HERTFORDSHIRE COUNTY COUNCIL

LFRMS 2

2019 - 2029

A STRATEGY FOR THE MANAGEMENT OF LOCAL SOURCES OF FLOOD RISK

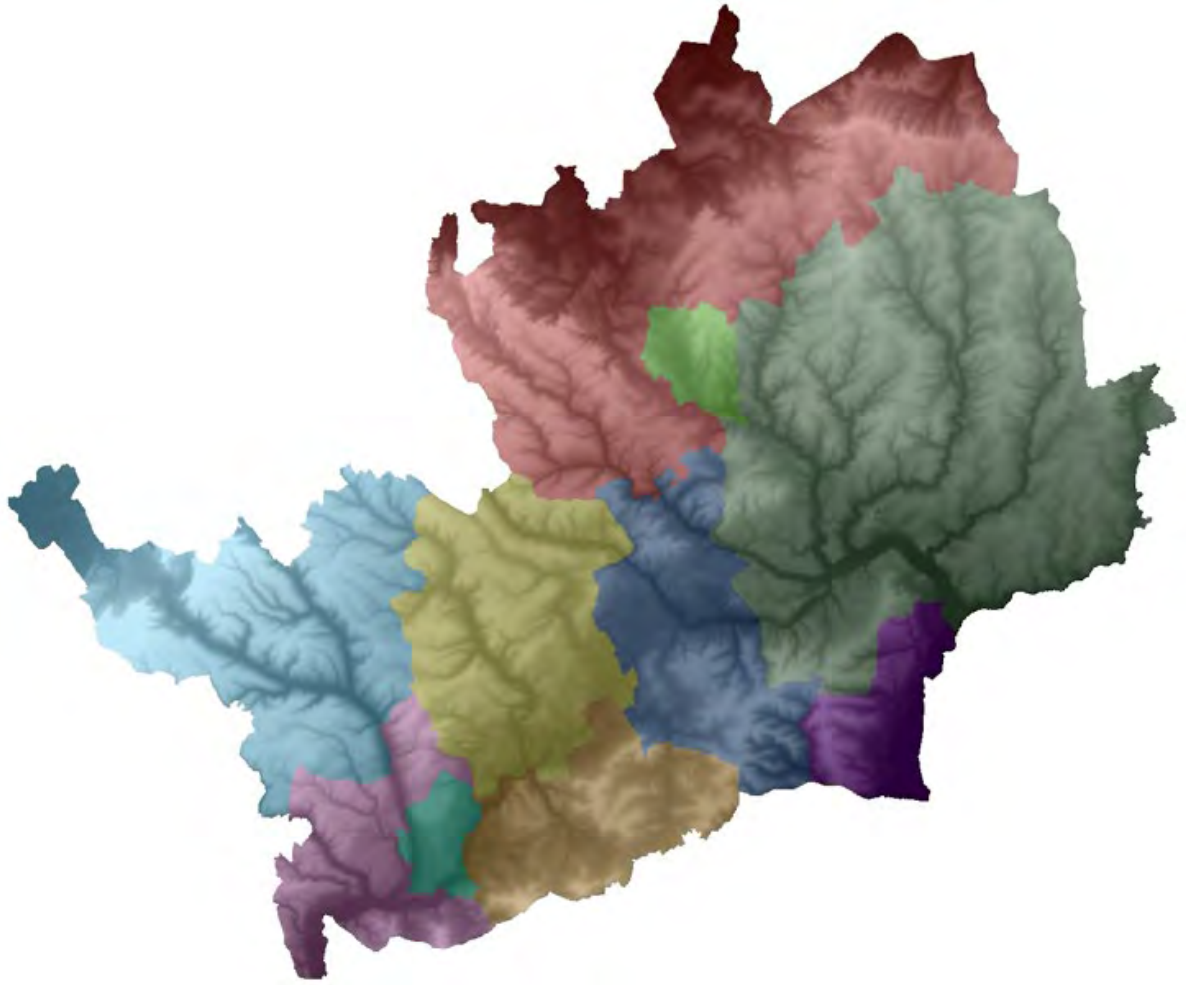


Table of Contents

Table of Figures

Table of Tables

Table of Photographs

Table of Maps

Glossary

Acronym	Term	Explanation
AEP	**Annual Exceedance Probability**	A way of expressing the probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is expressed as a percentage. It is used to help evaluate designs and investment in flood risk management. Bigger rainfall events occur (are exceeded) less often and will therefore have a lesser annual probability so a 0.1% AEP event would be expected to occur less frequently that a 1% AEP event. It would be anticipated that a 1% AEP event would on average occur once in 100 years however this is a probability based on historical statistics and so the time between such events may be greater or less than 100 years and the predicted changes to climate and weather patterns will mean that the probability of events of a given level will change over time.
AMP	**Asset Management Plan Period**	An asset management plan (AMP) period is a five-year time period used to set allowable price increases for the water companies and for the assessment of many key performance indicators. The water companies align their business plans with this cycle. Currently this is AMP 6 2015-2020, AMP 7 will run from 2020 for the following five years.

	Aquifer	Layers of permeable rock which provide water storage - important for supporting water supply and/or river flows.
AStGWF	**Areas Susceptible to Groundwater Flooding**	Mapping produced by the Environment Agency to show areas with a potential for groundwater emergence.
AStSW	**Areas Susceptible to Surface Water**	First generation mapping produced by the Environment Agency to provide broad areas where surface water flooding was likely to cause problems in three bands ranging from less susceptible to more susceptible flooding. The methodology assumed that sewer and drainage systems were full and did not account for infiltration or the impacts of the location of buildings.

Acronym	Term	Explanation
CFMP	**Catchment Flood Management Plan**	CFMPs assess flood risk from all sources across a river catchment area and establish flood risk management policies for those areas to assist in understanding flood risk within the catchment and delivering sustainable flood risk management in the long term.
	Climate Change	Long term variations in the climate of the earth including temperature, wind and rainfall patterns.
	Culvert	An enclosed section of watercourse. For example where a section of roadside ditch is piped to facilitate a vehicle crossing.
DCLG	**Department for Communities and Local Government**	(Now Ministry for Housing Communities and Local Government). Government department responsible for policy and regulations supporting local government, communities and neighbourhoods
Defra	**Department for Environment, Food and Rural Affairs**	Government department responsible for policy and regulations on the environment, food and rural affairs.
EA	**Environment Agency**	A non-departmental public body responsible for protecting and improving the environment and promoting sustainable development.
	European Floods Directive	European Commission legislation which aims to provide a consistent approach to managing flood risk across Europe.
FAS	**Flood Alleviation Scheme**	A capital scheme to provide defences or storage for flood water to alleviate flooding within a surrounding area.

FCERM	**Flood and Coastal Erosion Risk Management**	Measures including strategies, policies and schemes designed to manage flood and coastal erosion risk at a national, regional or local scale. Also referred to as FRM - Flood Risk Management.
FCERM GiA	**FCERM Grant in Aid**	Part of the Environment Agency's overall capital allocation to invest in flood risk management schemes.

