltd in April 2007. This has been updated and revised in 2012 by AVDC with the co-operation and support of the Environment Agency Anglian Region and South East Region, Buckinghamshire County Council, the Bedford Group of Internal Drainage Boards, Thames Water and Anglian Water.

GLOSSARY

Term	Meaning
Adoption of sewers	The transfer of responsibility for the maintenance of a system of sewers to a sewerage undertaker
Afflux	Increase in upstream flood level caused by an obstruction to flow in a watercourse or on a <i>floodplain</i> .
Annual flood probability	The estimated probability of a flood of given magnitude occurring or being exceeded in any year. Expressed as, for example, 1-in-100 chance or 1 per cent.
Antecedent conditions	The condition of a <i>catchment</i> area at the start of a rainfall event.
Artificial drainage system	A constructed drainage system such as a drain, sewer or ditch.
Attenuation	To reduce the peak flow and increase the duration of a flood event.
Balancing pond	A pond designed to attenuate flows by storing runoff during the peak flow and releasing it at a controlled rate during and after the storm. Also known as wet detention pond.
Basin	A ground depression acting as a flow control or water treatment structure that normally is dry and has a proper outfall, but which is designed to detain stormwater temporarily.
Boundary condition	A specified variable, typically water level or flow, which is defined at the edge of the spatial extent of a model to allow the model to solve its governing equations
Brownfield site	Any land or site that has been previously developed.
Catchment	The area contributing flow or <i>runoff</i> to a particular point on a watercourse.
Catchment Flood Management Plan (CFMP)	A strategic planning tool through which the Environment Agency seeks to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
Climate change	Long-term variations in global temperature and weather patterns, both natural and as a result of human activity. These are primarily greenhouse gas emissions.
Coastal flooding	Flooding from the sea.
Commuted sum	A single payment made at the beginning of an agreement to cover maintenance for an agreed period of time.
Critical ordinary watercourse	An <i>Ordinary watercourse</i> which the Environment Agency and other operating authorities agree is critical because it has the potential to put at risk from flooding large numbers of people and property.
Culvert	Covered channel or pipe that forms a <i>watercourse</i> below ground level.

Design criteria	A set of standards agreed by the developer, planners and regulators that the proposed system should satisfy.
Design event	An historic or notional <i>flood event</i> of a given <i>annual flood probability</i> , against which the suitability of a proposed development is assessed and <i>mitigation measures</i> , if any, are designed.
Design flood level	The maximum estimated water level during the <i>design event</i> .
Detention basin	A vegetated depression that normally is dry except following storm events. It is constructed to store water temporarily to attenuate flows and may allow <i>infiltration</i> of water to the ground.
Development	The carrying out of building, engineering, mining or other operations in, on, over or under land or the making of any material change in the use of any buildings or other land.
Development Plan Document	The Vale of Aylesbury Plan, Strategy, VAP Delivery, Minerals and Waste Development Plan and potential future Neighbourhood Plans are Development Plan Documents (DPD). Certain DPDs can be produced by District, County, Parish and Town Councils or designated Neighbourhood Forums. These plans are those which planning applications are required by law to be in line with unless material considerations indicate otherwise.
Discharge	Rate of flow of water.
Extended detention basin	A detention basin where the runoff is stored beyond the time for <i>attenuation</i> . This provides extra time for natural processes to remove some of the pollutants in the water.
Field drainage	System of drains to control the <i>water table</i> in agricultural land.
Filter drain or filter trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage. Its purpose is to store and conduct water, but may also permit <i>infiltration</i> .
Filter strip	A vegetated area of gently sloping ground designed to drain water evenly off impermeable areas and filter out silt and other particulars.
Filtration	The act of removing sediment or other particles from a fluid by passing it through a filter.
First flush	The initial <i>runoff</i> from a site/ <i>catchment</i> following the start of a rainfall event. As <i>runoff</i> travels over a catchment it will collect or dissolve pollutants and the “first flush” portion of the flow

	may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution wash-off may contaminate runoff throughout a rainfall event.
Flap valve	A simple form of non-return valve, employing a hinged flap to prevent reverse flow.
Flood defence	Flood defence infrastructure, such as flood walls and embankments, intended to protect an area against flooding, to a specified <i>standard of protection</i> .
Flood defence crest level	The level to which flood defences are constructed, that is the level of the top of flood walls and embankments, expressed relative to Ordnance Datum.
Flood event	A flooding incident characterised by its level or <i>flow hydrograph</i> .
Flood probability	The estimated probability of a flood of given magnitude occurring or being exceeded in any specified time period. See also <i>annual flood probability</i> .
Flood risk	An expression of the combination of the <i>flood probability</i> and the magnitude of the potential consequences of the <i>flood event</i> .
Flood risk assessment	A study to assess the risk of a site or area flooding, and to assess the impact that any changes or development in the site or area will have on <i>flood risk</i> .
Flood storage	The temporary storage of excess runoff or river flow in ponds, basins, reservoirs or on the <i>floodplain</i> during a flood event.
Flood Zones	Flood Zones are defined in the NPPF Technical Guidance. They indicate land at risk by referring to the probability of flooding from rivers ignoring the presence of defences. The fluvial Flood Zones are usually derived using a two-dimensional hydraulic model called JFLOW, into which a national coarse Digital Terrain Model is fed. However, in some instances, more detailed modelling can be undertaken, using refined information.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Flow control device	A device used to manage the movement of surface water into an out of an <i>attenuation</i> facility, e.g. weirs.
Fluvial flooding	Flooding from a river or other <i>watercourse</i> .
Freeboard	The difference between the <i>flood defence crest level</i> and

	the <i>design flood level</i> .
Functional floodplain	Land where water has to flow or be stored in times of flood. It includes the 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, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.
Greenfield runoff rate	The rate of <i>runoff</i> that would occur from the site in its undeveloped (and therefore undisturbed) state.
Greywater	Greywater is water from sinks, baths, showers and domestic appliances. Kitchen sink or dishwasher wastewater is not generally collected for use, as it has high levels of contamination from detergents, fats and food waste, making filtering and treatment difficult and costly.
Groundwater	Water in the ground, usually referring to water in the saturated zone below the <i>water table</i> .
Groundwater flooding	Flooding caused by <i>groundwater</i> escaping from the ground when the <i>water table</i> rises to or above ground level.
Highway authority	A local authority with responsibility for the maintenance and drainage of highways maintainable at public expense.
Hydrograph	A graph that shows the variation with time of the level or discharge in a <i>watercourse</i> .
Impermeable surface	An artificial non-porous surface that generates a surface water <i>runoff</i> after rainfall.
Infiltration (to the ground)	The passage of surface water through the surface of the ground.
Infiltration basin	A dry basin designed to promote <i>infiltration</i> of surface water to the ground.
Infiltration capacity	A soil characteristic determining or describing the maximum rate at which water can enter the soil.
Infiltration trench	A trench, usually filled with permeable granular material, designed to promote infiltration of surface water to the ground.
Land drain	Drain used in agriculture to control the <i>water table</i> and reduce the frequency with which land becomes waterlogged.
Local planning authority	Body responsible for planning and controlling development, through the planning system.
Main River	A watercourse designated on a statutory map of Main rivers, maintained by the Environment Agency.
Material consideration	Matters which need to be taken into account by a planning authority when determining an application for planning permission.
Mitigation measure	A generic term used in this guide to refer to an element of <i>development</i> design which may be used to manage <i>flood risk</i> to the <i>development</i> , or to avoid an increase in <i>flood risk</i> elsewhere.
Model Agreement	A legal document that can be completed to form the basis of an agreement between two or more parties regarding the maintenance and operation of sustainable water management systems.

Neighbourhood Development Plan	A plan prepared by a parish or town council or Neighbourhood Forum that has land use policies to guide planning applications and allocates non-strategic sites for development. The plan has to be in general conformity with the district plan and the National Planning Policy Framework
Ordinary watercourse	A watercourse other than public sewers as defined by the Water Industry Act 1991, canals and any service pipes designed to supply water to a premises; also watercourses which is not private drains and are not designated a <i>Main river</i> .
Overland flow flooding	Flooding caused by surface water <i>runoff</i> when rainfall intensity exceeds the infiltration capacity of the ground, or when the soil is so saturated that it cannot accept any more water.
Passive flood plain	Areas that are within the “natural” <i>floodplain</i> but are not now subject to frequent flooding, because of the presence of flood alleviation measures.
Permeable surface	A surface that is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration of water to the sub-base – for example, concrete block paving.
Pond	Permanently wet depression designed to retain stormwater above the permanent pool and permit settlement of suspended solids and biological removal of pollutants.
Precautionary principle	The approach, to be used in the assessment of <i>flood risk</i> , which requires that lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to avoid or manage <i>flood risk</i> .
Rainwater use systems	A system that collects rainwater from where it falls rather than allowing it to drain away, treats and stores it and then distributes it for use. This includes water that is collected within the boundaries of a property, from roofs and surrounding surfaces, including areas of hardstanding and pervious paving.
Rapid Inundation Zone	The area adjacent to flood defences or other source of flooding where flood hazard would be significant, i.e. there is a risk to life, due to high velocity and significant depth.
Retention pond	A pond where runoff is detained for a sufficient time to allow settlement and possibly biological treatment of some pollutants.
Return period	A term sometimes used to express <i>flood probability</i> . It refers to the estimated average time gap between floods of a given magnitude, but as such floods are likely to occur very irregularly, an expression of the <i>annual exceedance probability</i> is to be preferred.
River flooding	See <i>fluvial flooding</i> .
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable or saturated, or if rainfall is particularly intense.
Sequential test	A risk-based approach to <i>flood risk assessment</i> in accordance

	with National Planning Policy Framework, applied through the use of flood risk zoning, where the type of <i>development</i> that is acceptable in a given zone is dependent on the assessed <i>flood risk</i> of that zone and <i>flood vulnerability</i> of the proposed development.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal, including surface water from roofs and yards draining through public sewers.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Soffit	The underside of any construction element.
Source control	The control of runoff or pollution at or near its source.
Standard of protection	The estimated probability of a <i>design event</i> occurring, or being exceeded, in any year. Thus it is the estimated probability of an event occurring which is more severe than those against which an area is protected by <i>flood defences</i> .
Strategic flood risk assessment	A study to examine <i>flood risk</i> issues on a sub-regional scale, typically for a river <i>catchment</i> or local authority area during the preparation of a development plan.
Sustainable urban drainage systems (SUDS)	A sequence of management practices and control structures, often referred to as SUDS, designed to drain surface water in a more sustainable manner. Typically, these techniques are used to attenuate rates of <i>runoff</i> from <i>development sites</i> .
Swale	A shallow vegetated channel designed to conduct and retain water, but may also permit infiltration; the vegetation filters particulate matter.
Treatment	Improving the quality of water by physical, chemical and/or biological means.
Vale of Aylesbury Plan (VAP)	The district-wide land use development plan prepared by AVDC covering the period 2011-2031. It will be adopted in Spring 2013 and include the overall amount of housing and employment development to be provided, a spatial strategy and strategic policies. The next DPD on VAP Delivery, any subsequent DPDs and any neighbourhood plans must be in general conformity with it. VAP must also be in general conformity with national planning policy framework.
Water table	The level of <i>groundwater</i> in soil and rock, below which the ground is saturated.
Watercourse	Any natural or artificial channel that conveys surface water.
Wetlands	An area where saturation or repeated inundation of water is the determining factor in the nature of the plants and animals living there.
Whole Life Costing	Accounting system that considers all the costs (private and social) that accrue to the initiation, provision, operation, maintenance, servicing and decommissioning over the useful life of an asset or a service.

ABBREVIATIONS

Term	Meaning
AAP	Area Action Plan
AEP	Annual Exceedance Probability
AMP	Asset Management Plan
AVDC	Aylesbury Vale District Council
AVFAS	Aylesbury Vale Flood Alleviation Scheme
AVM	Automatic Voice Messaging
CAD	Computer Aided Drawing
CFMP	Catchment Flood Management Plan
COW	Critical Ordinary Watercourse
DCLG	Department of Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
DPD	Development Plan Document
DTM	Digital Terrain Model
EA	Environment Agency
EFO	Extreme Flood Outline
FAS	Flood Alleviation Scheme
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FSR	Flood Studies Report
FZ	Flood Zone
GIS	Geographical Information System
GUC	Grand Union Canal
IDB	Internal Drainage Board
LDS	Local Development Scheme
LiDAR	Light Detection And Ranging
LPA	Local Planning Authority
MDA	Major Development Areas
MKSM	Milton Keynes South-Midlands
NFCDD	National Flood and Coastal Defence Database
NPPF	National Planning Policy Framework
Ofwat	Office of Water Services
OS	Ordnance Survey
PBA	Peter Brett Associates
SA	Sustainability Appraisal
SAR	Synthetic Aperture Radar
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SUDS	Sustainable Drainage Systems
VAP	Vale of Aylesbury Plan
WCS	Water Cycle Strategy

1 BACKGROUND

1.1 General Overview

The Council has commenced its new development plan document (DPD), entitled the Vale of Aylesbury Plan (“VAP”). Initial public consultation on this Plan took place between December 2011 and January 2012. The VAP Pre-Submission Draft will be published in Autumn 2012 with a public examination and final adoption in Spring 2013. Separate DPDs will be produced for VAP Delivery on delivery policies (produced through 2013 and adopted in 2014) and Allocations (if required). A summary timetable is set out as follows:-

VAP Programme			
3 stage process			Timing
1	Strategy	VAP Strategy (AVDC led). This is the broad strategy only, no allocations.	Pre submission publication in Autumn 2012, examination and adoption mid 2013
	Numbers (jobs & homes)		
	Broad locations (jobs & homes)		
2	Delivery policies	VAP Delivery (AVDC led)	Consultation early 2013 – view to adoption early 2014
3	Allocations - Aylesbury - Buckingham - Winslow - Haddenham - Villages - Gypsy & Travellers	Dealt with via neighbourhood plans (parish/town led) or individual standalone plans for areas or topic (AVDC led)	As and when required – but the VAP Delivery DPD is the first priority

Source: AVDC, 7 August 2012

The December-January 2012 consultation document proposes an overall district-level of new jobs and homes and a broad distribution of where proportion of new homes in the district could go. The options for district-wide provision and sub-district apportionment to housing market areas are:-

Table 1 – Vale of Aylesbury Plan Housing and Jobs Ranges, Stage 1 Issues and Options, December 2011

2011-2031	Range A	Range B	Range C	Range D
New Jobs Range	0-3000	3000-6100	6100-9100	9100-12000
New Homes Range	4500-6750	6750-9000	9000-11250	11250-13500

Source – AVDC, November 2011

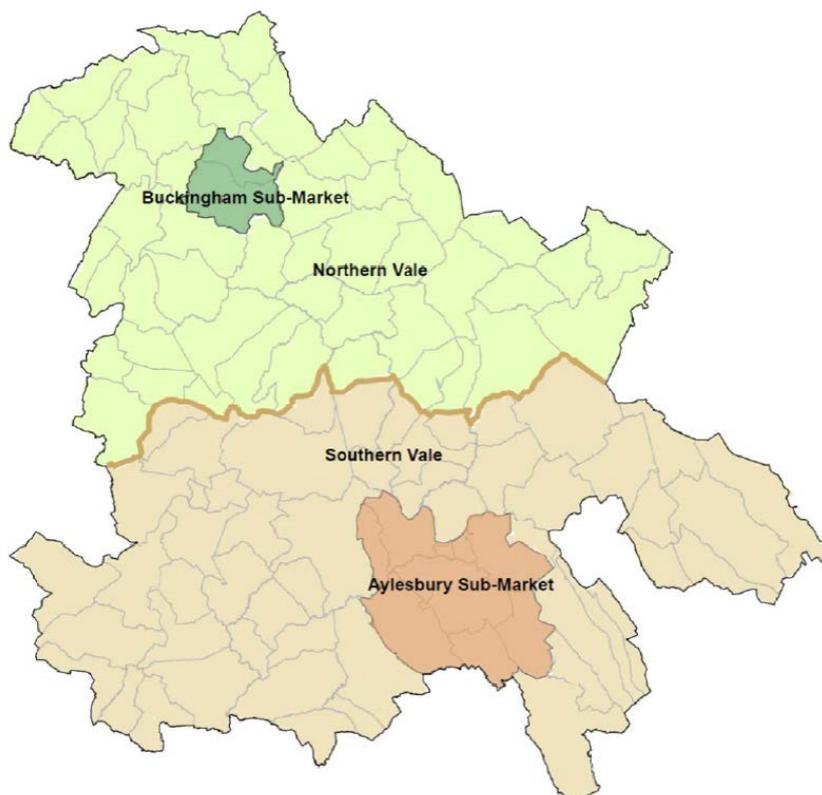
The December-January Stage 1 Consultation on the Vale of Aylesbury Plan considered the following options for the apportionment of housing to sub market areas (shown overleaf).