Acronym	Term	Explanation
FMfSW	**Flood Map for Surface Water**	Second generation mapping produced by the Environment Agency to provide broad areas where surface water flooding was likely to cause problems based on two different chances of rainfall and displayed in two bands - surface water flooding and deep surface water flooding. The methodology assumed an allowance for infiltration and a national average drainage capacity, and mapped building locations. This has been superseded by third generation mapping which is now termed RoFfSW map
	Flood Risk Area	An area where there is a significant risk of flooding from local flood risk sources including surface water, groundwater and ordinary watercourses, identified using guidance produced by Defra as areas where a 'cluster' of square kilometres affected by flood risk holds in excess of 30,000 people.
	Flood Risk Register	Records of property flooding from the drainage and sewer network collated and held by water companies.
FRR	**Flood Risk Regulations 2009**	UK regulations implementing the requirements of the European Floods Directive which aims to provide a consistent approach to managing flood risk across Europe, based on a six year cycle of assessment and planning.
FWMA	**Flood and Water Management Act 2010**	UK legislation which sets out the roles and responsibilities for flood and coastal erosion risk management in England, in response to the Pitt review of the 2007 floods.

	Flood Zone 3	This zone comprises land assessed as having a 1 in 100 (>1%) or greater chance in any year of fluvial flooding.
	Flood Zone 2	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 (1% – 0.1%) chance in any year of fluvial flooding.
	Fluvial	Relating to rivers or streams (compare with entry for pluvial below). Generally used to describe flooding from main rivers – fluvial flooding.
	Fluvial Flooding	Flooding where water in a river exceeds the capacity of the river banks and spills into the surrounding area.
	Groundwater Flooding	Flooding where water stored underground rises above the surface of the land level in areas which are not channels or drainage pathways.
Acronym	Term	Explanation
iFRAs	**Indicative Flood Risk Area**	Areas identified by the EA as part of PFRA development where more than 30,000 people are at risk of flooding (built up from clusters of 1km squares where at least 200 are potentially at risk of significant surface water flooding).
HCC	**Hertfordshire County Council**	The County Council, and Lead Local Flood Authority for Hertfordshire.
HRF	**Hertfordshire Resilience Forum**	A forum bringing together organisations which have a duty to co-operate under the Civil Contingencies Act, and those who respond to emergencies, to prepare an emergency plan.

LFRMS	**Local Flood Risk Management Strategy**	The local strategy for a LLFA to identify the various flood risk management functions of different authorities and organisations, assess local flood risk, produce objectives and measures for managing flood risk, the costs and benefits of those measures and how they will be implemented, and contributions to wider environmental objectives.
LLFA	**Lead Local Flood Authority**	A county or unitary authority responsible for taking the lead on local flood risk management matters
	Local levy	Annual levy collected from local authorities by the Regional Flood and Coastal Committee to fund flood and coastal erosion risk management within its area.
	Main river	Main rivers are usually larger rivers and streams which have been identified and recorded on the Main River map. Environment Agency powers to carry out flood defence work apply to main rivers only to carry out maintenance, improvement or construction work to manage flood risk. The Environment Agency decides which watercourses are main rivers after consultation with other risk management authorities and the public.

Acronym	Term	Explanation
NFRMS	**National Flood Risk Management Strategy**	The national strategy for England developed by the Environment Agency to identify the various flood risk management functions of different authorities and organisations, objectives and measures for managing flood risk, the costs and benefits of those measures and how they will be implemented, impacts of climate change and contributions to wider environmental objectives.
NPPF	**National Planning Policy Framework**	The new national planning regime. See entry on PPS25 below for an explanation of the relevance to this Strategy.
	Ordinary watercourse	A stream, ditch, cut, sluice or non-public sewer which is not classified as a main river.
PFRA	**Preliminary Flood Risk Assessment**	An assessment under the FRR which assesses significant historic and future flood risks within an area, identifying significant flood risk areas and providing information on flooding for reporting to the European Commission.
	Pluvial	Relating to rain (compare with entry for fluvial above). Generally used to describe surface water flooding – pluvial flooding.
PPS25	**Planning Policy Statement 25**	Guidance on how flood risk should be covered in planning policy and development control. Although superseded by the National Planning Policy Framework the principles are likely to be carried through in local plans and related guidance.

RFCC	**Regional Flood and Coastal Committee**	Committees established by the Environment Agency consisting of members representing LLFAs and independent members, who ensure that there are plans for identifying and managing flood risk across catchments, promote investment in flood and coastal erosion risk management and provide a link between risk management authorities and other relevant bodies.
RMA	**Risk Management Authority**	As defined under the Flood and Water Management Act as LLFAs, the Environment Agency, District or borough councils where there is no unitary authority, internal drainage boards, water companies and highways authorities.

Acronym	Term	Explanation
RoFfSW map	**Risk of Flooding from Surface Water map**	Risk of Flooding from Surface Water. Refresh of third generation national surface flood maps.
SfA7	**Sewers for Adoption**	Sewers for Adoption (currently 7th edition) contains guidance for the design and construction of sewers that will be adopted by Sewerage Undertakers in England and Wales. (8th edition due mid 2019)
	Single Data List	A list of all the data returns that central government expects from local government - it replaces the previous National Indicator Set and consolidates other requirements.
SFRA	**Strategic Flood Risk Assessment (Level 1 and Level 2)**	An assessment providing information on areas at risk from all sources of flooding, used to provide an evidence base for flood risk and planning decisions.
	Surface water flooding	Flooding where rainwater collects on the surface of the ground due to soil being saturated or drainage and watercourses in the area are full to capacity or not accessible by the rainwater due to land levels.
SWMP	**Surface Water Management Plan**	A plan which assesses surface water flooding within a given area and outlines the preferred approach to managing that risk. The plan is undertaken in consultation with key partners who are responsible for flood risk management and drainage in that area. The plan should influence future resources; emergency and land use planning and identify areas where flood alleviation works may be required.

	Sustainable Development	Development undertaken in a manner to ensure that the needs of the current generation do not adversely impact the lives of future generations, improving and enhancing the area concerned.
SuDS	**Sustainable Drainage Systems**	Methods for draining and storing surface water in a resilient way designed to mimic natural drainage processes as far as possible, providing multiple environmental benefits.

Overview

The first Local Flood Risk Management Strategy (LFRMS) for Hertfordshire was approved by the county council in February 2013. At the time of approval the Lead Local Flood Authority (LLFA) had only been in existence from May 2010. This new role was established by the Flood and Water Management Act 2010 which set out new powers and duties for local authorities, linked to the management of flood risk. At the time that the LLFA came into being there was no consistent approach to the management of flood risk at a local level across the county. The LLFA has now been in place for seven years and the understanding of local flood risk across Hertfordshire has improved considerably as a result of the research that has been undertaken and the experience of flooding events that have occurred across the county.

Photograph 1: Floodwater affecting the highway

Over this period there has been change in the legislation and guidance relating to the functions and responsibilities of the LLFA. The legislation requiring the establishment of a body to regulate and manage sustainable drainage on new development was not commenced; instead LLFAs have become a statutory consultee within the development planning process advising Local Planning

Authorities on local flood risk and the suitability of surface water drainage arrangements for major development.

The knowledge and experience that has been gained from the first seven years of the LLFA has informed this review of the LFRMS. The information gained on local flood risk and the significant points that this has raised for managing flood risk in the county are summarised below:

- The national mapping of predicted surface water flood risk was updated in December 2013. The current third generation mapping of Flood Risk from Surface Water provides a good starting point to understand the potential flood risk in an area arising from surface water flows.
- District wide assessments of surface water flood risk have been completed for St Albans, Watford, North Hertfordshire, Dacorum, East Hertfordshire and Broxbourne. The studies for Welwyn Hatfield, Hertsmere, Three Rivers and Stevenage are underway and are due to be completed in 2019.
- A risk assessment has been carried out for all known ordinary watercourses in Hertfordshire and those where the risk of flooding is predicted to be highest are now on an inspection programme.
- Flooding events are now recorded and investigated and this is helping the LLFA to develop a better understanding of local flood risk.