Scenario for Housing Market area	Continue Past Trends	Economic Led	New Settlement	Population & Demographic Change	Housing Need	Maintain Working Age	Urban Concentration
Northern Vale %	12	18	7	12	15	21	5
Buckingham %	12	6	7	11	10	9	10
Southern Vale %	17	32	10	21	15	35	7
Aylesbury %	59	44	34	56	60	35	78
Unspecified	-	-	42	-	-	-	-

Source – AVDC, November 2011

Each of the sub-market areas are defined in the Housing Numbers and Apportionment Options Briefing Paper September 2011 available at <http://www.aylesburyvaledc.gov.uk/planning-building/planning-policy/what-is-the-vale-of-aylesbury-plan-/aylesbury-vale-housing-economic-growth-assessment/> and shown below and overleaf.

Figure A – The Vale of Aylesbury Plan Housing Sub Markets, December 2011



Source - <http://www.aylesburyvaledc.gov.uk/planning-building/planning-policy/what-is-the-vale-of-aylesbury-plan-/consultation-vale-aylesbury-plan-december-2011/>

Area	Parishes
Aylesbury Sub-Market	Aylesbury, Bierton with Broughton, Buckingham Park, Coldharbour, Fleet Marston, Quarrendon, Stoke Mandeville, Stone with Bishopstone and Hartwell, Watermead, Weston Turville
Southern Vale	Ashendon, Aston Abbots, Aston Clinton, Aston Sandford, Boarstall, Brill, Buckland, Chearsley, Cheddington, Chilton, Creslow, Cublington, Cuddington, Dinton-with-Ford and Upton, Dorton, Drayton Beauchamp, Edgcott, Edlesborough, Grendon Underwood, Haddenham, Halton, Hardwick, Hogshaw, Hulcott, Ickford, Ivinghoe, Kingsey, Kingswood, Long Crendon, Ludgershall, Marsworth, Mentmore, Nether Winchendon, North Marston, Oakley, Oving, Pitchcott, Pitstone, Quainton, Shabbington, Slapton, Upper Winchendon, Waddesdon, Weedon, Wendover, Westcott, Whitchurch, Wing, Wingrave with Rowsham, Woodham, Worminghall, Wotton Underwood
Buckingham Sub-Market	Buckingham, Maids Moreton
Northern Vale	Addington, Adstock, Akeley, Barton Hartshorn, Beachampton, Biddlesden, Calvert Green, Charndon, Chetwode, Drayton Parslow, Dunton, East Claydon, Foscott, Gawcott with Lenborough, Granborough, Great Brickhill, Great Horwood, Hillesden, Hoggston, Leckhampstead, Lillingstone Dayrell with Luffield Abbey, Lillingstone Lovell, Little Horwood, Marsh Gibbon, Middle Claydon, Mursley, Nash, Newton Longville, Padbury, Poundon, Preston Bissett, Radclive-cum-Chackmore, Shalstone, Soulbury, Steeple Claydon, Stewkley, Stoke Hammond, Stowe, Swanbourne, Thornborough, Thornton, Tingewick, Turweston, Twyford, Water Stratford, Westbury, Whaddon, Winslow

Table 2 - Parish Councils within the Housing Sub Market Areas. Source - <http://www.aylesburyvaledc.gov.uk/planning-building/planning-policy/what-is-the-vale-of-aylesbury-plan-/consultation-vale-aylesbury-plan-december-2011/>

Due to additional flood risk caused by urbanisation and prospective climate change, a review of the 2007 SFRA is required to highlight pertinent flood risk issues at an early stage and then to address them accordingly. There are several studies undertaken by the Aylesbury Vale District Council (AVDC) and the Environment Agency in order to promote an integrated approach to the proposed development and also to provide the evidence base required to prepare the emerging Vale of Aylesbury Plan. In 2007, Royal Haskoning carried out a Flood Risk Management Study on behalf of the Environment Agency, which informed the preparation of the first Strategic Flood Risk Assessment Level 1 (SFRA) in 2007.

The need for Local Planning Authorities (LPAs) to consider flood risk when preparing their LDF and to produce SFRA is highlighted in the NPPF and NPPF Technical Guide on Flood Risk. AVDC appointed Royal Haskoning in March 2007 to prepare a Level 1 SFRA for its District. AVDC have updated the SFRA1 in December 2011-June 2012 and it has

been issued to support the next phase of work on the Vale of Aylesbury Plan and to finalise the Water Cycle Strategy.

1.2 Scope

- 1.2.1 The scope for the Level 1 SFRA was agreed with the Environment Agency in October 2011. The study has informed the preparation of the Water Cycle Strategy for the Vale of Aylesbury Plan, being produced by Halcrow and due to be published in the summer of 2012.
- 1.2.2 The Vale of Aylesbury Plan will set out the overall strategy for the District, and include a spatial strategy, housing and employment growth targets. There will be separate Development Plan documents on development management policies and potentially allocated sites. Neighbourhood Plans prepared by parish councils would also be able to utilise this SFRA and would need to be in general conformity with the Vale of Aylesbury Plan. A number of major developments are already committed around Aylesbury – the majority of these were allocated in the Aylesbury Vale Adopted Local Plan 2004. The other key towns in the study include Buckingham, Wendover, Winslow and Haddenham as major settlements in the other housing market areas. The Level 1 SFRA and Level 2 SFRA for Aylesbury updated in this review provide an appropriate level of information to inform the Vale of Aylesbury Plan production.
- 1.2.3 The SFRA covers all sources of flooding and the other key flood risk considerations expected by the NPPF and technical note on flood risk. It broadly looks at the flood risk issues across the entire Aylesbury Vale District and therefore the SFRA provides a sound evidence base required for AVDC to prepare emerging Vale of Aylesbury Plan.
- 1.2.4 Royal Haskoning produced the original base version of this SFRA back in April 2007 in close consultation with AVDC, the Environment Agency, the Bedford Group of Internal Drainage Boards (IDB) and the statutory water undertakers to satisfy the former PPS25 requirements but more specifically in accordance with the amplified guidance for undertaking Level 1 SFRAs (paragraphs 2.28 to 2.35) within the former Living Draft Practice Guide Companion to PPS25, published in February 2007. The district-wide SFRA1 has now been updated and added to by AVDC to inform the newly emerging Vale of Aylesbury Plan.

1.3 Study Area

- 1.3.1 Aylesbury Vale is a large area of flat land largely to be found in Buckinghamshire, England. Its boundary is marked by Milton Keynes to the north, Leighton Buzzard and the Chiltern Hills to the east and south, Thames to the south and Bicester to the west. The Vale is named after Aylesbury, the County town of Buckinghamshire. Key towns lying within the vale also include Buckingham, Wendover, Winslow and Haddenham. **Figure 1** shows the study area including key features such as watercourses, roads and railways.
- 1.3.2 The bed of the Vale is largely made up of clay that was formed at the end of the ice age. Most of the area is underlain by the limestones and sands of the Portland Beds and the Kimmeridge and Gault Clays. The head of the Upper Thames and the Bear Brook catchments incorporates the Chiltern Hills and contains highly permeable chalk which

produces very low runoff rates. A vast underground reserve of water exists which makes the water table higher than average in the Vale of Aylesbury. However, the lower part of the Bear Brook catchment contains a mixture of limestone, sandstone, clay and alluvium, which produce much less permeable conditions and therefore generates a higher rate of runoff. **Figure 2** represents the geological map for Aylesbury and the surrounding area.

- 1.3.3 The town of Aylesbury has experienced extensive development over the last thirty to forty years. **Figure 3** shows committed development in the district which has planning permission and is in the process of, or is waiting to be built out. **Figures 5-9** show committed development in the larger settlements in the district as well as flood zones. Outside of the major towns, the remaining area within the District boundary is fairly rural and, within small villages, the form of development is most likely to be acceptable only if it respects the scale and character of the existing settlement.
- 1.3.4 Today the area is a local government district of northern Buckinghamshire, administered by AVDC. In the 2010 mid-year population estimates by the Office of National Statistics, the population of Aylesbury Vale was 174,400 representing an increase since 1994 of 22,100 people. The population increase 1994-2009 in Aylesbury Vale represented over two-thirds of the increase in the whole of Buckinghamshire. In mid-2009, Aylesbury itself had a population of 70,846 people (approximately 41 per cent of the district).

1.4 Data Used

- 1.4.1 The data used in the study derives from several sources, most notably the Environment Agency. The data register provided in **Appendix E** was prepared in accordance with Royal Haskoning's quality management system. This data has where appropriate been updated by AVDC officers in 2012.
- 1.4.2 The key types of data obtained include:
- OS background mapping;
 - Topographic survey – LiDAR (though not updated for 2012), ground surveys and watercourse surveys;
 - National Flood Zones and historic flooding records from all sources of flooding ;
 - Flood defences, structures and flood alleviation measures;
 - Flood risk studies and modelling reports;
 - Catchment Flood Management Plans;
 - Flood warning and Flood watch areas;
 - Vale of Aylesbury Plan documents;
 - and the Buckinghamshire Preliminary Flood Risk Assessment and Surface Water Management Plan (as far as this covers Aylesbury Vale)
 - Guidance on flood risk management.

1.5 Limitations and Assumptions

- 1.5.1 The conclusions of this SFRA are based on information currently available. No future development areas are shown because the Vale of Aylesbury Plan has not yet progressed to point of considering broad locations or sites.

- 1.5.2 The Environment Agency in association with AVDC implemented the Aylesbury Vale Flood Alleviation Scheme (AVFAS) in mid 1990s. The scheme was designed to provide 1 in 100 year standard of protection on the urbanised parts of the Bear Brook through the town to cater for the development planned up to 1996. Annual surveys have confirmed that the AFAS still provides the standard of protection as it did when constructed i.e. it is still in excess of a 1 in 100 year flood.
- 1.5.3 A 2-dimensional hydrodynamic model has been developed by Peter Brett Associates (PBA) on behalf of the Environment Agency for the Bear Brook and the Upper Thame catchment. The model led to refining the Environment Agency's national Flood Zones in Aylesbury and to indicate the areas that are currently benefiting from the existing flood defences.
- 1.5.4 The Level 1 SFRA maps of Flood Zones 2 and 3 for the entire Vale District are based on the Environment Agency's Flood Zones, June 2012 version, as per NPPF Table 1 ignoring the presence of existing flood defences. However, these Flood Zones have some limitations in places, such as not necessarily following the alignment of watercourses shown on Ordnance Survey background maps due to the coarse nature of the digital terrain used in the Flood Zone modelling. A 1 in 20 Flood Zone 3b (The Functional Flood Plain) has been plotted just for Aylesbury Town as this area has had flood modelling.

2 CATCHMENT DESCRIPTION AND CAUSES OF FLOODING

2.1 CATCHMENT DESCRIPTION

General

2.1.1 Under the Vale of Aylesbury Plan Housing and Employment growth scenarios for the sub market areas, the towns of Aylesbury and Buckingham are most likely to see strategically significant levels of development to some degree given the May 2012 agreed housing and employment targets for those areas. **Figure 4** illustrates the river system within the Vale District which largely falls within the following two main river catchments:

- River Thames; and
- River Great Ouse.

The Vale District is also affected by the Bear Brook (a principal tributary of River Thames), River Ouzel (a principal tributary of the Great Ouse) and the Grand Union Canal.

River Thames and Bear Brook Catchment

2.1.2 The River Thames is a tributary of the River Thames. The general course of the River Thames is north-east to south-west and the distance from its source to the confluence with the River Thames at Dorchester is about 40 miles. The River Thames's source is several small streams which rise in the Vale of Aylesbury on the north side of the Chiltern Hills. These streams converge in Rowsham, to the north-east of Aylesbury. The River Thames then flows in a south-westerly direction to the North of Aylesbury through farmland, passing the small villages of Nether Winchendon and Chearsley before reaching the market town of Thames.

2.1.3 The River Thames joins with the Bear Brook at the western side of Aylesbury. The Bear Brook has several tributaries discharging both the upstream rural catchment and relatively quick urban runoff. Aylesbury, Wendover and Haddenham are located within this catchment.

2.1.4 River network information surrounding Aylesbury town has been mainly collected from 'Aylesbury Arterial Drainage Study', Final Report, published by the National Rivers Authority (NRA) Thames Region on December 1989. **Figures 5 to Figure 7** illustrate the river network around Aylesbury, Wendover and Haddenham. A summary of the key watercourses is also given below.

River Thames

- The upper reaches of the River Thames adjoin at Aylesbury
- The river flows around the northern limits of the town and flows in a south west direction to the north west of Aylesbury and Haddenham, towards Thames
- The principal tributaries of the River Thames include the Bear Brook, Fleet Marston and Denham Brook, the Hardwick Brook, Chearsley Brook and Sctosgrove Brook
- The Fleet Marston and Denham Brook and the Hardwick Brook join the River Thames north west of Aylesbury as shown in **Figure 5**

- The Chearsley Brook and Scotsgrove Brook join the River Thames north west and south west of Haddenham respectively as shown on **Figure 7**
- The major tributary of the River Thames – the Bear Brook - rises in the east of Aylesbury near Aston Clinton and flows north east to pass under the Aylesbury Arm of the Grand Union Canal
- The Bear Brook then flows through Aylesbury Town from east to west and joins the River Thames to the north west of Aylesbury
- The **southern** tributaries of the Bear Brook are:-
 - The Wendover Brook*
 - West End Ditch*
 - Bedgrive Brook*
 - California Brook*
 - Southcourt Brook*
 - Stoke Brook*
 - Hartwell Ditch*
- The **northern** tributaries of the Bear Brook are:-
 - Broughton Brook*
 - Stocklake Brook*
 - Coldharbour Way Ditch*
- The works carried out on the Bear Brook as part of the AVFAS include:-
 - 105,000m² flood storage area using a clay embankment
 - Improvements to the Bear Brook Siphon under the Grand Union Canal Aylesbury Arm
 - Removal of the weir under the Grand Union Canal siphon
 - Implementation of flood defence at the Oxford Mill site

Wendover Brook

- A tributary of the Bear Brook which originates south of Wendover as shown on **Figure 6**.
- It joins the Bear Brook downstream of Aston Clinton, east of Aylesbury

West End Ditch

- This ditch runs along the eastern edge of the existing edge of the town of Aylesbury
- It joins the Bear Brook west of Broughton Lane

Bedgrove Brook

- The brook runs to the south east of Aylesbury at the Bedgrove area
- It crosses the A41 and runs through several culverts in built up areas
- It joins the Bear Brook just downstream of the West End Ditch

California Brook

- This brook is an overflow channel for the Grand Union Canal at Aylesbury Basin
- The watercourse flows south west through several culverts
- The brook passes through a long relatively low soffit railway culvert
- It joins the Bear Brook west of Oxford Road

Southcourt Brook

- The Southcourt Brook drains the south western part of the town
- Channel improvement works were done to the lower reaches of the brook in 1970 and 1974 during the development of land lying between the brook, railway and Oxford Road
- The channel capacity is now believed to be at a 1 in 30 year return period flow

Stoke Brook

- The Stoke Brook flows along the south western edge of Aylesbury draining mainly agricultural land
- The Sedrup Ditch is a tributary of the Stoke Brook
- Channel improvement works were carried out in 1977 and 1978 to increase the capacity to a 1 in 30 year return period standard

Hartwell Ditch

- The Hartwell Ditch originates to the west of Aylesbury
- During the channel improvement works on the Stoke Brook in 1978, Hartwell Ditch was separated from the Stoke Brook and outfalls in the Bear Brook downstream of Haydon Mill
- Hartwell Ditch was also realigned and improved during the planning for Fairford Leys, an urban extension at Aylesbury approved under principles set out in the Aylesbury Vale District Local Plan

Broughton Brook

- The brook originates at Broughton to the east of Aylesbury
- It crosses the Grand Union Canal through a siphon
- This rural watercourse joins the Stocklake Brook just downstream of Stocklake

Stocklake Brook

- The Stocklake Brook originates at Burcott generally flowing southwest through open fields
- The Brook crosses the Oakfield Road Stocklake in culverts, both of which are relatively long low soffits
- The Brook flows through an industrial area before joining the Bear Brook near Walton Mill
- A 30,000sqm flood storage area using a clay embankment was built on Stocklake Brook as part of the AVFAS in the mid-1990s

Coldharbour Way Ditch

- The Coldharbour Way Ditch originates on Roman Road, to the west of the Aylesbury Business Centre

- It flows towards the South, draining a small urban area comprising the Aylesbury Business Centre and the trading estate
- It joins the Bear Brook on Coldharbour Way

Grand Union Canal

- The GUC system is described in Section 2.1.11 below

River Great Ouse and Ouzel Catchment

- 2.1.5 The northern area of Aylesbury Vale District, which includes Buckingham and Winslow, lies in the Great Ouse catchment. **Figure 8** and **Figure 9** illustrate the river network around Buckingham and Winslow.
- 2.1.6 The River Great Ouse, a designated Main River, enters the study area at Brackley and flows through Buckingham. Several minor tributaries of the Great Ouse catchment join this river before it leaves the study area near Milton Keynes. Also, there are several minor tributaries that are maintained by the Bedford Group of Internal Drainage Boards (IDB).
- 2.1.7 The Padbury Brook (or the Twins) joins the Great Ouse approximately 2km east of Buckingham. It is a very composite stream, or rather collection of streams. The largest branch rises east and west of Oving, partly from springs from the Portland Beds, and flows northward to near Winslow, where it is joined by another stream from the east, the drainage of the clay-tract of Mursley and Swanbourne; the combined stream then flowing west-ward for about two miles, receiving an addition from the neighbourhood of North Marston and Hogshaw; and then turning north-westward, along the northern boundary of the parish of Steeple Claydon, receiving another addition from the neighbourhood of the Horwoods, and finally taking a northerly course to the Great Ouse, about two miles east of Buckingham, with a small easterly addition from Nash, just before joining the main river.
- 2.1.8 There are no major watercourses around Winslow other than the drains maintained by the Bedford Group of IDB. The upstream extents of some of the IDB watercourses around Winslow flow through the village and are ordinary watercourses outside the IDB jurisdiction.
- 2.1.9 The River Ouzel is a tributary of the Great Ouse. It rises in the Chiltern Hills and flows 20 miles north to join the Great Ouse at Newport Pagnell. From springs just north of Dagnall, the river initially forms the boundary between Bedfordshire and Buckinghamshire. It is joined by the Ouzel Brook from Houghton Regis, by Whistle Brook from Pitstone and by Clipstone Brook from Milton Bryan. It then flows through Leighton Buzzard and Milton Keynes, where it is joined by Water Eaton Brook, and finally through Newport Pagnell to its confluence with the Great Ouse.
- 2.1.10 Royal Haskoning has carried out a Catchment Flood Management Plan (CFMP) for the Great Ouse catchment. Historic flooding, flood defences, standard of protection etc. have been collected from the CFMP and through further consultation with the Environment Agency and IDB staff during this study. The final version of the Great Ouse CFMP (January 2011) is available at <http://www.environment-agency.gov.uk/research/planning/114303.aspx>

Grand Union Canal (GUC)

2.1.11 As shown in **Figure 4**, the GUC flows across the eastern side of Aylesbury Vale and includes the following features:

- The Aylesbury Arm;
- The Wendover Arm (partially water/rewatered) and;
- The former Buckingham Arm (very small area watered)

Aylesbury Arm

The system of Weston Turville and Wilstone reservoirs (east and south-east of Aylesbury) keeps the GUC flowing as the Canal is mainly raised above the surrounding ground level without a natural drainage catchment.

2.1.12 The Aylesbury Arm of the GUC is approximately 9.6km long and it is regulated by means of several navigation locks. It is an artificial watercourse coming down from Marsworth to Aylesbury and is used for mainly leisure purpose with several permanent house boats. The canal ends at the town centre near Walton Street. Downstream of the canal is connected to the California Brook through an overflow weir.

2.1.13 There is no direct inflow from the natural catchment into the Grand Union Canal. Water can generally only enter the Aylesbury Arm in three places east of Aylesbury:

- i) from Marsworth Pound via lock 1, over the head gate weirs;
- ii) from Wilstone Reservoir via the sluice on Wilstone (Gudgeon) Brook and the two pipes beneath the towpath; and
- iii) from Draytonmead Brook via the pipe beneath the towpath.

2.1.14 Water essentially flows out of the Aylesbury Arm of the canal in three places:

- i) over a sidespill weir into Draytonmead Brook near Merrymeade Farm;
- ii) over the 'offside' bank of the canal (opposite to towpath) in the two mile pound between College Road and Broughton Lane, and
- iii) over a weir into California Brook at the downstream of the canal in Aylesbury.

Wendover Arm

2.1.15 The Wendover Arm is fed by the Wendover Spring and therefore flow is controlled largely by groundwater levels. The Wendover Arm flows under gravity to a chamber close to the Tringford Reservoir where it is pumped to the summit. There is also scope for flow to run by gravity from the Wendover Arm, through Drayton Beauchamp to the Wilstone Reservoir although this is not normally used. At Drayton Beauchamp, the Wendover Arm partly flows into a pipe along the dry bed of the canal and is partly in process of being fully rewatered. The sluices can be opened to release water through Drayton Beauchamp when the pipe along the Wendover Arm is surcharged. Any additional flow which cannot pass through the pipe or sluices overtops the sluice and flows along the dry bed of the canal.

2.1.16 The Wendover Arm Trust (<http://wendoverarmtrust.co.uk/restoration/>) have a vision to rewater and reopen the Wendover Arm to Wendover. This has so far been worked up with British Waterways for two phases:-

Phase 1 - from Bulbourne Junction to Little Tring Farm was completed and opened in 2005

Phase 2 – Little Tring to Drayton Beauchamp (excavation works in progress east of Drayton Beauchamp during summer 2012)

Phase 3 – Drayton Beauchamp via Buckland Wharf and Halton to Wendover (no date yet but there would be major engineering works needed to three road bridges)

Buckingham Arm

2.1.17 In February 2011, AVDC at a Cabinet Meeting expressed its support for the Buckingham Canal Society's (<http://www.buckinghamcanal.org.uk/>) aim to eventually reopen the Buckingham Arm of the GUC. The waterway to Buckingham, disused since the 1960s, ran a total of just under 11 miles from the Grand Union Canal at Cosgrove Lock along the Stony Stratford and Buckingham Arms. The original route passed through Old Stratford, Deanshanger, Thornton, Leckhampstead Wharf, Thornborough Mill, Maids Moreton Mill and Bourton Meadow.

2.1.18 Any strategic development sites east of Aylesbury, at Wendover or Buckingham affecting the existing or potential restoration of the GUC Arms would need to be assessed in more detail in a Level 2 SFRA for the Vale of Aylesbury Plan.

2.2 Types of Flooding

2.2.1 The potential types of flooding within Aylesbury Vale District are:-

- Surface water run-off from rural catchments during severe rainfall events
- Main river flooding leading to other localised flooding events
- Surface water flooding due to the presence of extensive areas of impermeable ground surfaces
- Flood defence failure
- Mechanical, structural or operational failure (including due to blockages) of hydraulic structures, pumps and other water cycle infrastructure covering water supplies and wastewater networks
- Failure of canal infrastructure to cope with intense and prolonged rainfall events
- Flooding from ordinary watercourses;
- Flooding from groundwater/springs
- Failure of other artificial raised waterbodies (e.g. reservoirs).

3 DATA COLLECTION AND REVIEW

3.1 Historic Flooding

3.1.1 General

Historical flood information from all sources of flooding has been collected from the Environment Agency, AVDC, Bedford Group of IDB, Thames Water and Anglian Water. Aylesbury and Buckingham have an ongoing history of flooding; significant flooding occurred in 1947 and 1987 (in Aylesbury), 1998 and 2007 (in Buckingham).

One of the key sources of flooding within the District is from the main river network shown in **Figure 1**. However, outside Aylesbury and Buckingham, the highest risk of flooding in the District is flash flooding from excessive overland flow and overtopping of minor (often very minor) watercourses according to AVDC.

Figure 10 shows the historic flood extents and the places that are known to have flooded from all sources of flooding in the Aylesbury Vale District. Separate historic flood maps are given as **Figures 11 to 15** for Aylesbury, Wendover, Haddenham, Buckingham and Winslow.

Table B1 and **Table B2** in **Appendix B** summarise the different historic flood events including an indication of causes of flooding (if known). Whereas a single incident of Main River flooding has the potential to cause disruption to a large number of properties, very heavy rainfall in Aylesbury Vale invariably results in large numbers of individual local floods. Surface water run-off management in the entire District therefore remains an important issue for all developments which highlight the need for Sustainable Drainage Systems (SUDS) thereby maximising the use of source control measures.

3.1.2 Flooding from watercourses

Tables in **Appendix B** and associated historic flood maps indicate extensive flooding across the district is essentially caused by the main watercourses. Whilst the overtopping of minor watercourses would appear to be a significant issue outside Aylesbury and Buckingham, only partial records are available concerning the extent of major and minor flood events upon properties.

3.1.3 Sewer flooding

Thames Water, Anglian Water, the Environment Agency Area staff, Buckinghamshire County Council and AVDC departments have been consulted and asked to provide information on previous sewer flooding and those areas deemed to be at potential risk. Information concerning sewer and other forms of flooding (e.g. groundwater flooding) was obtained via Halcrow who have been commissioned by AVDC to undertake the Aylesbury Vale Phase 1 Water Cycle Strategy for the Vale of Aylesbury Plan.

3.2 THAMES WATER

Thames Water Draft Water Resources Management Plan 2010-2035

- 3.2.1 All water companies in England and Wales have a duty to produce Water Resources Management Plans (WRMPs). Taking into account factors such as housing growth, increased water usage and climate change, the plans assess the adequacy of existing water resources to meet projected water demand for the next 25 years and identify and compare options to meet shortfalls where necessary. The Water Resources Management Plans are one of a number of documents that inform water companies' Asset Management Plans (AMPs). The Thames WRMP 2010-2035 has completed a Public Inquiry and in March 2011 a Government Inspector produced an Inspector's Report. Thames Water now need to make amendments to the draft plan that meets the minimum requirements recommended by the Inspector. For details on the plan and latest progress please see <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/5373.htm>

Thames Water AMP4 – 2005-2010

- 3.2.2 It appears the capacity of the Aylesbury town existing sewerage system is limited and that further reinforcement will be required to cope with the proposed major expansion. Crucially, the infrastructure schemes were scheduled into Thames Water's capital programme for Asset Management Plan, 4th Review (known as AMP4) for the period covering 2005 – 10 in order to address some of the current, known incapacity issues.

Thames Water AMP5 – 2010-15

- 3.2.3 AMP5 commenced in April 2010. Thames Water are proposing to protect homes and businesses at greatest risk of floods from our sewers. Projects will be prioritised by taking into account the severity and frequency of flooding, and the cost per property of improvements.

The water company will make improvements to the sewer network in Buckinghamshire to reduce the risk of sewer flooding to 20 properties that have flooded previously.

In addition, Thames Water expect to make further improvements across our region to protect more than 600 properties outside the capital that are flooded for the first time. The company also aim to tackle flooding at around 400 properties across their region where they are provided with new information about previous flooding incidents of which they were previously unaware. (Source: <http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/13480.htm> searched 22/11/2011)

- 3.2.4 There are also a number of properties on Thames Water's Sewage Flooding History Database (SFHD). SFHD is the database that Thames Water uses to capture reported incidents of sewer flooding within their area. Those properties affected by sewer flooding are reported to the Office of Water Services (Ofwat) as part of Director General Performance Measure 5 (known as DG5).

DG5 is the performance measure that Ofwat judges water companies by for sewer flooding. It covers two measures:

- The number of properties at risk of internal flooding from sewers due to hydraulic overloading within last ten years; and
- Properties which are internally flooded. Sewer flooding can be caused by temporary problems, such as blockages or sewer collapses, or because of hydraulic overloading.

3.2.5 Thames Water has confirmed that all current entries on the DG5 register are being investigated to identify the cause of flooding and if an engineering solution is required. Delivery of any engineering solution will be determined by the severity frequency of the flooding and also by the cost benefit of the solution. Development upstream of these locations should be restricted until engineering solutions to reduce the risk of flooding has been implemented.

The locations of previously flooded properties are covered by the Data Protection Act. For this reason Thames Water is unable to supply a map indicating properties at risk of sewer flooding but they agreed to supply this information in an alternative less detailed format such as truncated post codes subject to a specified licensing agreement between Royal Haskoning and Thames Water. This makes it possible to broadly identify where sewer flooding occurred. Thames Water is also happy to work closer with AVDC to identify which proposed development sites require off site network upgrades to reduce the risk of flooding further down the catchment.

A large part of the Vale District (i.e. north of Aylesbury town to the northern limit of the District) also falls within the Anglian Water management. Anglian Water were consulted in producing the 2007 SFRA1 and 2012 update and obtained the DG5 flooding register information to include within this report.

3.3 ANGLIAN WATER

3.3.1 Similar to Thames Water, Anglian Water produced their draft Water Resource Management Plan in May 2008 and draft Asset Management Plan in August 2009. During the AMP for period 2010-2015, Anglian Water plan to invest £1.5 billion in the four key areas of:-

- Drinking water quality
- Improving the environment
- Service to customers
- Maintaining Anglian Water Assets

Table B1 and **Table B2** include the locations that have been subject to some localized sewer flooding (both surface and foul) according to the information released by Thames Water and Anglian Water. They are also mapped in **Figure 10**.

3.3.2 Groundwater and overland flooding

Environment Agency's hydrogeology team and AVDC have indicated some groundwater flooding issues but the risk of this form of flooding in the Aylesbury area is low due to the geology of the area. According to this information, there are a few reported incidents of perceived groundwater flooding, which mainly occur in isolated properties on high ground where springs have occurred at the base of permeable chalk strata where they adjoin the

impermeable clays beneath them. In the wider Aylesbury Vale area, there are some records of flooding from chalk on lower ground. The Environment Agency has provided a total of seven reported groundwater flooding incidents in Aylesbury and the surrounding area although none of these are confirmed as they are reports from the public.

3.3.3 In addition, there are a few more examples of areas that may have or possibly could be affected by the localized high groundwater table within Aylesbury urbanised area according to AVDC, which include:

- The undeveloped area just to the east of Douglas Road (known as 'three ponds field'; and
- Cleveland Road (HP20 2AZ)

All reported groundwater flooding incidents are included in **Table B1** and **Table B2**. As indicated in **Table B1**, the GUC has previously suffered from seepage problems at some locations which can also lead to high groundwater table in the surrounding area.