Photograph 2: An abandoned car in floodwater

- A number of studies have been undertaken following formal flood investigations to provide an assessment of the viability of practical interventions to manage flood risk.
- The LLFA has established a register of structures and features that significantly affect local flood risk and this has been published. The research for this has helped the LLFA to identify significant assets which are not currently being managed.
- Studies for a number of flood risk management projects in the county have benefitted from funding through the Regional Flood and Coastal Committees as part of their 6 year programme and this work has provided the LLFA with a greater awareness of the practical challenges of funding flood risk management projects in the county.
- The LLFA has explored the potential for working with multiple partners on flood risk management issues and projects at both the strategic and project level.
- As a statutory consultee to the land use planning process for major development the LLFA is now better placed to identify flood risk issues and opportunities linked to major new development across the county and to seek betterment where this is possible.
- More information is now available to the general public about local flood risk from all sources but this does not yet seem to be resulting in individuals taking an active role in managing flood risk to their own property.

1. Why is a strategy needed?

Flooding due to intense or prolonged rainfall is an environmental risk that we need to understand as there will be a range of potential consequences depending on the area where it occurs. Where it involves property it can cause substantial physical, financial and emotional damage; adversely affecting the local economy and quality of life. It is therefore important to evaluate flood risk within Hertfordshire and review how the potential impacts can be managed.

At a household level flooding will cause varying degrees of disruption and whatever the level of damage suffered the experience is likely to have longer term consequences. In the case of internal flooding people as a minimum will have to deal with wet floor coverings and potential contamination. In extreme cases it has meant that people have been unable to return to their home for an extended period, while they wait for it to be repaired. So in addition to damage and material loss suffered during an event there is potential for longer term disruption of people's lives which may have an impact on schooling, work, caring responsibilities, and general well-being.

Photograph 3: Internal property flooding

When businesses and infrastructure are affected by flooding it will have a wider impact than the specific property or site. It may disrupt travel, utility supply employment or services such as hospitals and care of vulnerable people. The majority of infrastructure providers take flood risk into account and larger organisations will normally have business continuity and resilience plans in place which will help to guide recovery from flooding impacts. Smaller businesses will generally be less able to deal with a flood event and to manage the subsequent recovery.

The majority of people understand the general mechanism of flooding, in that water ends up in places where it is not usually found and that the water may have come from one or more of a range of sources (including rainfall, rivers, the sea or through the failure of a manmade structure such as a reservoir, sewer or a water main). There may not be a similar understanding of the detail of the potential mechanisms

of flooding or the respective roles of organisations that are involved in the management of flood risk.

For some, awareness of the damage that can be caused will come from news coverage of flooding events on a regional or national scale. For others it will be the personal experience of the misery and disruption caused when water enters a building. As a consequence, for some the risk of flooding will be a remote consideration and for others with personal experience, it is something that can cause apprehension whenever heavy rain is forecast.

Most reporting of flooding focuses on large or catastrophic events where intervention is required by organisations such as the Environment Agency or the relevant local authority. As a result there may be an assumption that these bodies are responsible for dealing with all things relating to flooding and that individuals or communities have no role to play outside the immediate period of any flood event. Whilst these organisations have a role to play in the management of flood risk and in responding to civil emergencies, they cannot eliminate the risk of flooding. So the general population has to be encouraged and supported to play an active role in managing their own flood risk as individuals and within communities.

Photograph 4: Fire & Rescue Service attending flooding

The level of flood risk across the county will change over time. The predicted impacts of climate change are likely to result in the frequency and severity of flooding increasing. Our improved understanding of flood risk needs to be applied to guide new development in order that it can be located and designed to minimise flood risk and where possible reduce it for existing properties.

A range of legislation gives powers and duties to agencies and authorities to manage aspects of flood risk, with each organisation having a remit which covers one or more specific sources of flooding. Whilst the definition of roles may be necessary for practicality and accountability it has the potential to fragment available resources, confuse and interfere with communication. The major pieces of legislation are:

- Flood and Water Management Act 2010 - Defines Lead Local Flood Authorities, Risk Management Authorities (RMAs) and sets out the requirements for Local Flood Risk Management Strategies, Investigations and Asset Registers.

- Flood Risk Regulations 2009 - Enshrines the European Flood Risk Regulations in UK legislation and sets out the requirement to carry out assessment and reporting on management of significant flood risk.
- Water Industry Act 1991 - Sets out the role of private Water and Sewerage providers and the requirement to effectually drain their area.
- Water Resources Act 1991 - Sets out the role and many of the duties and powers of the Environment Agency.
- Land Drainage Act 1991 - Sets out powers to regulate watercourses (LLFAs and IDBs, and to manage flood risk from watercourses (non-county LLFAs and district councils), surface runoff and groundwater (LLFAs).
- Highways Act 1980 - Sets out powers of Highway Authorities to manage drainage and flooding affecting highways.
- Public Health Act 1936 - Sets out district, borough and parish councils' powers to manage nuisances from ditches and ponds.

Ultimately the responsibility for managing flood risk to an individual property lies with the property owner. However in some circumstances it is appropriate for a local authority or other organisation to develop a scheme that will protect a number of properties. Generally these would be publicly funded and so need to meet the criteria that the cost of building and operating the scheme over a period of time will be less that the calculated predicted benefits (avoidance of damage) for the same period.

Experience over the past seven years has shown that the majority of proposals for engineering schemes involving fewer than ten properties are unlikely to be viable, so to effectively manage flood risk alternative approaches will need to be developed. This may include small scale interventions widely dispersed across catchments introducing elements of sustainable drainage (SuDS) in urban areas and working with natural processes, Natural Flood Management (NFM), in urban fringe and rural areas.

As well as considering developing new structures or assets, a comprehensive approach to flood risk management also needs to make the best use of existing assets including watercourses and man-made features. Flood risk structures that have fallen into disrepair have been found in the course of investigating flooding incidents. This may have been due to assets being overlooked following organisational change or unforeseen consequences from budgetary prioritisation. Identification of these structures and their flood risk function will help support the case for appropriate management, providing the owner can be identified. Where this is not the case and assets have become “orphaned” consideration needs to be given to a means of securing their function.

Photograph 5: Unmaintained culverts blocked by trees, plants & debris

The aim of this strategy is to give an understanding of local flood risk in Hertfordshire and the actions that will be taken to manage it most appropriately within available resources.

2. Understanding Local Flood Risk

In Hertfordshire the main sources of flood risk are surface water, rivers and other watercourses (fluvial) and, less frequently, groundwater.