Buckingham and many places of the District (see **Table B2**) have reported to have overland flooding problems (often coupled with overtopping of minor watercourses) causing flash flooding during the periods of heavy rainfall.

3.4 Topographical Data

3.4.1 The Environment Agency has LiDAR (Light Detection And Ranging) and SAR data for the District and they also have several watercourse surveys – see **Table C1 in Appendix C**. The Bedford Group of IDB is also currently commissioning several watercourse surveys. AVDC would obtain this information from the Environment Agency and the IDB for carrying out a Level 2 SFRA for the Vale of Aylesbury Plan at a future date.

The LiDAR spatial resolution in this area is 2m. Taken together with the generally accepted vertical accuracy of $\pm 11\text{cm}$ to 25cm, this indicates that in the areas covered by the LiDAR data would provide a good representation of ground surface for the required flood risk mapping where modifications to the current Flood Zones are required.

The vertical accuracy of SAR data quoted by the suppliers, Intermap, for the study area is $\pm 0.5\text{m}$ for the Surface Model and $\pm 0.7\text{m}$ for the DTM at a positional accuracy of up to $\pm 1.25\text{m}$. SAR data is provided at a spatial resolution of 5m.

Figure 16 graphically shows the extent of LiDAR and other watercourse surveys currently available within the District.

3.4.2 Existing Studies and Hydraulic Models

Table C2 summarises the key existing flood risk and drainage studies and hydraulic models within the District. This information is also graphically presented in **Figure 16**.

3.5 Identification of Land at Flood Risk and Existing Flood Defences

3.5.1 The sources of flooding and historic flooding information are identified above. **Figure 4** shows the Flood Map for Aylesbury Vale District. Separate Flood Maps are provided for the district's largest settlements - Aylesbury, Wendover, Haddenham, Buckingham and

Winslow as **Figures 5 to 9**. However, the land at risk of flooding shown in these Flood Maps should be considered in conjunction with historic flooding information given in **Figures 10 to 15** and Section 3.1.

- 3.5.2 The land at risk is depicted in terms of Environment Agency's Flood Zones, historic flood outlines and the places known to have some flooding problems. This includes floodplain of the River Thames, the Bear Brook, the tributaries of the Bear Brook and the watercourses in the Great Ouse catchment. The non-main rivers marked in 'orange line' in **Figure 4** are managed by Bedford Group of Internal Drainage Boards (IDB) and there are no historical flooding records associated with these drains. According to the IDB, the drains provide a Standard of Protection (SoP) of 1 in 10 years for the surrounding agricultural land.
- 3.5.3 Part C of the developer guidance in Appendix F defines the Environment Agency's Flood Zones and provides a flood risk vulnerability classification, including policy aims and Flood Risk Assessment (FRA) requirements.
- 3.5.4 The risk area shown in **Figure 4** mostly lies at agricultural field in rural areas and some parts of committed developments in Aylesbury and Buckingham. It should be noted however that outside Aylesbury and Buckingham, the highest risk of flooding in the District is flash flooding from excessive overland flow and overtopping of minor watercourses.
- 3.5.5 **Figure 5** shows similar information on flood risk around Aylesbury including the proposed developments and the existing flood defences. Historically upstream of the Grand Union Canal Syphon on the Bear Brook, industrial properties around Stocklake, Park Street and High Street were flooded on several occasions. Flooding occurred in Aylesbury mainly due to inadequate structure sizes and blockages.
- 3.5.6 The Environment Agency in association with AVDC implemented the AVFAS in mid 1990s to resolve the flooding issues in Aylesbury. It was designed to provide a standard of protection of 1 in 100 years return period on the urbanised parts of the Bear Brook through the town to cater for the development planned up to 1996. Annual surveys have confirmed that the AFAS still provides the standard of protection as it did when constructed i.e. it is still in excess of a 1 in 100 year flood see **Table B1**).
- 3.5.7 Two places have been identified as at potential risk of flooding in the 'Grand Union Canal/Upper Thames Flood Study Report, PBA, April 1998. The GUC Aylesbury Arm is subject to overtopping, particularly along the two mile pound between College Road and Broughton Road. This flooding mainly affects agricultural land at present, but it may affect any future development in this area. Another flooding event occurs between Broughton Lane and Oakfield Road due to canal seepage.
- 3.5.8 A heavy rainfall event in 2002 also caused some flooding at Aston Clinton area from a lower section of the GUC Wendover Arm. However, it is believed that this flooding was probably caused by the seepage through the saturated embankments but not from the direct overtopping of the banks.
- 3.5.9 Dozens of homes were severely affected by the July 2007 floods when the Great Ouse came over its banks in Buckingham after heavy rainfall. Aylesbury Vale District Council applied for a £325,000 Defra grant and together with the Environment Agency funded a

£575,000 flood protection scheme to protect 90 properties. After the Council carried out surveys on the homes a construction company was employed to install the various products and measures and the work was completed by the end of 2010.

- 3.5.10 The key hydraulic structures in Aylesbury are identified from the published modelled water levels and flows for the river network from Halcrow's ISIS hydraulic model (results dated 1998), which incorporates Aylesbury FAS including an allowance for the proposed development (1988 – 1996). Upstream and downstream water levels at every structure for 1 in 100 year return period were reviewed to find out the structures that can significantly influence river hydraulics in conjunction with other information available on blockage risk and previous flooding. **Table D1 in Appendix D** summarises the key hydraulic structures that we have identified in Aylesbury from this exercise, together with additional structures that are considered by the Environment Agency Area staff to be key structures or vulnerable to blockages.
- 3.5.11 Most of Buckingham lies above the 1 in 100 year flood water level, but a few properties are at risk of flooding from 1 in 10 year flood event and two properties are at risk of flooding from 1 in 5 year event. A potential flood alleviation scheme consisting of upstream flow balancing was identified by the Environment Agency that would have raised the standard of protection for the Town from about 1 in 25 years to 1 in 50 years and offer increased protection to approximately 44 properties. However, In October 2008 the EA announced that it would not be proceeding with the potential alleviation scheme. A replacement scheme involving protection for properties at risk has now been implemented with the help of developer Section 106 contributions.
- 3.5.12 For Wendover, Haddenham and Winslow there are a few historic flood records and consideration to this historical information should be given in addition to the Flood Zones shown on Flood Maps when making planning and development control decisions. The Environment Agency's Thames West Area Flood Risk Mapping and Data Management Team reviewed the Flood Zones in Wendover in 2007 and the EA fluvial flood maps were afterwards updated although this is for a small area (between SP8696408199 and SP8671908870).
- 3.5.13 **Table D2 in Appendix D** summarizes the key hydraulic structures that we have identified within the rest of Vale District through consultation with the Environment Agency Area Staff and review of NFCDD and other reports.
- 3.5.14 **Figures 17 to 22** show the above locations and the remaining key hydraulic structures within the Aylesbury Vale District. The other structures included in these figures include:
- Raised flood walls and embankments;
 - Flood storage reservoirs and other significant water bodies; and
 - Grand Union Canal System.
- 3.5.15 However, in **Figure 22** no key structures are shown for Winslow as none could be found from the information collected to date during this study. The IDB may be able to confirm through further consultation if IDB drains have key structures.

The Environment Agency's National Flood and Coastal Defence Database (NFCDD) consists details of the embankments and flood storage reservoirs at Stocklake Brook (19,900m³) and Bear Brook (90,000m³) constructed during the AVFAS.

- 3.5.16 The only other formal defence of relevance to AVDC and included within the NFCDD is in the Great Ouse catchment, along the left bank of the River Great Ouse in Buckingham, and was constructed as a part of a housing development protection and is maintained by AVDC.
- 3.5.17 The Environment Agency has the responsibility for looking after the formal defences that are owned by them. In addition to inspection and routine maintenance of their formal defences and other structures, the Environment Agency has permissive powers to perform outline maintenance on main rivers, such as bank clearance or in-channel work to remove weed growth and silt, and non-routine maintenance (e.g. removal of blockages).
- 3.5.18 Watercourses should be maintained by the riparian owner. Buckinghamshire County Council will shortly be taking over responsibility for the maintenance of ordinary watercourses.
- 3.5.19 AVDC and the IDB do not have any formal flood defences within the Vale District although there may be several defacto defences (i.e. major infrastructure such as road and railway embankments that perform a secondary flood defence function) which have to be identified and agreed with the Environment Agency during the Level 2 SFRA. It is important to identify defacto defences as future changes to them can affect any flood risk areas protected by them. Also, there may be other privately owned localised flood defences that are not included in NFCDD or are yet to be identified.
- 3.5.20 The maintenance and operation of key hydraulic structures has a significant impact upon Flood Risk management and it is therefore critical to identify the owners of such structures. The owners of these structures are either AVDC, BCC or private landowners.

3.6 Flood Warning and Emergency Response

Flood Warning

- 3.6.1 The latest Environment Agency Flood Warning Codes (from November 2010) is available at <http://www.environment-agency.gov.uk/homeandleisure/floods/31620.aspx>. This sets out that there are three parts to the new codes:-
- Flood alerts (2 days to 2 hours before a possible flood – be prepared)
 - Flood warning (a flood is expected between 30 mins and 1 day's time - immediate action required)
 - Severe flood warning – there is a threat to life

Within Aylesbury Vale District, as elsewhere in England, the responsibility for flood warning rests primarily within the Environment Agency Anyone interested can search by town or postcode or river for flood warnings in their area – please see <http://www.environment-agency.gov.uk/homeandleisure/floods/31618.aspx>

3.6.2 The historic flooding locations mentioned in **Table B1** and **Table B2** have been checked against the information supplied by the Environment Agency. Those locations which are not covered by the Agency's Flood Warning coverage have been listed below but most of these places are not affected by Main River flooding whereas Wendover and Marsh Gibbon may be possibly affected by Main River. Also, Winslow, Pitstone Green, Calvert and Little Horwood could be subjected to flooding from other watercourses but further investigations are required to confirm the exact source.

- Wendover – The Flood Alert Area starts to the North, downstream of the Town, and hence only part of the Town is covered
- Winslow – The Flood Alert Area is located to the South, on Claydon Brook, but does not cover the town centre;
- Newton Longville;
- Brill;
- Ivinghoe Aston – The Flood Warning Flood Alert Area starts downstream of the village;
- Pitstone Green;
- Marsh Gibbon;
- Mursley;
- Calvert;
- Stone;
- Cuddington;
- Dinton;
- Gawcott;
- Little Horwood;
- Soulbury;
- Waddesdon; and
- Westcott

Warning Dissemination and Emergency Response

3.6.3 Flood Warnings are disseminated by the Environment Agency via a system known as Floodline Warnings Direct. The service is a free flood warning service that provides warnings directly to customers 24 hours a day by telephone, mobile, fax or pager. It replaces the older Automatic Voice Messaging System which was used to send out flood warnings direct to the public since 1996. The message details the level of warning issued, the area for which the warning is in force and advice on what action to take. As flood events develop the public is encouraged to phone Floodline for updates. This system requires residents of "at risk property" to register their telephone numbers with the Environment Agency. Concerned parties are able to obtain current flood warning information according to a particular river or Flood Warning Risk Area.

3.6.4 Other current methods of warning dissemination include:

- The media – warnings are issued through the media; they are broadcast on TV weather bulletins and on radio weather and travel reports. Flood warnings are also displayed on the BBCi (BBCTV digital television text information) page 419).
- **Floodline 0845 988 1188** – offers callers the option to listen to recorded flood warning information 24 hours a day and speak to a trained operator for more advice.

- Internet – The EA’s website <http://www.environment-agency.gov.uk/homeandleisure/floods/31618.aspx> contains live warning information.
- RSS Feeds (Really Simple Syndication). This information stream can be sent to an internet browser and is particularly aimed at mobile phones. RSS from the EA on Flooding shows the number of national or regional flood warnings in force. The information is updated every 15 minutes.

3.6.5 If anyone has not currently registered their phone number but is at risk of flooding, they should consider contacting the Environment Agency.

The EA issues flood warnings using a set of three easily recognisable codes set out above in paragraph 3.6.1 (Flood Alert, Flood Warning and Severe Flood Warning). These, for the purposes of Aylesbury Vale, cover rivers and can also tell the customer when groundwater flooding is likely.

3.6.6 The Environment Agency generally aims to give a two-hour lead time for all of the above levels of warning. However in certain cases of severe or “flash flooding” this may not always be possible. Certain areas may be at additional risk due to their location downstream of heavily urbanised areas and urban areas that have the potential for “flash flooding”, surcharging the capacity of existing sewers and watercourses. This aspect should be further considered in conjunction with the emerging flood warning arrangements for this area to ensure that adequate telemetry, flood warnings etc. are provided.

3.6.7 AVDC have no formal responsibility or system for providing flood warning. During severe events they work alongside or within the Buckinghamshire County Council Emergency Plan where appropriate to liaise with the emergency services and the Environment Agency to co-ordinate such activities as the provision of sand bags to the properties at risk and, if required, the evacuation of properties. AVDC does not have a detailed emergency response plan at present and therefore there is a need to draw up emergency planning and evacuation procedures for the District. In large events, however, flooding would be covered by the General Emergency Plan for Vale.

3.6.8 In exceptional circumstances, having undertaken the Sequential Test and the Exception Test, if development is allowed then emergency plans are to be prepared. Evacuation plans should be in place in those areas known to be at risk of flooding and should make provision for:

- i. How flood warning is to be provided;
 - Availability of existing flood warning systems;
 - Rate of onset of flooding and available flood warning time; and
 - Method of dissemination of flood warning.
- ii. What will be done to protect the infrastructure of the development and contents, such as:
 - How more easily damaged items (including parked cars) will be relocated;
 - The potential availability of staff/occupants/users to respond to a flood warning; and
 - The potential time taken to respond to a flood warning.

- iii. Ensuring safe occupancy and access to and from the development, such as:
- Occupant awareness of the potential frequency and duration of flood events;
 - Provision of safe access to and from the development;
 - Ability to maintain key services during an event;
 - Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and
 - Expected time taken to re-establish normal practices following a flood event (clean-up times, time to re-establish services etc.).

Where evacuation plans are required they need to consider the lifetime of the development by fully taking into account the prospective climate change impacts.

DEVELOPMENT AND FLOOD RISK ISSUES

3.7 THE NATIONAL PLANNING POLICY FRAMEWORK AND TECHNICAL GUIDANCE TO THE NATIONAL PLANNING POLICY FRAMEWORK (2012)

Overview

- 3.7.1 The NPPF sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system to the extent it is relevant, proportionate and necessary to do so. The statement provides a framework within which AVDC can produce policies in the Vale of Aylesbury Plan and that communities can use in neighbourhood planning. The Technical Guidance sets out the approach to be used on the Sequential and Exception Tests, all types of Flood Risk Assessment and managing residual resilience and resistance.

Sequential Test

- 3.7.2 The policies in the NPPF require that all stages of the development planning process should take account of both the nature and spatial distribution of flood risk and the degree of vulnerability of different types of development. Reinforcing the philosophy of managing flood risk through avoidance/prevention, the NPPF and Technical Guide require that planners and developers do not simply match land use types to areas or zones with an 'acceptable' degree of flood risk. Rather, a sequential approach to location of new development is required, by application of the Sequential Test as defined in paragraph 100 of the NPPF and paragraphs 3-5 and Table 1 of the Technical Guide.

- 3.7.3 The application of the Sequential Test requires the identification of Flood Zones as defined in Paragraphs 100-102 of the NPPF and Table 1 of the NPPF Technical Guide. Also, it will require in the event of any allocations for the LPAs to demonstrate that there are no reasonable available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed, by considering all forms of flooding based on a Level 1 SFRA (i.e. as reported in this report and accompanying maps).

Specific comments on the emerging Vale of Aylesbury Plan and any Neighbourhood Development Plans prepared by parish council are discussed in sections below.

Exception Test

- 3.7.4 If, following the application of the Sequential Test, it is not possible for a development to be located in a zone with a lower probability of flooding, the Exception Test should be applied as defined in Paragraphs 102 of the NPPF and paragraphs 3 to 5 of the NPPF Technical Guide to assess its suitability for development.
- 3.7.5 The Exception Test makes provision for sites where flood risk is outweighed by wider sustainability considerations and is designed to ensure that the flood risk posed to such sites is controlled and mitigated to an acceptable level, taking account of climate change, without increasing flood risk elsewhere. Therefore, the Exception Test ensures reasoned justifications are provided for any decision to allocate land in areas at high risk.

- 3.7.6 An increased scope Level 2 SFRA as per paragraph 8 of the NPPF Technical Guide will be required to facilitate possible application of Exception Test and also to address widespread flood risk issues within the Vale District, prior to the submission of any DPD (of AVDC or Neighbourhood Development Plan) that allocates sites outside of Flood Zone 1. This more detailed SFRA should consider the detailed nature of the flood hazard by building upon the findings of this Level 1 SFRA and by fully taking account of the presence of flood management measures (e.g. AVFAS in Aylesbury and other flood defences in Buckingham) through further detailed hydraulic modeling.

Functional Flood Plain

- 3.7.7 As defined in Table 1 of the NPPF Technical Guide, the Functional Floodplain (i.e. Zone 3b) comprises land where water has to flow or be stored in times of flood. It includes the 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, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.

For Aylesbury, a 1 in 20 flood event outline based on detailed flood modeling is to be used as Flood Zone 3b - the functional flood plain. For the purposes of this SFRA outside of Aylesbury, the Council identifies where more detailed assessment has not been undertaken to define the functional floodplain that all areas within the Flood Zone 3 are considered to be Flood Zone 3b. This position is supported by the Environment Agency. As part of any Level 2 SFRA, the Functional Floodplain may be re-mapped and changes may be made at that time as agreed with the Environment Agency. A site specific FRA that is agreed by the local planning authority, in consultation with the Environment Agency, may also make changes to areas identified as Flood Zone 3b.

Flood Risk Assessment

- 3.7.8 Properly prepared assessments of flood risk will inform the decision-making process at all stages of development planning. NPPF Technical Guidance stipulates the requirements for two levels of flood risk assessment:

- Strategic Flood risk Assessments (SFRAs); and
- Site-specific Flood Risk Assessments (FRAs).

- 3.7.9 Local Planning Authorities are responsible for preparing SFRAs. In order to provide relevant information and to steer the planning-process in the right direction, the minimum requirements for flood risk assessments are that they should:

- be proportionate to the risk and appropriate to the scale, nature and location of the development;
- consider the risk of flooding arising from the development in addition to the risk of flooding to the development;
- take the impacts of climate change into account as per Paragraph 11 of the NPPF Technical Guidance;
- be undertaken by competent people, as early as possible in the particular planning process, to avoid misplaced effort and raising landowner expectations where land is unsuitable for development;

- consider both the potential adverse and beneficial effects of flood risk management infrastructure including raised defences, flow channels, flood storage areas and other artificial features together with the consequences of their failure;
- consider the vulnerability of those that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification as per Paragraphs 3-5 and Table 1 of the NPPF Technical Guidance, including arrangements for safe access;
- consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;
- consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;
- include the assessment of the residual risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development or land use;
- consider how the development will modify run-off and promote the use of Sustainable Drainage Systems (SuDS) to mitigate that impact; and
- be supported by appropriate data and information, including historical information on previous events.

3.7.10 At the planning application stage, an appropriate site-specific FRA should be carried out to demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others would be managed by fully taking into account climate change impacts. NPPF Paragraph 103 and the NPPF Technical Guidance paragraph 6 defines the requirements for carrying out FRAs for development sites depending on their location within each type of Flood Zone.

3.7.11 Therefore, following the application of the Sequential, and where appropriate Exception Tests, planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by an FRA, which satisfies the above minimum requirements. Further guidance on FRAs is given in Appendix F of this report.

OTHER STUDIES

The Water Framework Directive 2000/60/EC (23 October 2000)

3.7.12 This Directive was transposed into domestic law in 2003. The Directive led to the requirement for River Basin Management Plans. The main aim however of the Directive is promoting the sustainable use of water and reducing pollution of surface and groundwater.

The Floods Directive, 2007

3.7.13 The European Directive on the Assessment and Management of Flood Risks (the 'Floods Directive', 2007/60/EC, 23 October 2007) came into force in November 2007 and was transposed into domestic law by the Flood Regulations December 2009. These regulations

set out that Lead Local Flood Authorities would be taking over responsibility for flooding from sources other than the sea, main rivers and reservoirs.

Future Water, DEFRA, 2008

- 3.7.14 This is the Government's water strategy for England and sets out a vision for the water sector in 2030 covering water demand, water supply, water quality, surface water drainage. The strategy sets out how flood risk management contributes to sustainable development, how more adaptable drainage systems are needed and how surface water drainage needs to be better managed.

The Pitt Review, June 2008

- 3.7.15 Southern England was hit by severe floods in the summer of 2007 and Sir Michael Pitt was charged with producing a comprehensive review of lessons to be learnt. The final report 'Learning Lessons from the 2007 Floods' (http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/_media/assets/www.cabinetoffice.gov.uk/flooding_review/pitt_review_full%20pdf.pdf) included 92 recommendations for improving all aspects of flood management. The review also set out that the effects of climate change may be more extreme than previously estimated for example in the DTI's 'Foresight Future Flooding' project of 2004. Of the 92 recommendations the following are considered the most relevant to the Local Planning Authority and this SFRA. These are considered the most relevant because they are actions the Local Planning Authority specifically is suggested to take forward and are things that can be carried out.

Recommendation	How This can be taken Forward
7 – There should be a presumption against building in high flood risk areas and developers should contribute to the cost of maintaining providing flood defences	Implementing the NPPF and developing the VAP policy framework. Action on planning applications with support on this stance from the Environment Agency
15 – To positively tackle local flooding problems	Implemented through the Council's responsibilities as drainage and planning authorities and through the Buckinghamshire Flood Risk Management Strategy
16 – To collate a map of the main flood risk management and drainage assets	To be done for this SFRA

The Floods and Water Management Act, 2010

- 3.7.16 The Act clarified the roles and responsibilities in flood risk management.

These were:-

- The Environment Agency would have a strategic role to oversee flood risk from all sources of flooding

- Upper tier local authorities (including Buckinghamshire County Council) will become the lead local flood authority for local flood risk management, including flood risk assessment, mapping and planning in relation to ordinary watercourses, surface water run-off and groundwater
- A duty on all relevant organisations including the water and sewerage companies to share information about potential risks and actions needed to manage those risks locally
- The power for the EA, lead local flood authorities and Interim Drainage Boards to formally designate natural and man-made features which help manage flood risk
- A requirement for developers to put SuDS in place in new developments wherever practicable and to end the automatic right to connect new development to the existing surface water sewers.
- Lead local flood authorities (Buckinghamshire County Council) to develop a strategy for flood risk management in their area (this is in draft form as at 21 06 12 and please contact floodmanagement@buckscc.gov.uk for the latest position.

River Basin Management Plans (RBMPs)

- 3.7.17 These plans identify long-term policies for water environment management at the regional scale. The Aylesbury Vale District includes parts of both the Anglian and Thames RBMP study areas. The final River Thames and Anglian RBMPs 'Water For Life and Livelihoods' were published by the EA in December 2009 and are available at <http://publications.environment-agency.gov.uk/PDF/GEAN0910BSPM-E-E.pdf>. The RBMPs for both areas seek to promote the widescale use of SuDS, integrate green infrastructure planning with floods and water and to reduce pollution and flow issues arising in water bodies caused by new development.

Catchment Flood Management Plans (CFMPs)

- 3.7.18 These are drawn up by the Environment Agency to identify long-term policies for sustainable flood risk management at the regional scale. There are two plans relevant to Aylesbury Vale. These are:-
- The Thames Region CFMP (EA, 2008 <http://www.environment-agency.gov.uk/research/planning/127387.aspx>) covers areas in Aylesbury Vale that drain southwards to the River Thames via the River Ray and River Thame
 - The Great Ouse CFMP (EA, 2011 <http://www.environment-agency.gov.uk/research/planning/114303.aspx>) includes the Rivers Great Ouse, Ouzel and Padbury Brook

Surface Water Management

- 3.7.19 The key document setting out past and potential future surface water flooding events across Buckinghamshire is the Preliminary Flood Risk Assessment 2011 (PFRA) available at <http://www.buckscc.gov.uk/moderngov/mglIssueHistoryHome.aspx?Ild=21369>. It looks at local sources of flood risk, primarily from surface runoff caused by intense rainfall, high groundwater levels and out-of-bank flows from ordinary watercourses. The report is used to inform the SFRA where the risk of flooding has been significant, and could be again in the future. The PFRA contains maps of past and possible future floods and high level indications of possible consequences. The report was compiled by collating existing and

available national and local information, which is illustrated through mapping and summary tables. Historically, surface water drainage systems have been designed to remove surface water from a site as quickly as possible by means of underground piped systems. This has the potential to increase flooding problems downstream and does not contribute to the natural recharge of groundwater levels. Such systems contribute to the transport of pollutants from urban areas to watercourses and groundwater.

- 3.7.20 With concerns surrounding the impacts of climate change and the requirements of the NPPF and Water Framework Directive, a more sustainable approach to drainage is required to reduce flood risk, manage water quality and provide integrated amenity benefits. The effective disposal of surface water from development is a material planning consideration in determining proposals for the development and use of land. It will always be much more effective to manage surface water flooding at and from new development early in the land acquisition and design process rather than to resolve problems after development.
- 3.7.21 Local authorities are encouraged to promote the use of SUDS for the management of run-off. SUDS aim to mimic natural drainage processes and remove pollutants from urban run-off at source. They comprise a wide range of techniques, including green roofs, permeable paving, rainwater harvesting, swales, detention basins, ponds and wetlands. To realize the greatest improvement in water quality and flood risk management these components can be used in combination. Rainwater harvesting unit, however, should not be relied upon for stormwater attenuation. The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.
- 3.7.22 Successful implementation of SUDS will require the early consideration of a wide range of issues surrounding their management, long-term adoption and maintenance. The design team and stakeholders should take every opportunity for early discussion about SUDS and should consider them at the feasibility stage of a development, to realize the optimum contribution. The Flood & Water Management Act 2010 confers upon a Lead Local Flood Authority the duty to act as the SuDS Approval Body (SAB), to be concerned with aspects of SuDS such as design, flood risk, adoption, and maintenance. This duty has not yet commenced however and at the time of producing this SFRA, it was expected the Government (DEFRA) would be starting this requirement from October 2012.
- 3.7.23 While it is clear that a single incident of Main River flooding has the potential to cause disruption to a large number of properties, very heavy rainfall in Aylesbury Vale results far more often in large numbers of individual local floods. Therefore, surface water run-off management in the District is clearly an important issue on all developments of any size (including the growth sites discussed above), clearly highlighting the need for Sustainable Drainage Systems (SuDS) maximising the use of source control measures throughout the District.
- 3.7.24 Any major new development can increase flood risk on the receiving watercourses (For Aylesbury this is particularly relevant for the Bear Brook and the River Thames) unless the additional runoff from the future development is adequately managed. As already highlighted in Section 3.1 these watercourses have been subjected to frequent flooding in the past

Flood Warning and Emergency Planning

3.7.25 As discussed in Section 3.6, new developments should consider the role of flood warning.

The Environment Agency operates a national flood warning system for a large number of existing properties currently at risk of flooding in order to enable householders to protect life or take early action to manage the effect of flooding on property. New developments should consider the role of flood warning in managing residual risks although they should not rely solely on them. Section 3.4 already discussed the availability of flood warning and emergency response arrangements within the Vale District.

3.7.26 The Environment Agency generally aims to give a two-hour lead time for giving warning where it has a flood warning coverage within the District. However, in certain cases of severe or “flash flooding” this may not always be possible and can experience at both urbanised and rural parts of the District.

3.7.27 In addition, developments which include areas likely to flood will need to provide appropriate flood warning and formulate appropriate emergency plans to ensure their safe occupancy in the future. As a minimum, where any such development takes place in flood risk areas it is important that there is adequate passive flood warning in place, with signs highlighting the susceptibility to flooding and clearly signed evacuation routes where necessary. For clarification, just because an area is served by the Flood Warnings Direct service (or other flood warning service) that this does not automatically make the site suitable for development – all the provisions of the NPPF and NPPF Technical Guidance on Flood Risk and the Buckinghamshire County Council Flood Risk Management Strategy need to be considered.

Residual Risk Management

3.7.28 Flood risk to people and property associated with new developments can be managed but it can never be completely removed; a residual risk will always remain after flood management or mitigation measures have been put in place. Residual risk can be defined as the risk remaining after applying the sequential approach and taking mitigating actions.

Local Planning Authorities and developers should always consider residual flood risk issues relating to a development. The potential sources of this residual risk will need to be identified in the FRA, along with their potential impacts, and the most significant will have to be mitigated through flood risk management measures. The costs of such measures may be low compared to the damages they avoid and may enhance the value of the development.

3.7.29 As with all aspects of development and flood risk, it is best to consider residual flood risk early in the planning process, as measures to manage it may impact on site layout and the extent of developable land.

Although some built up areas of towns and villages are already at risk of flooding, the impacts can be reduced through good planning and management on adjacent new sites. Therefore on major developments, opportunities should be identified as early as possible to reduce off-site (such as town or village centres) flood risk by re-creating and safeguarding

functional flood plain and washlands and to design more livable developments, green/recreational space and increasing flood storage for towns and villages. Residual flood risk management needs to be coordinated with emergency procedures.

Developer Guidance

- 3.7.30 General guidance to developers on preparation of FRAs and the likely applicability of different SUDS techniques for managing surface runoff for development sites are given in Appendix F.

SFRA Mapping

- 3.7.31 The key results from the SFRA are shown on the accompanying maps. Paper copies of the maps are only produced for areas where flood risk has been identified.
- 3.7.32 A summary set of maps have been produced. Maps show the three Flood Risk Zones for the present day conditions (2012). It also shows Flood Zone 3 for 50 year's time (2062) taking into account the impact of climate change on river flows which, in the absence of modelling studies available and as a conservative approach, was considered to be identical to the present-day Flood Zone 2. These maps show OS grid co-ordinates and include a legend and title block; additional notes are given to aid the interpretation of the mapped data. Based on the best available information to date, the maps indicate areas at risk of flooding within the study area. Special attention is needed when maps are used for the areas at the study boundary as the data has been cut to the study boundary and potential flooding outside the study boundary has not been shown.
- 3.7.33 The key colour scheme identifies the delineated Flood Zones, as agreed with AVDC and the Environment Agency. As set out above in 3.7.7, as a starting point, Flood Zone 3 is considered Flood Zone 3b outside of Aylesbury where no other agreed detailed assessment has been carried out. Opportunities may be presented through an FRA (to the satisfaction of the LPA and Environment Agency) or in the event of an SFRA Level 2, to make refinements to Flood Zone 3b. Relevant guidance on this approach for Flood Zone 3b is set out in paragraphs 3-5 and Table 1 of the NPPF Technical Guidance and should be followed.
- 3.7.34 Also included on the maps are the locations of the raised defences and the watercourses studied. The locations of the raised defences were taken directly from the Environment Agency's NFCDD data. Where the Environment Agency's data (e.g. raised defences, Main river centre lines, Flood Zones, flood storage areas etc.) is used directly for mapping purpose no attempt was made to edit the data supplied.