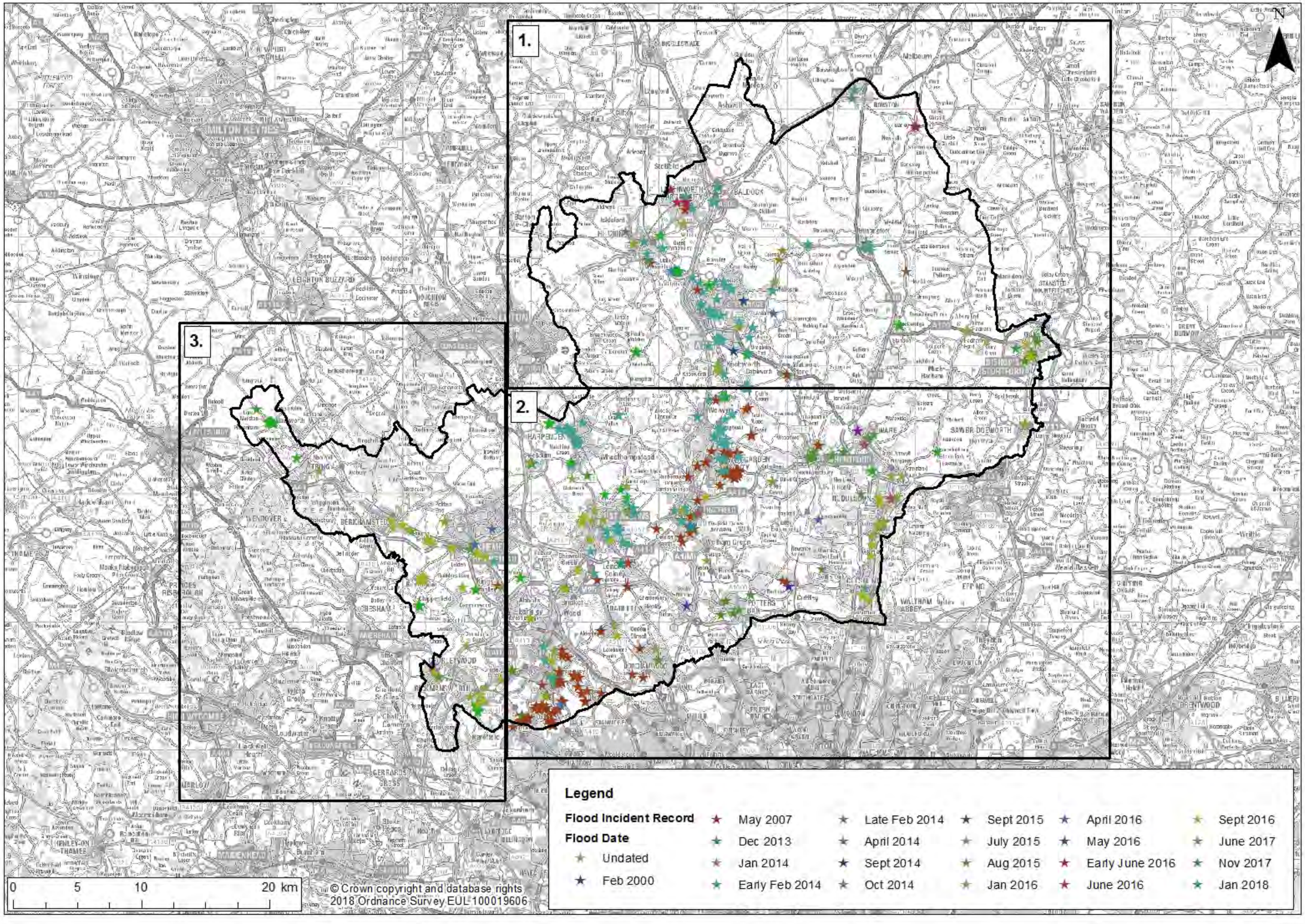
Research for the second PFRA in 2017 confirmed the understanding that local flood risk (mainly surface water) is not concentrated in a few locations but is dispersed across the county. The assessment also considered flood risk from ordinary watercourses and groundwater, which was found to represent only a small proportion of reported flooding. Flood risk from ordinary watercourses has not been estimated separately as in smaller catchments there is a large degree of overlap with surface water. Groundwater flood risk is difficult to estimate accurately and is not directly comparable as it is usually the result of rainfall over a longer period of time rather than from a single storm.

As well as events caused by a single source there may be in-combination effects, such as when elevated river levels impede surface water drainage, which then results in flooding due to surface water not being able to drain away. Some areas may be at risk from more than one source of flooding, for example a property in a river valley may be vulnerable to river flooding as a result of prolonged rainfall or surface water flooding on another occasion due to an intense storm.

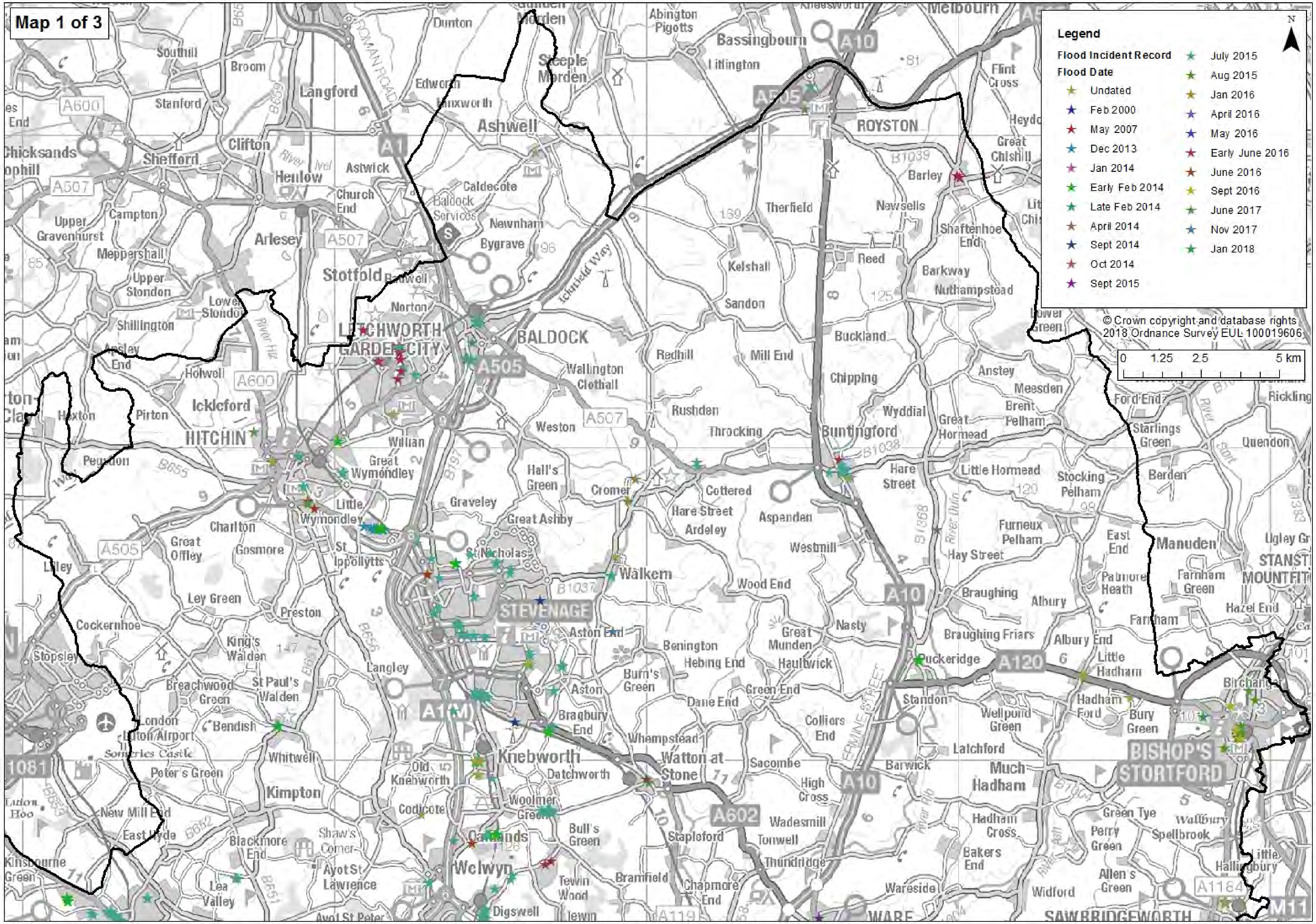
Historic records of flooding across the county are not consistent and vary greatly depending upon the location; over time making it difficult to provide a consistent picture of any past flooding across the county.