In addition, GIS data has been prepared showing the location of key hydraulic structures, historic flood locations and key water storage facilities. These have not been included in the SFRA maps but are shown in the figures included within the **Appendix A** of this report.

3.8 Implementation of AVDLP Allocated Sites and Committed Development

- 3.8.1 This Level 1 SFRA Update has reviewed existing land allocations in the currently adopted Local Plan for the Aylesbury Vale District in order to identify the key development issues, in

terms of flood risk and water cycle management. The Update identifies what progress there has been on implementation of the relevant sites since the original SFRA1 was done in April 2007. Other significant sites that have gained planning permission up to January 2012 are also reported.

3.8.2 **Table 3** indicates the details of the currently allocated development sites within the District and whether they are located within Flood Zones 2 and 3. As highlighted in Section 4.1.5, all planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by a FRA to satisfy the requirements of the NPPF and NPPF Technical Guidance.

Table 3: Implementation of AVDLP Allocated sites and Committed Development in Aylesbury Vale District (as at March 2012)

AVDLP Policy	Site Allocated	No of dwellings subject of outstanding planning permission at March 2012	Current best estimate of likely number of dwellings	Flood Zones (June 2012)	Comments
AY.5	Stoke Mandeville Hospital, Aylesbury (part)	203 (there were also 82 demolitions)		No	Site completed March 2012.
AY.5	Stoke Mandeville Hospital, Aylesbury (part)	330		No	Site under construction, 158 dwellings completed by end March 2012.
AY.6	Former Bearbrook House, Oxford Road, Aylesbury (part)	75		Flood Zones 2 & 3	This site is being taken forward by the Homes & Communities Agency, who have now selected a delivery partner and will be progressing the planning application.
AY.7	Former TA Centre, Oxford Road, Aylesbury (The Serpentine)	94		No	Site under construction, nearing completion in March 2012.
AY.11	Circus Fields, Aylesbury		72	Flood Zone 2	A planning application for the new canal basin was approved in May 2011. The remainder of the land is being marketed for residential development.
AY.13 & AY.12	Berryfields MDA, Aylesbury	3,000	3,235	Part in Flood Zones 2 & 3	Taylor Wimpey, Bellwich Homes, Martin Grant Homes and Banner Homes are all currently constructing new

					dwellings on this site. A total of 186 dwellings were complete by the end of March 2012.
AY.14 & AY.12	Weedon Hill MDA, Aylesbury	1,022	1,037	Southern edge in Flood Zones 2 & 3	Construction is underway, and there have been 730 dwellings completed as at end March 2012 Various applications have been approved/submitted for the non-residential elements of the scheme (local centre, retail/commercial units, primary school, care home, community centre and sports and recreational facilities).
BU.1	Moreton Road, Buckingham	200		No	Site under construction, 179 dwellings completed by end March 2012.
BU.8	Market Hill (between West Street and Moreton Road), Buckingham		61	No	An application for residential units and commercial floorspace was approved in November 2010 subject to completion of a planning obligation agreement.
BU.8	Market Square/Bridge Street, Buckingham	103		Flood Zones 2 and 3	Site under construction, 77 dwellings completed by end March 2012.
WE.1	Princess Mary's Hospital, Wendover	400		No	Site under construction, 333 dwellings completed by end March 2012.
WI.1	Verney Road, Winslow	220		No	Site under construction, 65 dwellings completed by end March 2012.
RA.25	Former brickworks at Calvert	98		No	This part of the site was originally allocated for employment, and had outline consent for B1 use which lapsed in April 2009. An application for 98 dwellings and two retail units was approved in April 2011. Site under construction, 2 dwellings completed by March 2012.
RA.26	Former Pitstone Cement Works (Castlemead)	164	200	No	Site under construction, 139 dwellings completed by end March 2012.

Progress on other significant housing sites

Site	No. of homes permitted	Flood	Commentary
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			Zone	
	Former Schwarzkopf site, Penn Road, Aylesbury	391	Part Flood Zones 2 and 3	Site completed December 2011.
	Gatehouse Quarter (between Bicester Road and Gatehouse Road), Aylesbury	370	No	Site under construction, 78 dwellings completed by the end of March 2012
	Land to the south of the A421 and east of the A413, London Road, Buckingham	700 dwellings as part of a comprehensive development (including affordable housing, primary school, employment land, healthcare, outdoor playspace, changing pavilion, landscaping and creation of drainage detention basin and highway, cycle and pedestrian provision	No	Under construction. 10 dwellings started by end March 2012.
	Land East of Aylesbury, Broughton Crossing	Urban extension comprising 2450 homes, 10ha employment land, neighbourhood centre, two primary schools, and associated infrastructure and facilities		Application approved in principle (March 2012) subject to the completion of a planning obligation agreement
	Land south of Newton Leys, Drayton Road, Stoke Hammond	350		Application approved on appeal January 2012

Source: AVDC, 29 June 2012. The sites in the table are the AVDLP allocations where progress is being made in implementation. The table also includes other non-allocated sites of 300 dwellings or more.

3.9 Regional Spatial Strategy - South East Plan

- 3.9.1 Please note the following section concerns the South East Plan (A Regional Spatial Strategy for South East England) which is expected to be revoked later in 2012. The Government previously announced the RSSs were to be revoked at the time of enactment of the Localism Act.
- 3.9.2 The South East Plan covers all of Buckinghamshire, Milton Keynes and runs from 2006 to 2026. The Plan seeks to take a longer-term view of development needs, in a manner that is consistent with principles of sustainable development.
- 3.9.3 The South East has the largest regional population in the UK – over 8 million in 2001. Sea-level rise combined to a predicted land tilt of 6 millimetres a year poses a threat to the long term sustainability of the region. On top of that stringent regulations being put in place (e.g.

the European Water Framework Directive) trigger the need for the inclusion of water and flood risk management issues early on in the planning process.

3.9.4 Within the Plan's Regional Policy Framework, flood risk issues are thereby mentioned in a number of policies, as listed below:

Policy CC2 – Climate Change: which states that adaptation to risks and opportunities will be achieved through:

- i. "Guiding strategic development to locations offering greater protection from impacts such as flooding, erosion, storms, water subsidence
- ii. Ensuring new and existing building stock is more resilient to climate change impacts
- iii. Incorporating sustainable drainage measures and high standards of water efficiency in new and existing building stock
- iv. Increasing flood storage capacity and developing new water resources
- v. Ensuring that opportunities and options for sustainable flood management and migration of habitats and species are not foreclosed."

3.10 Local Planning Policy Documents

General

- 3.10.1 As part of the new planning system in England, local authorities have to prepare a Local Plan for the whole district which would have statutory Development Plan Document status. The Local Plan must aim to achieve the objective of sustainable development and be consistent with the National Planning Policy Framework (published 27 March 2012) including the presumption in favour of sustainable development. Local Plans should address the spatial implications of environmental, economic and social change and set out the strategic priorities to deliver housing, economic growth, infrastructure and other development.
- 3.10.2 The Local Plan for Aylesbury Vale is to be known as the 'Vale of Aylesbury Plan' and other DPDs to be produced – please see the programme and timetable set out in section 1.1 of this document. The Vale of Aylesbury Plan will set out the Vision and Spatial Strategy for meeting known and anticipated development requirements to 2031, including the number of dwellings, jobs and infrastructure required. The Vale of Aylesbury Plan will also have to be in general conformity with the National Planning Policy Framework.
- 3.10.3 This SFRA has been produced by AVDC to inform the Water Cycle Strategy and next stages of VAP and other DPDs including Neighbourhood Development Plans.
- 3.10.4 If in the event strategic sites are allocated in a future DPD or indeed if neighbourhood plans choose to allocate, any site allocations potentially impacting on Flood Zone 3, including an allowance for prospective climate change, would lead to the requirement for a Level 2 SFRA prior to DPD submission. Similarly, if proposed strategic transport or other infrastructure improvement schemes potentially impacted on Flood Zone 3 then a Level 2 SFRA would be required for a DPD.

3.11 Planning For Flood Risk at Aylesbury

- 3.11.1 If in a future DPD, strategic allocation (s) are made including any land in Flood Zones 2 or 3 then a SFRA Level 2 would be required. Similarly, if any strategic transport or other infrastructure schemes could potentially impact on Flood Zones 2 and 3 then a Level 2 SFRA will be required to ensure their safe design, and assess and mitigate their impact elsewhere. Safeguarding functional floodplain and also taking opportunities to restore functional floodplain in built-up areas, is an important part of the sustainable flood risk management.
- 3.11.2 With regard to surface water management, on the northern side of Aylesbury, the geological formation mostly consists of Kimmeridge Clay. Soil is formed with fine loamy over clayey type with slow permeability and seasonal water logging. Therefore, the low permeability of the soil may increase runoff volumes to some extent if further development took place. This could be tackled by imposing stringent allowable runoff rates through a combination of source control and strategic SUDS measures to attenuate flows.
- 3.11.3 The majority of southern side of Aylesbury is Gault formation with mudstone and pebbles. Fine loamy calcareous soils over chalky gravel affected by groundwater have moderate permeability. This would allow a moderate infiltration into surface soils. Any development sites that are put forward for consideration by the Council (or considered in the Vale of Aylesbury Plan) in this part of Aylesbury maybe suitable for application of SUDS that encourage infiltration to underlying ground. The examples of such techniques include soakaways, swales, permeable pavements and infiltration basins.
- 3.11.4 For all sites being considered or proposed at Aylesbury, further ground investigation will be required to determine the likely infiltration rates and confirm the choice of SUDS techniques. The runoff management from any site within the Vale District must be agreed with the Environment Agency, AVDC, Buckinghamshire County Council, Bedford Group of IDB and statutory water undertakers following the requirements stipulated in the NPPF and NPPF Technical Guidance (2012). This will involve the effective use of SUDS limiting the allowable runoff rates from the development sites to predefined maximum runoff rates.
- 3.11.5 The Environment Agency has carried out annual surveys that confirm the standard of protection provided by the AVFAS is the same level of storage as when constructed i.e. 1 in 100 years. However, the protection provided by the implemented works within Aylesbury town would decrease if the existing flood storage and channel capacity is gradually utilised by the additional uncontrolled surface water runoff (rates and volumes) from any development sites in Aylesbury Town together with the adverse impact of the prospective climate change.
- 3.11.6 However, there may be opportunities to enhance/ supplement the flood storage already provided by AVFAS through the careful intervention and planning of sites (through design proposals, mitigation measures and contributions secured from planning permissions or through the detailed planning of any sites in the Vale of Aylesbury Plan). Also, the major site to the East of Aylesbury (see planning application 10/02649 which has a resolution to grant planning permission as at 28 June 2012) provides the opportunity to create additional strategic flood storage and better utilisation on the Bear Brook and its tributaries. This will

prevent excessive flood water entering the constricted channels of the Bear Brook through the built-up areas of Aylesbury town.

- 3.11.7 Any sites considered in the southeast or south of the town may provide some more limited opportunities for reducing flood risk in Stoke Brook and downstream reaches of the Bear Brook if ground conditions encourages infiltration runoff and extra land for strategic flood management can be made available through the development planning process to overcompensate the runoff generating from these growth sites. Nevertheless, such opportunities in the event of any strategic site allocations in a future DPD would need to be explored through a more detailed Level 2 SFRA as it is beyond the scope of this Level 1 SFRA.

3.12 Flood Risk Management Strategy

- 3.12.1 A Buckinghamshire Flood Risk Management Strategy is being prepared by Buckinghamshire County Council during 2012 and will be informed by this SFRA. This strategy should aim to address the existing flood risk issues in the District whilst accommodating the additional needs of future growth in the Vale of Aylesbury Plan.

According to the Thames CFMP, the key relevant flood management policies for the Middle Thames are:

- In the Thame sub-catchment, Aylesbury excluded, to accept the risk as the Environment Agency's current scale of actions is sufficient to manage the current risk and future increases will be acceptable; and
- In Aylesbury, to accept the risk, but in the longer term to take action to ensure that risk does not increase from the current level.

- 3.12.2 According to the Great Ouse CFMP, the key relevant flood management policies for the Great Ouse west of Milton Keynes are:

- To take action to increase flooding in some areas to reduce flood risk in others where there is opportunity to use areas as active floodplain;
- To take further action to reduce flood risk for large areas with significant risk of flooding;
- To continue with current flood risk actions and to respond to future change (e.g. urban development and climate change) for large urban settlements including Milton Keynes; and
- To continue with current flood risk actions but accept future increases in flooding due to climate change for areas where flood risk management actions can be reduced.

- 3.12.3 It is recommended that the flood risk management strategy consists of the following key aspects:

- Policies;
- Planning conditions;

- Physical flood risk management measures (including their operation and maintenance);
- Flood warning and emergency planning; and
- Guidance.

The strategy should explore the opportunities to reduce the existing flood risk in the District such as in Aylesbury and Buckingham and also more common and widespread localised flooding outlined in **Table B2** through a combination of the above elements and suitable planning interventions by collaborative working with all parties involved (e.g. planners, developers, regulators and community groups).

Physical measures will involve both local and strategic options to manage flood risk within the District in a sustainable fashion over the next 50 to 100 years. Nevertheless the success of these measures will be dependent on securing funds from the central government, prospective developers and in line with Defra's new Partnership Funding arrangements, a variety of funding sources including local beneficiaries – please see <http://www.defra.gov.uk/environment/flooding/funding-outcomes-insurance/>. Other crucial factors include planning, phasing, monitoring and long-term management of these measures.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

- 4.1.1 The Vale of Aylesbury Plan has completed the Issues and Options (Stage 1) consultation. All the options published in December 2011 consider a significant percentage of 4,500-13,500 homes could be apportioned to the Aylesbury Area.
- 4.1.2 The Aylesbury Vale Strategic Flood Risk Management Study prepared by Royal Haskoning, on behalf of the Environment Agency, provided the basis for the original version of this SFRA in 2007. The SFRA has now been fully updated by AVDC Officers for 2012. The information and knowledge gathered through this Level 1 SFRA will inform the emerging Vale of Aylesbury Plan, other DPDs, neighbourhood development plans, planning applications and future flood risk management needs of the Vale District. It will also provide a sound basis in the event of a future Level 2 SFRA for parts of the District being required. This Level 1 SFRA considers all sources of flooding within the District based on a desktop study and consultation carried out with the Environment Agency, AVDC, Bedford Group of IDB, Thames Water and Anglian Water. Following sign-off by the Environment Agency on the 18th June 2012, the SFRA satisfies the requirements for SFRA's and more specifically the amplified guidance given in the NPPF Technical Guidance paragraphs 3-5 and 7. The findings of the Level 1 SFRA are given in the form of this report, developer guidance (also included in Appendix F) and the accompanying scale SFRA maps covering the entire Vale District.
- 4.1.3 Due to being at the early stage of development plan preparation in VAP, it is too early to know whether there will be the need for any strategic allocated housing sites in a future DPD at any of the major settlements in the district. However the NPPF and NPPF Technical Guidance set out that individual site boundaries should be defined totally excluding both Flood Zones 2 and 3. On the basis of this guidance, any planning applications and any planned development required should not include housing development areas within these Flood Zones.
- 4.1.4 Flooding is a key issue in the District and one of the key sources of flooding is from the main river network. However, outside Aylesbury and Buckingham, the highest risk of flooding within the District is flash flooding from excessive overland flow and overtopping of watercourses. Therefore, surface water run-off management in the District is clearly an important issue on all developments of any size, clearly highlighting the need for SUDS that maximise source control measures.
- 4.1.5 According to a preliminary desktop study it appears that the southern part of Aylesbury has more permeable soils than the northern part and therefore can encourage infiltration through SuDS. However, site investigation and infiltration tests will be needed to clarify the permeability of soil. Nevertheless, poor infiltration does not prevent the use of other forms of SuDs such as above ground conveyance and storage such as ditches, swales and ponds. The application for Land to the East of Aylesbury, Broughton Crossing (ref 10/02649/AOP), which currently has a 'minded to approve' Council resolution, provides opportunities to reduce flood risk in Aylesbury by enhancing the protection currently provided by the AVFAS. Developments elsewhere should look to reduce any local flood

risk issues and will be expected to manage the risk of surface water flooding by maintaining and where appropriate reducing run-off rates and volumes.