From 2011 all incidences of flooding that have come to the attention of the LLFA have been validated and logged in a consistent format. Over 800 new records have

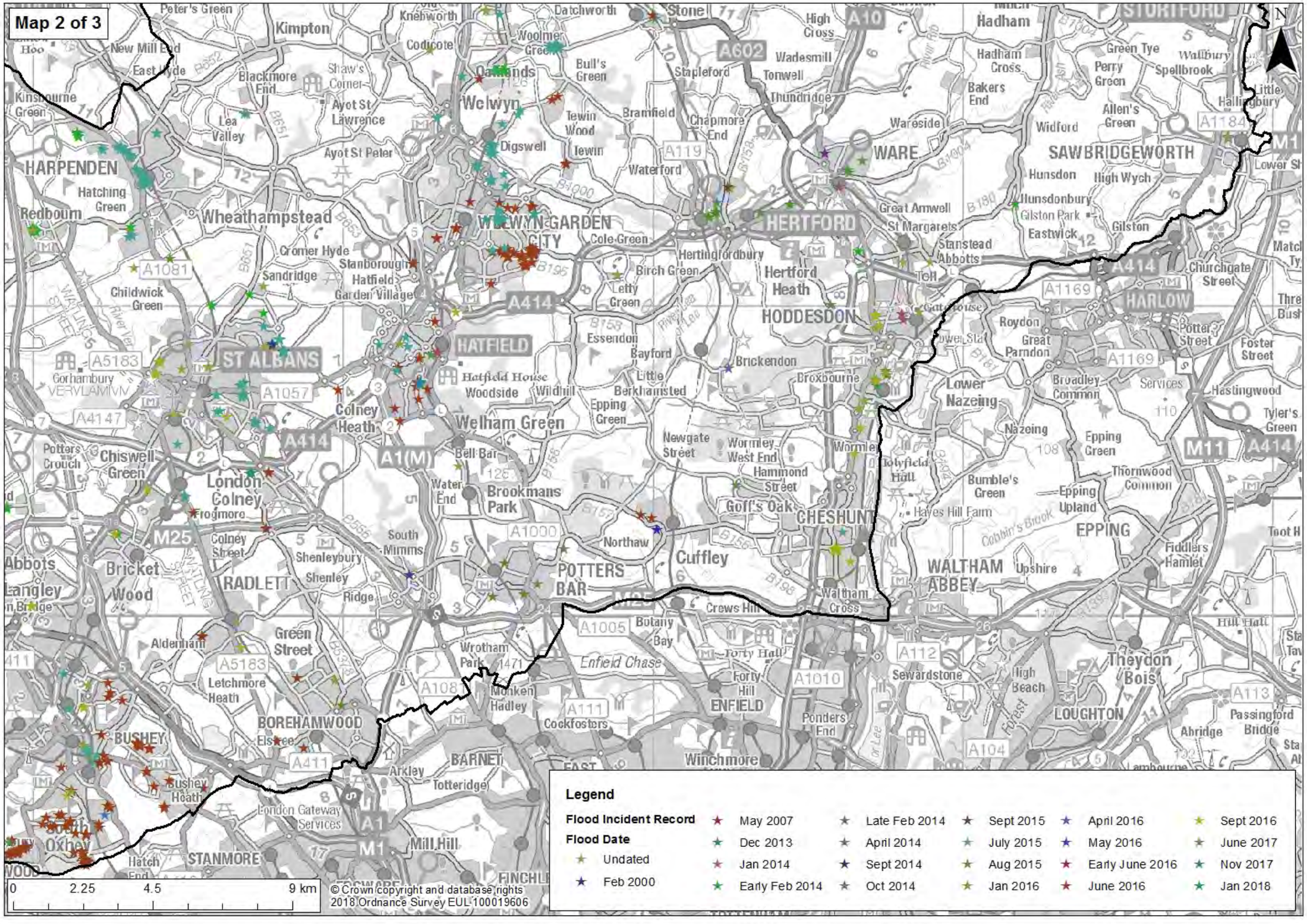
been entered in the authority's flood incident database since 2011. The majority of these flooding events are from surface water resulting from storm events in December 2013; February, July and September 2014; July 2015; and June and September 2016. Map 1 shows the locations of reported flooding events since 2011.



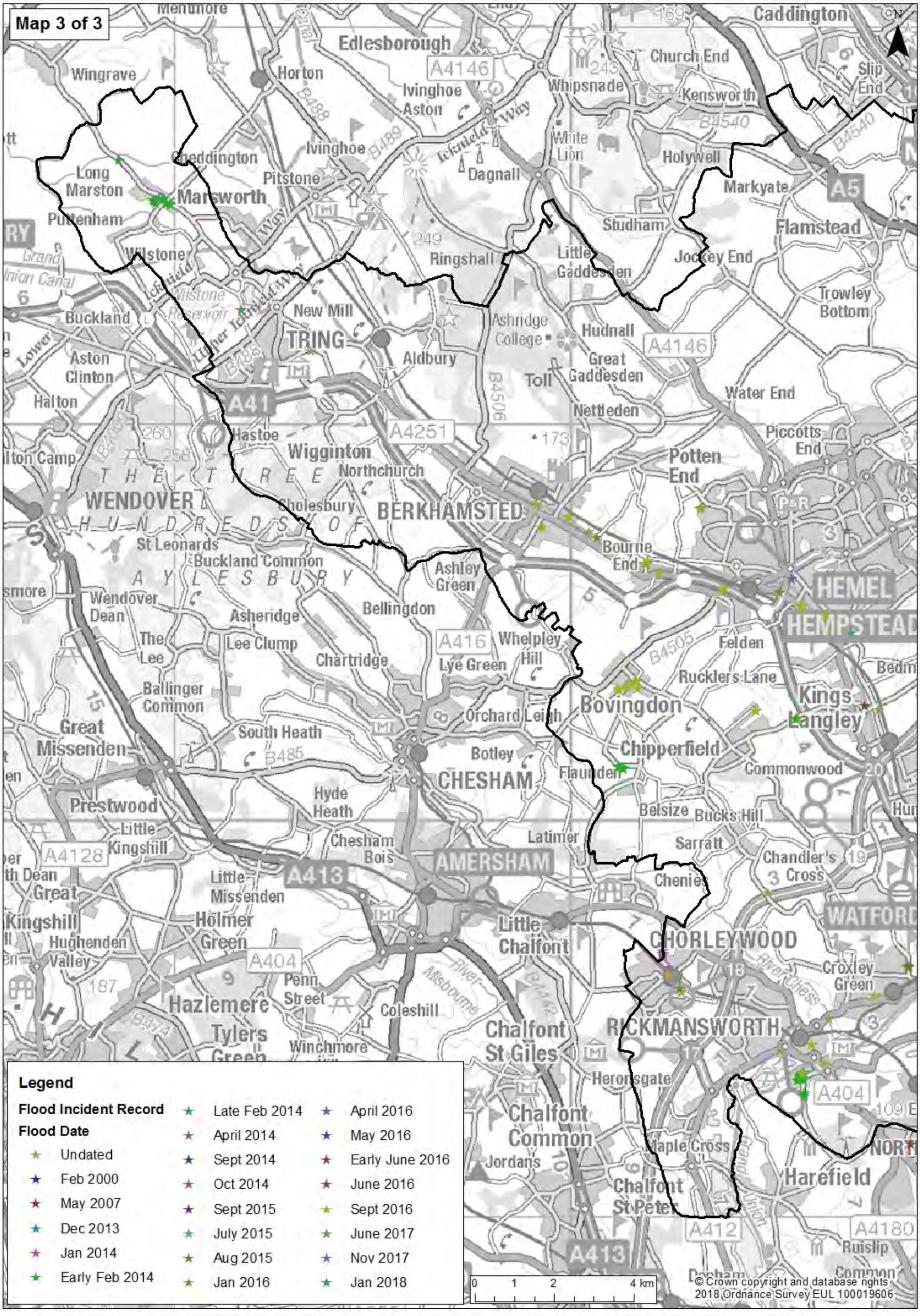
Map 1: Overview Map – Flood Incident Record for Hertfordshire



Map 1a: Map 1 of 3 – Flood Incident Record for Hertfordshire (North)



Map 1b: Map 2 of 3 – Flood Incident Record for Hertfordshire (South)



Map 1c: Map 3 of 3 – Flood Incident Record for Hertfordshire (West)

2.1 Surface Water Flooding

Surface water flooding is caused when local drainage capacity and infiltration is unable to cope with the volume of water experienced during periods of sustained or heavy rainfall. Flooding then results from overland flows causing ponding of water where it becomes obstructed or collects in low lying areas.

Modelling the potential impact of storm events gives an insight into the risk of future flooding. Currently the national surface water flood risk map RoFfSW is the best available indication of predicted surface water flood risk across Hertfordshire. Although this is the third generation of the national surface water mapping, it still cannot be used to absolutely determine the flood risk for individual properties. This is because of the assumptions that have had to be used to make it practical to produce. Property specific information such as threshold heights are assumed, individual drainage networks have not been included and the base mapping and modelling methodology does not pick up the effect of small scale features which can have an influence on surface water flows in a specific location.

The map indicates a dispersed pattern of many small areas with predicted surface water flood risk across the whole of Hertfordshire which when added together give a total of between 30 to 60 thousand properties in or near areas where there is a predicted high or medium risk of flooding from surface water. The potential for surface water flooding is predicted to be present in most of Hertfordshire's settlements. The estimated numbers of properties for each district area (Local Authority) are shown in Table 1 and the general locations can be seen in Map 2 on the following pages.

Table 1: Number of properties shown to be at risk in the RoFfSW map
Note: Property is counted to be at risk, where any part of its boundary is touching the modelled flood outline in the RoFfSW map with a predicted flood depth of 150mm or greater

Local Authority	High 1 in 30 (3.33% AEP)	Medium 1 in 100 (1% AEP)
Broxbourne	1,242	4,227
Dacorum	4,188	8,213
East Herts	4,272	8,615
Hertsmere	3,347	6,665
North Herts	3,945	7,772
St Albans	3,667	7,661
Stevenage	1,911	3,944
Three Rivers	2,452	4,868
Watford	2,167	4,886
Welwyn Hatfield	2,478	6,027
Total (Hertfordshire)	29,669	62,878

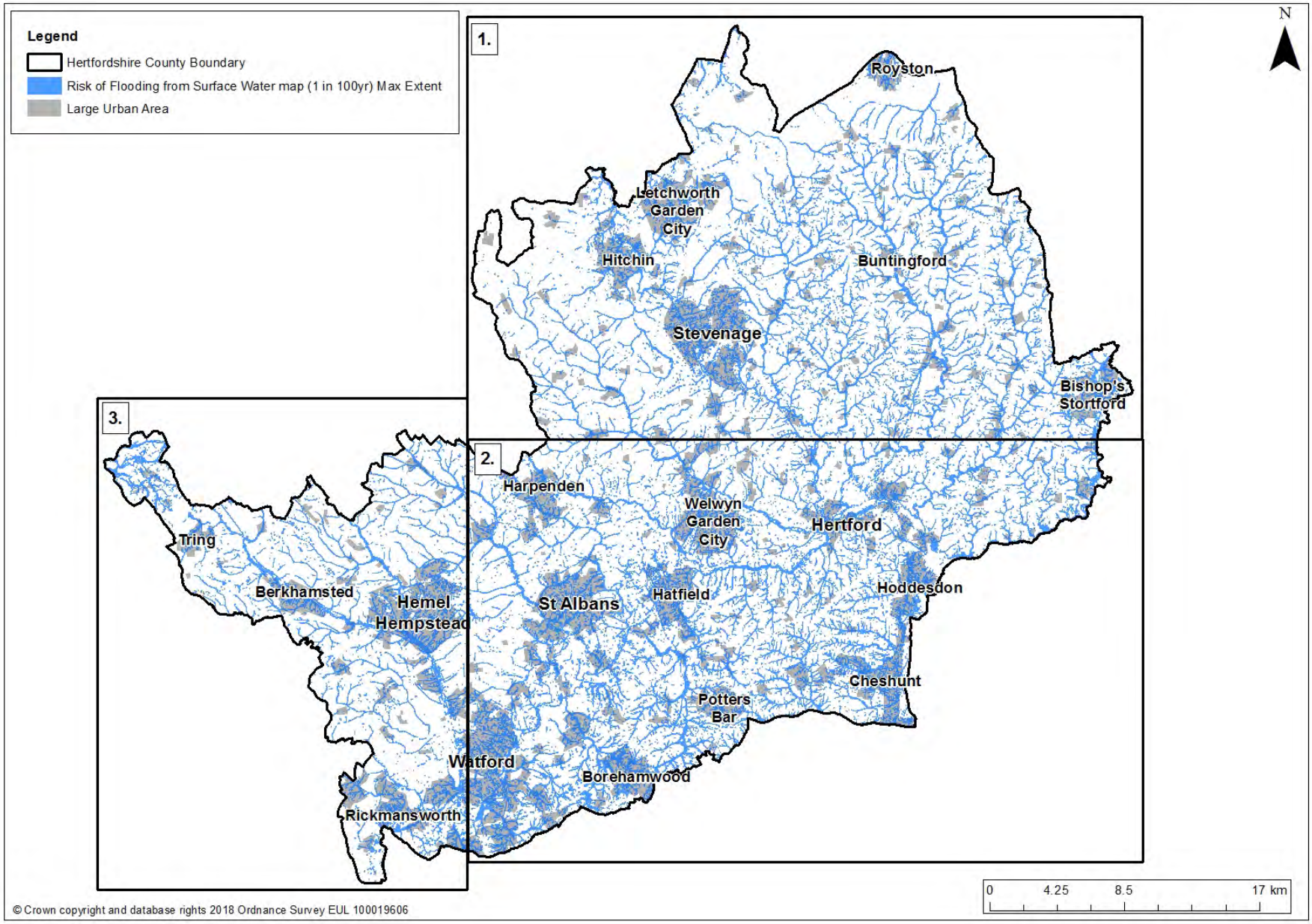
The lack of certainty about the predicted total is due to the complexities and challenges associated with the modelling of flood risk. For surface water and small watercourses the relatively small catchment sizes being analysed make models complex to develop and small features in the landform, man-made features and drainage systems can have an influence. Therefore in order for the models to be accurate they require detailed survey information to be included.

It is challenging to carry out any large scale spatial analysis to accurately predict the impacts of surface water flooding down to the property level. Accurate modelling requires the collection of detailed survey data which can be costly to collect and integrate into any large scale flood model.