- 4.1.6 Since the time of producing the 2007 SFRA, 2-dimensional modelling has been undertaken for Aylesbury and areas benefiting from the AVFAS have now been added to the Flood Maps (see Flood Maps for Aylesbury town and Flood Zone 3b – the Functional Floodplain). A precautionary as well as a strategic approach to flood risk management in Aylesbury and the rest of the Vale District is needed when making development planning decisions. The NPPF and NPPF Technical Guidance also recommends for using such an approach to manage flood risk in particular to deal with uncertainty over climate change and residual flood risk.

4.2 Recommendations

- 4.2.1 **Recommendation 1** - Site boundaries for any future strategic sites required in any future allocations DPD, neighbourhood development plans and in planning applications should avoid inappropriate development in Flood Zones 2 and 3 (in accordance with section 3.7.7 of this SFRA) by fully taking into account the NPPF and NPPF Technical Guidance requirements.
- 4.2.2 **Recommendation 2** - A sequential test must be undertaken by AVDC for any sites within flood zones 2 or 3 to be considered for allocation in a future allocations DPD or in a neighbourhood plan in accordance with this report findings and any future required Level 2 SFRA.
- 4.2.3 **Recommendation 3** - In the event of a Level 2 SFRA being required, the owners of key hydraulic infrastructures should be identified as their operation and maintenance has potential to influence flood risk management. Consultation with the British Waterways Board will be of vital importance as their operation of canals and associated infrastructure bears a significant impact upon flood risk management (e.g. overspill weirs between the Grand Union Canal and the River Ouzel) within the Vale.
- 4.2.4 **Recommendation 5** - Management of surface runoff from any sites proposed for allocation in a future DPD, including neighbourhood development plans or in planning applications should use a combination of site specific and strategic SUDS measures encouraging 'source control' where possible. These measures should be agreed by the Council and relevant stakeholders with a strategic approach to flood management in mind.
- 4.2.5 **Recommendation 6** - Blockage and breach risk of the key hydraulic structures should be evaluated and existing standard of protection provided by the AVFAS and other key watercourses should be reviewed for all strategic locations to draw up emergency planning and evacuation procedures for the District. The updated emergency plans should be published as part of any Level 2 SFRA should this be required.
- 4.2.6 **Recommendation 7** - Any proposed key infrastructure in development proposals should avoid the interference with the floodplain flow and floodplain storage where they cross the existing river valleys unless they are also specifically designed as part of strategic flood risk

management options. More consultation with the Environment Agency will be essential before finalising any infrastructure proposals for the District.

- 4.2.7 **Recommendation 8** - An integrated flood risk management strategy, which considers all sources of flooding within the District, is being developed for Buckinghamshire by the Buckinghamshire County Council. Future development should be planned, implemented and monitored taking account of this strategy and the SFRA. It is fundamental that this strategy not only considers the needs of Aylesbury but also other key towns (Buckingham, Wendover, Winslow and Haddenham) and the rest of the Vale District where localised flooding is common and widespread, yet not much effort is currently taken to identify the causes of such flooding or address these issues.

APPENDICES

Appendix A – Figures

Appendix B – Historic Flooding Tables

Table B1: Historic Flooding Records form watercourses within Aylesbury Town

Location ¹	Watercourse and Cause ³	Dates	Source	Comments
West of Aylesbury Town: - Railway Bridge - Stone Bridge	River Thames; Cause i	1947	Bear Brook & Upper Thames Draft Flood History Database ² , Peter Brett Associate, March 2003.	Since 1947 flooding land raised east of Railway Bridge & Stone Bridge that already had been developed for residential housing.
North of Aylesbury Town: - Holman's Bridge - Rowsham Bridge	River Thames; Cause i	1947	Bear Brook & Upper Thames Draft Flood History Database ² , Peter Brett Associate, March 2003.	
Broughton Right Bank of GUC between Broughton Lane and Oakfield Road	GUC, Aylesbury Arm Cause vi	Historically	Record of meeting between AVDC and Halcrow	Underground flow path along the northern direction.
Park Street and Highbridge Walk	Bear Brook– exceedance of channel and structure capacity; Cause i	1954, 1959, 1974 and 1980. Also in 2001 (shopping trolley blockage at Park Street)	Bear Brook & Upper Thames Draft Flood History Database ² , Peter Brett Associate, March 2003.	AVFAS implemented in mid 1990s.
Park Street Industrial Estate closed by High Street and Vale Park Drive at the west, Stocklake in the north Oakfield Road to the east side	Bear Brook– Right bank of Bear Brook exceedance of channel and seepage; Causes i and vi	2000, 2001	Record of meeting between AVDC and Halcrow	Recent flooding incidents question the effectiveness of AVFAS implemented in mid 1990s.
High Street	Bear Brook Culvert Blockage flooded the vale and swimming pool; Cause iii	1999	Bear Brook & Upper Thames Draft Flood History Database ² , Peter Brett Associate, March 2003.	Permanent Trash screen supposed to be constructed by December 2002.
Walton Mill	Bear Brook Overtopping, inadequate surface water drainage after a ditch was filled up; Cause i	16-10-87, 1974	Bear Brook & Upper Thames Draft Flood History Database ² , Peter Brett Associate, March 2003.	4 inch water depth at car park & petrol pump. AVFAS implemented since.

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Location ¹	Watercourse and Cause ³	Dates	Source	Comments
Industrial Estate, Osier Way	Bear Brook Overtopping left bank, 20m downstream of GUC Siphon; Cause i	16-10-87	Bear Brook & Upper Thame Draft Flood History Database ² , Peter Brett Associate, March 2003.	6 inch water depth at industrial units & an electricity substation flooded. AVFAS implemented in mid 1990s.
Denby Walk	Bear Brook Overtopping left bank. Upstream of the siphon blocked by debris and trees; Causes i and iii	16-10-87	Bear Brook & Upper Thame Draft Flood History Database ² , Peter Brett Associate, March 2003.	AVFAS implemented since.
Stocklake Industrial Estate	Stocklake Brook Blockage at Pembroke Road Bridge and Osier Way Road Bridge; Cause iii	16-10-87	Bear Brook & Upper Thame Draft Flood History Database ² , Peter Brett Associate (PBA), March 2003.	AVFAS implemented since.
Health Centre near the railway station	California Brook Cause i	1974	Aylesbury Arterial Drainage Study, NRA Thames Region, December 1989	AVFAS implemented since.
Verney Walk, Paterson Road, Russell Avenue, Churchfill Avenue, Hartwell End, Oxford Road, Fowler Road	Southcourt Brook; Cause i	1947	Flood Outline Map, Bear Brook & Upper Thame Draft Flood History Database ² , PBA, March 2003.	
Luvric Road, Edinburgh Sports Ground and nearby school	Southcourt Brook; Cause i	1954	Flood Outline Map, Bear Brook & Upper Thame Draft Flood History Database ² , PBA, March 2003.	
Downstream of Stoke Brook	Stoke Brook; Cause i	1947, 1954, 1963, 1968	Flood Outline Map, Bear Brook & Upper Thame Draft Flood History Database ² , PBA, March 2003.	
Woodford Close, Fairford Leys Way, Phillips Road, Coldharbour Way	Stoke Brook; Cause i	1954	Flood Outline Map, Bear Brook & Upper Thame Draft Flood History Database ² , PBA, March 2003	
Eastern Street	Cause vi	2003	Environment Agency/ Report from the public	Springs from Portland Limestone outcropping over clay.
Stone, Eythrope Road	Cause vi	October 2001	Environment Agency/	Spring from Portland

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Location ¹	Watercourse and Cause ³	Dates	Source	Comments
			Report from the public	and Purbeck beds over clay
Stone	Not known	January 2003	AVDC	
North East Aylesbury, near Manor Park	Cause iv	Within last 10 years	Thames Water	8 properties flooded by foul water from overloaded sewers 1 property flooded by surface water from overloaded sewers
North East Aylesbury, Watermead	Field Ditch; Cause iv	December 2006	Environment Agency and AVDC	
Highbridge Walk	Cause iv	19 June 2007	Report from the public and follow up investigation by AVDC	Surface Water Sewers
Barnard Crescent	Cause iv	19-20 June 2007	AVDC	Excessive water in the carriageway from road drainage being overwhelmed
Cambridge Street, Wooton Path, Meadowcroft, Norfolk Terrace	Cause iv	19-20 June 2007	Bucks Fire and Rescue	Investigations followed by BCC
Adjacent Tesco	Heavy rain and choked lock bypass, Overtopping dimensions 6m x 0.08m	March 2008	British Waterways	

Notes

1. The above is not an exhaustive list of flooding records. In particular, note that the River Thames valley is subjected to regular flooding in its low-lying parts around Aylesbury.
2. In the PBA Flood History Database report, the ½" 1947 flood outline is deemed to be at a very coarse scale.
3. Causes of flooding are given in Section 2.2. They include:
 - I. Overflow of watercourses and existing flood defences including water retention facilities such as flood storage reservoirs/washlands and storm water balancing ponds;
 - II. Breaching of flood defences (including flood storage areas);
 - III. Mechanical, structural or operational failure (including due to blockages) of hydraulic structures, pumps etc;
 - IV. Localised surface water flooding (including sewer flooding and overland flooding);
 - V. Functional Floodplains or Washlands; and
 - VI. Groundwater flooding.

Table B2: Historic Flooding Records form watercourses outside Aylesbury Town

Location ¹	Watercourse and Cause ²	Dates	Source	Comments
Buckingham Town Centre	River Great Ouse; Cause i	1979 (25 yr return period), 1998 (between 70-100 yr return period), January 2003 and others in 1980's/1990's	Pre-feasibility Study for Buckingham, Posford Duvivier, July 1999. Buckingham Flood Defence Improvement Scheme, Project Appraisal Report (EA – Atkins). Environment Agency.	Channel improvement works implemented in 1979 to 1 in 25 yr Standard of Protection (SoP). Also, further work implemented in 1980's, 1990's. and flood resilience measures in 2010
Buckingham, Bourton Road	River Great Ouse; Cause i		Bedford Group of IDB	Ouse back-up downstream causes Padbury Brook to flood..
Buckingham – Houses in Chandos Road, Cecils Yard, Fishers Field, Nelson Street, March Edge, Norton's Place, Pateman Close, Stratford Road, Victoria Row, Well Street, Wharfside Place	River Great Ouse and other sources	July 20-21 2007	Home owner-occupier reports	Approximately 75 properties were flooded
Buckingham University – Students Union Building and Franciscan Building	River Great Ouse and other sources	July 20-21 2007	University of Buckingham	
Buckingham – various businesses in Nelson Street, Wharf Yard, Stratford Road, Tingewick Road Industrial Estate, Bridge Street, Ford Street, Well Street	River Great Ouse and other sources	July 20-21 2007	Business owner-occupiers	
Buckingham – Community Facilities at the West End Bowls Club, Chandos Park Bowls Club, Stratford Fields Football Club and Buckingham Town Football Club	River Great Ouse and other sources	July 20-21 2007	Owner-occupiers of Community Facilities	
Buckingham, Chandos Park, Buckingham Tennis Club and Buckingham Town Football Club's Ford Meadow ground	River Great Ouse; Cause i	22-01-1999	Buckingham and Winslow Advertiser	"Chandos Park and Buckingham Tennis Club were submerged on Wednesday morning and, Buckingham Town Football Club's Ford

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Location ¹	Watercourse and Cause ²	Dates	Source	Comments
				Meadow ground falls foul of the waters again.”
Buckingham	Cause iv		Anglian Water	4 areas affected by external sewer flooding only; 1 area by both internal and external sewer flooding ³
Wendover, Halton Lane	Cause iii and Cause iv		AVDC	Flooding to the road and a few properties mainly from the surcharging of former highway drain (now enmained as main river by the EA) – exacerbated by blocked culvert
Winslow, Verney Junction	Claydon Brook; Cause i		Bedford Group of IDB	Roads and fields flood regularly but no properties.
Winslow, Granborough Road	Claydon Brook; Clause i and clause iv	January 2007	Bedford Group of IDB	No properties flooded.
Winslow, Elmfields Estate	Not Known	15-04-1998	Buckinghamshire Herald	“In Winslow, streets in the Elmfields estate were flooded.”
Newton Longville	Not Known	19-07-1968 January 2003	Bletchley Gazette AVDC	
Steeple Claydon, White Bridge	Claydon Brook; Cause i			Road flooding
Brill, Crossroads	Cause vi	January 2003	Environment Agency/ Report from public	Lower Greensand and Portland beds causing springs over clay
Aston Clinton, Bucks CC building at Green Park	Cause vi	February 2001	Environment Agency/ Report from public	Actually thought to be from the Aylesbury Arm of the Canal
Aston Clinton	Grand Union Canal (GUC), Wendover Arm; Cause vi	2002	Record of meeting between AVDC and Halcrow	Seepage through embankment, not by overtopping.
Aston Clinton, 4 Dennis Close	Cause vi	February 2001	Environment Agency/ Report from public	Chalk – spring line visible above property
Aston Clinton	Not known	January 2003	AVDC	
Leckhampstead	River Leck; Cause i		Bedford Group of IDB	
Leckhampstead,	River Leck/ River		Bedford Group of IDB	Road flooding,

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Location ¹	Watercourse and Cause ²	Dates	Source	Comments
Cattleford Bridge	Great Ouse; Cause i			upstream floodplain of Great Ouse
Padbury, Oxlane Bridge	Padbury Brook; Cause i	January 2003	Bedford Group of IDB	Road flooding
Main Street, Tingewick	Cause iv	July 20 2007	Resident owner-occupier	AVDC investigated
Twyford, Three Bridge Mill and Twyford Mill	Padbury Brook; Cause i		Bedford Group of IDB	Field flooding
Twyford	Padbury Brook; Cause i	January 2003	Bedford Group of IDB	Watercourse overflowing along road, no properties flooded
Twyford	Cause iv		Anglian Water	1 area affected by external sewer flooding ³
Beachampton	Brook flowing through the village; Cause i		Bedford Group of IDB	Main street and watery lane flooded due to inadequate capacity
Beachampton, High Street	Cause iv		AVDC	Flash response causing High Street to flood 3 to 4 times last year
Ledburn and Grove	Brook flowing through the village; Cause i		Bedford Group of IDB	Fields flood
Ivinghoe Aston	Brook flowing through the village; Cause i	January 2003	Bedford Group of IDB	Flooding due to drainage pipe problem
Ivinghoe Aston	Cause iv		Anglian Water	1 property affected by external flooding only ³
Pitstone Green	Whistle Brook; Cause i		Bedford Group of IDB	Fields flood
Pistone Green	Cause iv		Bedford Group of IDB	Overland flooding
Radclive – Mill House and Old Barns	Unclear	19-20 July 2007	AVDC	Post-event survey in 31 October 2007
Slapton	Not Known		Bedford Group of IDB	Fields flood
Slapton, Old Spice Mill	River Tove; Cause i	03-11-2000	Buckingham and Winslow Advertiser	“Clifford and Denise Jamison of the Old Spice Mill at Slapton found their grounds flooded by the River Tove.”
Marsh Gibbon, Station Road	Overflowing pond; Cause i	03-11-2000	Buckingham and Winslow Advertiser	“An overflowing pond in Marsh Gibbon flooded the street,