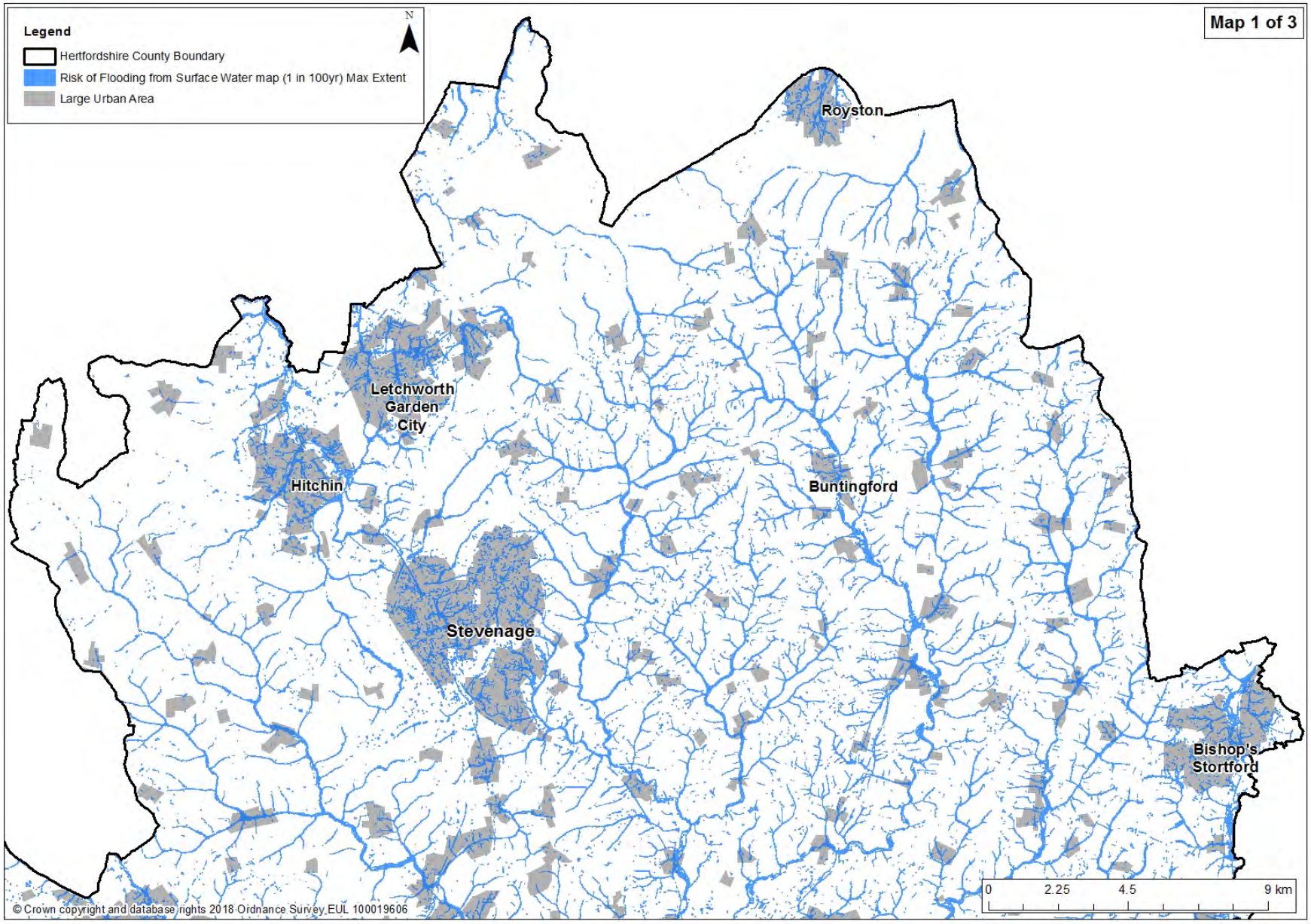
The recording and investigation of flooding events in the county is helping to refine the LLFA's understanding of how the RoFfSW can be used to assess the potential

flood risk for an area and to give an insight into the significant factors that affect flood risk at the property level.

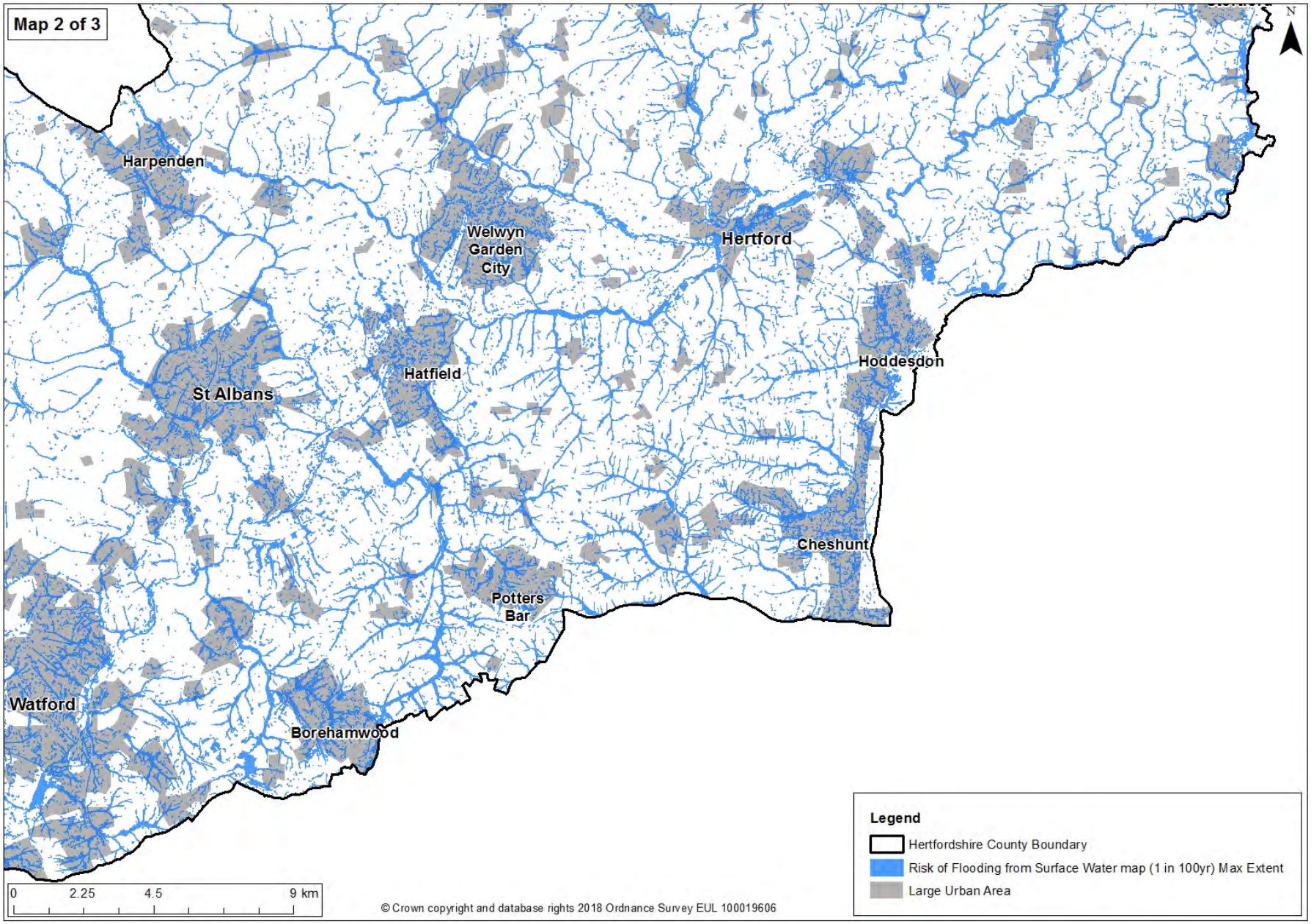
The risk of surface water flooding in the county is likely to increase as the extent of built-up areas and the area of impermeable hard surfacing (such as driveways, car parking, paths and extensions) is added too across the county. It is therefore essential that suitable mitigation such as Sustainable Drainage Systems (SuDS) is put in place to reduce and manage this risk where possible. In addition climate change predictions are indicating that the likelihood and frequency of surface water flooding will increase and this increase in risk has to be considered when planning for new development in the county.