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Location ¹	Watercourse and Cause ²	Dates	Source	Comments
				stopping deliveries to and from the post office and shop in Station Road".
Marsh Gibbon	Not Known	January 2003	AVDC	
Stoke Hammond, Rose Cottage	Not Known	19/07/1968	Bletchley Gazette	"At Rose Cottage, Stoke Hammond, where the water was waist-deep..."
Stoke Hammond	Not Known		AVDC	Two properties at risk of flooding near Orchard Mill
Mursley	Cause iv		Bedford Group of IDB	
Calvert, Grebe Lake	Cause i	03-11-2000	Buckingham and Winslow Advertiser	"Drivers all but became divers for this brave route by Grebe Lake near Calvert."
Thornborough	Cause iv	22-01-1999 and others	Buckingham and Winslow Advertiser; AVDC	"A stranded digger sits in the middle of a flooded field in Thornborough."; Regular overland flooding from the hillside according to AVDC
Drayton Beauchamp, near Tring	Cause vi	March 2001	Environment Agency/ Report from the public	Lower Chalk
Princes Risborough, Horsenden	Cause vi	December 2002	Environment Agency/ Report from the public	Lower Chalk
Bierton	Not Known	January 2003	AVDC	
Cuddington	Not Known	January 2003	AVDC	
Edlesborough	Not Known	January 2003	AVDC	
Dinton	Not Known	January 2003	AVDC	
Ford	Not Known	January 2003	AVDC	
Gawcott	Not Known	January 2003	AVDC	
Gawcott	Cause iv		Anglian Water	1 area affected by external sewer flooding ³
Grendon Underwood	Not Known	January 2003	AVDC	
Ickford	Cause vi and cause iv	January 2003	AVDC	Groundwater seepage and surcharge outfalls on highway
Little Horwood	Cause i and Cause iv	January 2003	AVDC	Flash flooding due to overland flow and overtopping of a minor watercourse
Ludgershall	Not Known	January 2003	AVDC	
Nether Winchendon	Not Known	January 2003	AVDC	

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Location ¹	Watercourse and Cause ²	Dates	Source	Comments
Northall	Not Known	January 2003	AVDC	
Oakley	Not Known	January 2003	AVDC	
Rowsham	Not Known	January 2003	AVDC	
Shabbington	Not Known	January 2003	AVDC	
Soulbury	Not Known	January 2003	AVDC	
Waddesdon	Not Known	January 2003	AVDC	
Waddesdon	Cause iv	Within last 10 years	Thames Water	3 properties flooded by foul water from overloaded sewers
Westbury	Not Known	January 2003	AVDC	
Westcott	Not Known	January 2003	AVDC	
Worminghall	Not Known	January 2003	AVDC	
Horton-cum-Studley	Cause iv	Within last 10 years	Thames Water	2 properties flooded by foul water from overloaded sewers
Towersey	Cause iv	Within last 10 years	Thames Water	1 property flooded by foul water from overloaded sewers
Hardwick	Cause iv	Within last 10 years	Thames Water	1 property flooded by surface water from overloaded sewers
Akeley	Cause iv		Anglian Water	1 area affected by external sewer flooding ³
Newport Pagnell and Leighton Buzzard ⁴	River Ouzel; Cause i	1992	Great Ouse Draft CFMP	Heavy rain following a long dry period overwhelmed the River Ouzel.

Notes

1. The above is not an exhaustive list of flooding records.
2. Causes of flooding are given in Section 2.2. They include:
 - I. Overflow of watercourses and existing flood defences including water retention facilities such as flood storage reservoirs/washlands and storm water balancing ponds;
 - II. Breaching of flood defences (including flood storage areas);
 - III. Mechanical, structural or operational failure (including due to blockages) of hydraulic structures, pumps etc;
 - IV. Localised surface water flooding (including sewer flooding and overland flooding);
 - V. Functional Floodplains or Washlands; and
 - VI. Groundwater flooding.
3. External sewer flooding refers to flooding to highways, public open space, open land, parkland, as well as private gardens, as opposed to internal sewer flooding to properties.
4. In 1992, heavy rain following a long dry period overwhelmed the River Ouzel and caused severe flooding in Newport Pagnell and Leighton Buzzard, two towns lying just outside of the Aylesbury Vale District.

Appendix C – Survey Data, Existing Studies and Hydraulic Models

Table C1: Existing topographic survey data held by the Environment Agency

Location or Watercourse	Description	Comments
River Great Ouse	Cross-sections	In CAD format
Tetchwick Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Gubbinshole Ditch	Arrangement plan Long-profile Cross-sections	In scanned format
Panshill Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Oakley Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Clifden Road, Worminghall	Pumping station plan	In scanned format
Grendon Underwood	Gauging station drawings	In CAD format
Grendon Underwood ditch	Arrangement plan Long-profile Cross-sections	In scanned format
Grendon Underwood, River Ray	Arrangement plan Long-profile Cross-sections	In scanned format
Tetchwick Brook	Arrangement plan Long-profile	In scanned format
Peppershill Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Scotsgrove Mill	Arrangement plan Long-profile	In scanned format
Shabbington Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Fleet Marston Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Hartwell Ditch	xyz files Halcrow survey reports (x4) Arrangement plan Cross-sections Long-profile	In scanned and CAD format
Eythrope Park Lake	Arrangement plan Long-profile Cross-sections	In CAD format
Meadle Brook	Arrangement plan Long-profile Cross-sections	In scanned format

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Location or Watercourse	Description	Comments
Denham Brook	xyz files Halcrow survey reports (x2) Arrangement plan Long-profile Cross-sections	In CAD format
River Thame, Eythrope Park Loop – Divergence from River Thame	xyz files Halcrow survey report Long-profile Cross-sections	In CAD format
River Thame, Eythrope Park Bridge to Rowsham Bridge	xyz files Halcrow survey reports (x7) Arrangement plan Long-profile Cross-sections	In CAD format
California Brook	Arrangement plan Long-profile Cross-sections Pictures	In CAD format
Lower Hartwell Ditch	xyz files Halcrow survey reports (x3) Arrangement plan Long-profile Cross-sections	In CAD format
Sedrup Ditch	xyz files Arrangement plan Long-profile Cross-sections	In CAD format
Southcourt Brook	Arrangement plan Long-profile Cross-sections Manhole levels	In scanned format
Broughton Lane Drain	Long-profile Cross-sections	In scanned format
Bedgrove Brook	Arrangement plan Long-profile Cross-sections	In scanned and CAD format
Rowsham Bridge	Drawings	In CAD format
Stocklake Brook	Arrangement plan Long-profile Cross-sections	In scanned and CAD format
Stoke Brook	xyz files Halcrow survey reports (x2) Arrangement plan Long-profile Cross-sections	In scanned and CAD format

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Location or Watercourse	Description	Comments
Bear Brook	xyz files Halcrow survey reports (x2) Pictures Arrangement plan Long-profile Cross-sections	In scanned and CAD format
Hardwick Brook	Halcrow survey reports (x4) Arrangement plan Long-profile Cross-sections	In CAD format
Burcott Brook	Long-profile Cross-sections	In scanned format
Grand Union Canal	Arrangement plan Pictures	In scanned format
College Farm Ditch (Draytonmead Brook)	Long-profile Cross-sections	In scanned format
West End Brook	Arrangement plan Long-profile Cross-sections	In scanned format
Claydon Brook	Watercourse survey available from Bedford Group of IDB	Surveyed in 2007
Claydon Brook tributary	Watercourse survey available from Bedford Group of IDB	Surveyed in 2004
Padbury Brook	Watercourse survey available from Bedford Group of IDB	Surveyed in 2003
Thornborough Brook	Watercourse survey available from Bedford Group of IDB	Length of 1.2 km to be surveyed in 2007-2008
Whistle Brook	Watercourse survey available from Bedford Group of IDB	Length of 7.3 km to be surveyed in 2007-2008

Table C2: Existing studies and hydraulic models

Description	Prepared by	Date produced
Aylesbury Arterial Drainage Study Final Report	National Rivers Authority, Thames Region	December 1989
Environmental Report, Bear Brook Flood Storage	Environment Agency	January 2002
Berryfields CD – SUDS Strategy	WSP Development	
Aylesbury Surface Water Drainage Study – 2 nd edition	Thames Water, Western Division	
Report on Aylesbury Surface Water Drainage Initiative	Thames Water, Rivers Division	
Aylesbury FAS Hydraulic Model - Results of the ONDA hydraulic model	Halcrow	
Aylesbury Arterial Drainage Technical	Halcrow	March 1990

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Description	Prepared by	Date produced
Annex 1 – Hydraulic Modelling Report		
Report on Effects on Flood Risk of revised Proposals for the Bear Brook – Fairford Leys Tranche II	Bettridge Turner and Partners	13 May 2002
Flood Zone amendment and approval report	Environment Agency	03 April 2006
Development Flood Study – Weedon Hill MDA Aylesbury	Brookbanks Consultancy	January 2002
Coldharbour Farm Development Aylesbury – Hydraulic Modelling Study	Halcrow	October 1991
Aylesbury Football Club Flood Compensation Study	Atkins	March 2000
Aylesbury Arterial Drainage Study	Hydro Research and Development	October 1988
Aylesbury Transport Study – Technical Note	Halcrow	03 May 2006
Aylesbury FAS – Results of the ISIS hydraulic model	Peter Brett Associates	17 November 1998
Grand Union Canal/Upper Thame Flood Study	Peter Brett Associates	April 1998
Bear Brook and Upper Thame Project – Draft Flood History Database	Peter Brett Associates	March 2003
Aylesbury Local Plan – Written statement and proposals map	Aylesbury Vale District Council	January 2001
Thame Valley First Periodic Review	Environment Agency	November 2001
Aylesbury Vale District Council Local Plan – Parts I and II	Environment Agency	January 2004
Core Strategy and Aylesbury Allocated Sites Development Plan Documents – Issues and Options, Initial Sustainability Appraisal	Colin Buchanan	June 2006
Sustainability Appraisal of Aylesbury Vale LDF – Scoping Report	Aylesbury Vale District Council	May 2006
Aylesbury Vale District Local Plan – Topic Paper Drainage	Aylesbury Vale District Council	May 2006
Aylesbury Water Cycle Strategy – Draft Report	Halcrow	January 2007
Pre-Feasibility for Buckingham – Final Report	Posford Duvivier	July 1999
Buckingham Flood Defence Improvement Scheme – Project Appraisal Report	Atkins	May 2005
Brackley Urban SoP/Section 105	Posford Duvivier	August 1999
Great Ouse at Brackley Pre-feasibility Study	Atkins	January 2003
Brackley FAS Model	Atkins	Current
River Great Ouse, Stony Stratford to Maids Moreton SoP Study	Atkins	March 2004
Great Ouse CFMP	Environment Agency	January 2011
Thames CFMP	Environment Agency	December 2009

Appendix D – Key Hydraulic Structures

Table D1: Key Hydraulic Structures within Aylesbury Town

Watercourse	Detail of Structure
River Thames	Holman's Bridge
River Thames	Stone Bridge
River Thames	Railway Viaduct
River Thames	Sluice weir on Eythrope Park
River Thames	Inlet weir to lakes and trash screen
River Thames	Sideweir
Bear Brook	Broughton Lane Bridge (B2001), 70 mm head drop (for 1 in 100 year water level)
Bear Brook	Oakfield Road Bridge (B49), 2000 mm head drop (for 1 in 100 year water level)
Bear Brook	Grand Union Canal Syphon (B48, B49), 100 mm head drop (for 1 in 100 year water level)
Bear Brook	Sluice (B42) near to Industrial Park, 70 mm head drop (for 1 in 100 year water level)
Bear Brook	Park Street Bridge (B39), 40 mm head drop (for 1 in 100 year water level)
Bear Brook	High Street Bridge (B37), 20 mm head drop (for 1 in 100 year water level)
Bear Brook	Bear Brook Flood Storage Area
Bear Brook	Vale Park Grating
Bear Brook	High Street Bridge Grating
Bear Brook	High Bridge Walk
Bear Brook	Railway Station Grating
Bear Brook	Overspill weir
Bear Brook	Spillway
Bear Brook	Throttle crest and flume with trash screen
Broughton Brook	Syphon under the Grand Union Canal
Broughton Brook	Hydraulically long culvert under Oakfield Road.
Stocklake Brook	Pembroke Road Bridge and Osier Way Road Bridge were blocked during October 1987 flooding
Stocklake Brook	Grating on the Stocklake Flood Storage Area
Grand Union Canal	Sidespill weir into Draytonmead Brook near Merrymead Farm
Grand Union Canal	Weir into California Brook at the downstream of the canal in Aylesbury
Southcourt Brook	Old Stoke Road Grating
Southcourt Brook	Towersey Way Culvert
Southcourt Brook	Streamside Walk Grating
Bedgrove Brook	Culvert under Tring Road
Bedgrove Brook	Broughton Avenue Grating
Bedgrove Brook	Several Culverts in Bedgrove estate
Stoke Brook	Culvert on the Stoke Mandeville to Marsh Road
Stoke Brook	Oxford Road Culvert
California Brook	Oxford Road Culvert
California Brook	Railway Crossing
California Brook	Health Centre Culvert
West End Ditch	Culvert under A41 on Aston Clinton Road

Certain assets above are owned by the Buckinghamshire County Council. Please see <http://www.transportforbucks.net/Flooding/Flood-Asset-Register-Map.aspx>

Table D2: Key Hydraulic Structures outside Aylesbury Town

Watercourse	Detail of structure	Location
River Great Ouse	Tingewick Weir	Tingewick
River Great Ouse	Weir and Spillway in throttle under mill building	Radcliffe
River Great Ouse	Weir with Rock Spillway	Radcliffe
River Great Ouse	Two-stage Concrete-crested Weir	Buckingham
River Great Ouse	Stone and Concrete Cascade Weir	Buckingham
River Great Ouse	Fixed Concrete Weir	Buckingham
River Great Ouse	Fixed Concrete Weir	Buckingham
River Great Ouse	Rock Cascade Weir	Buckingham
River Great Ouse	Trash screen	Buckingham
River Great Ouse	Ford	Buckingham
River Great Ouse	Castle Bridge	Buckingham
River Great Ouse	Lord's Bridge	Buckingham
River Great Ouse	London Road Bridge	Buckingham
River Great Ouse	Road Bridge under A413	Buckingham
River Great Ouse	Maids Moreton weir	Buckingham
River Great Ouse	Maids moreton weir #2	Buckingham
River Great Ouse	Thornborough weir	Thornborough
River Great Ouse	Thornborough sluice	Thornborough
River Great Ouse	Thornton weir	Thornton
River Ouzel	Canal overflow weir	Stoke Hammond
River Ouzel	Paper Mill weir	Stoke Hammond
River Ouzel	Paper Mill weir #2	Stoke Hammond
River Ouzel	Canal overflow weir	Stoke Hammond
River Ouzel	Orchard Mill weir	Stoke Hammond
River Ouzel	Orchard Mill weir #2	Stoke Hammond
River Thame	Weir	Haddenham
River Thame	Viaduct	Haddenham
River Thame	Culvert	Cuddington
Wendover Brook	Brick Weir	Weston Turville
Wendover Brook	Sluice Weir	Weston Turville
Wendover Brook	Fixed Crest Weir	Weston Turville
Wendover Brook	Concrete box culvert	Weston Turville
Bear Brook	New concrete culvert	Aston Clinton
Ludgershall Dain	Stone Fixed Crest Overfall Weir	Ludgershall
Tetchwick Brook	Overfall Weir	Kingswood
Tramroad Ditch	Trash screen	Westcott
Haddenham Drain	Concrete Culvert	Haddenham

Certain assets above are owned by the Buckinghamshire County Council. Please see <http://www.transportforbucks.net/Flooding/Flood-Asset-Register-Map.aspx>

Appendix E – Data Register

Appendix F – Developer Guidance