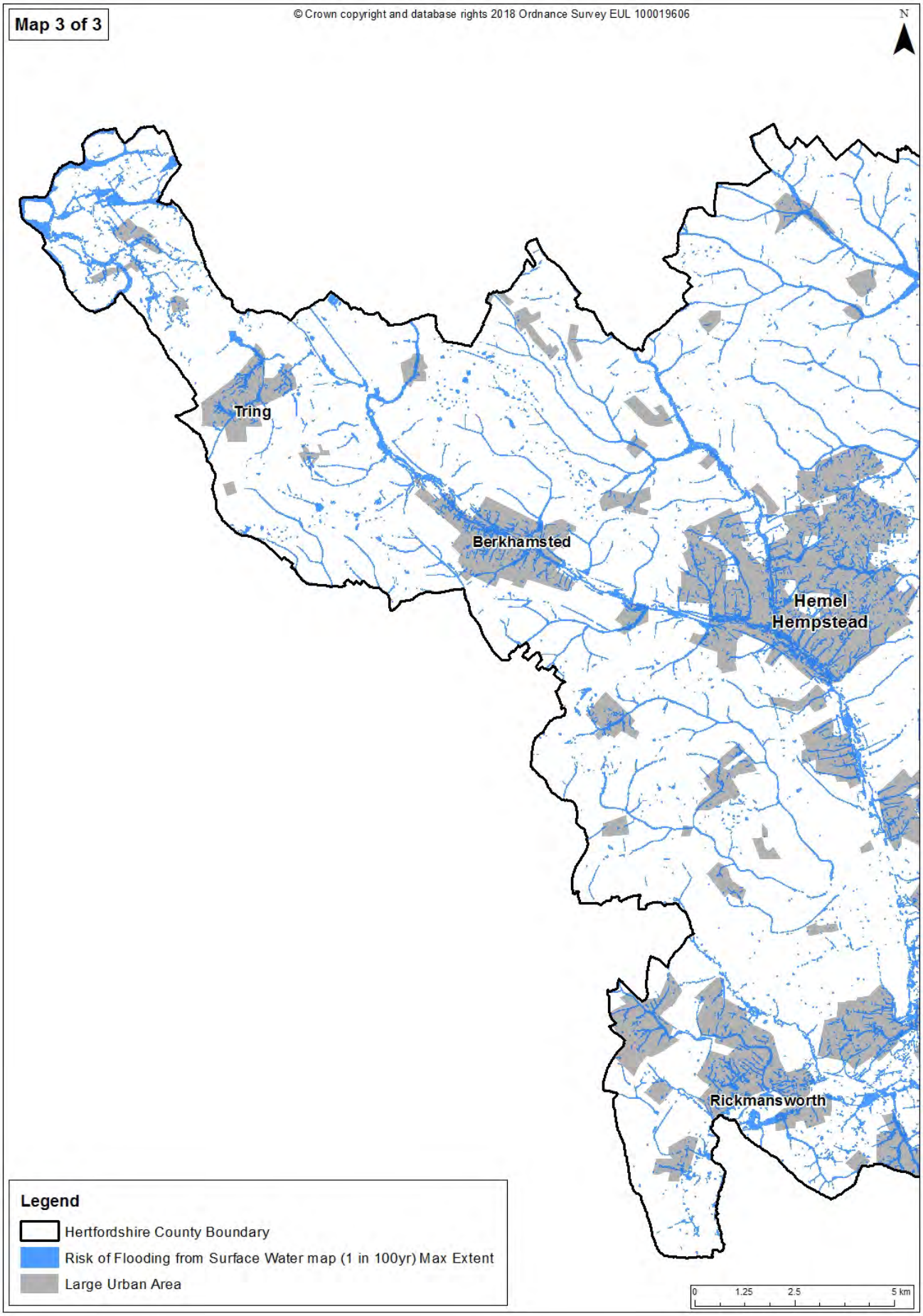
Map 2: Overview Map – Risk of Flooding from Surface Water map (1% AEP event) for Hertfordshire



Map 2a: Map 1 of 3 – Risk of Flooding from Surface Water map (1% AEP event) for Hertfordshire (North)



Map 2b: Map 2 of 3 – Risk of Flooding from Surface Water map (1% AEP event) in Hertfordshire (South)



Map 2c: Map 3 of 3 – Risk of Flooding from Surface Water map (1% AEP event) for Hertfordshire (West)

2.2 Fluvial Flooding

Fluvial flooding occurs when the capacity of a watercourse is reached, causing water to spill out of the channel onto adjoining areas, known as the floodplain. In some areas, the floodplain of the river may be undeveloped or have more flood compatible[1] uses such as farming, but in some areas development has occurred within floodplains.

Larger watercourses especially where there may be significant flood risk are designated as Main River and the Environment Agency hold the necessary legal powers and responsibilities to manage the associated flood risk. The remaining watercourses are known as ordinary watercourses and in a shire county area such as Hertfordshire the relevant district or borough council holds the legal powers to manage the associated flood risk.

Predicted flood zones associated with Main Rivers are mapped and available to view online at the following location:

https://flood-warning-information.service.gov.uk/long-term-flood-risk

An overview is included in Map 3 on the following pages.

Floodplain modelling does not exist for the majority of ordinary watercourses across the county, some of the larger ones have been mapped as part of main river systems and recently some of the Strategic Flood Risk Assessments published by the Local

[1] Although farming will not significantly reduce the volume of water able to be stored in the flood plain farming activities can nonetheless be impacted depending on the timing of flooding and type of farming being carried out.

Planning Authorities have included modelled flood risk for the larger ordinary watercourses.

In the flood plains of larger rivers there may appear to be an overlap between flood risk from the river and surface water. However this is usually the result of two distinct and separate flooding mechanisms, one where water is leaving the river channel the other where the passage of water running over the surface is interrupted on its path to the river channel. The significance of this is that an action that would reduce the risk of flooding from a river may not reduce the risk of flooding from surface water and could in some cases increase the risk (in practice this would be reviewed as part of any scheme assessment).

For practical purposes there is a large degree of overlap between flood risk associated with watercourses in small catchments and surface water. Although some flood risk from small watercourses may be associated with constrictions in the channel such as culverts, generally the influence of small watercourses will be picked up in detailed modelling for surface water flood risk. Photograph 6 shows an example of a constriction on a small watercourse.

Photograph 6: A culvert on a small watercourse

In Hertfordshire there are an estimated 1,709 residential addresses that are in areas with a high fluvial flood likelihood (3.3% AEP or greater in any one year) and 4,159 that are in areas of medium fluvial flood likelihood (between 3.3% and 1% AEP in any one year) (2014 figures reported by the EA to the Thames RFCC 24/11/16). There have been intermittent occurrences of fluvial flooding across the county during the past few years, with the most notable events occurring in February 2014.

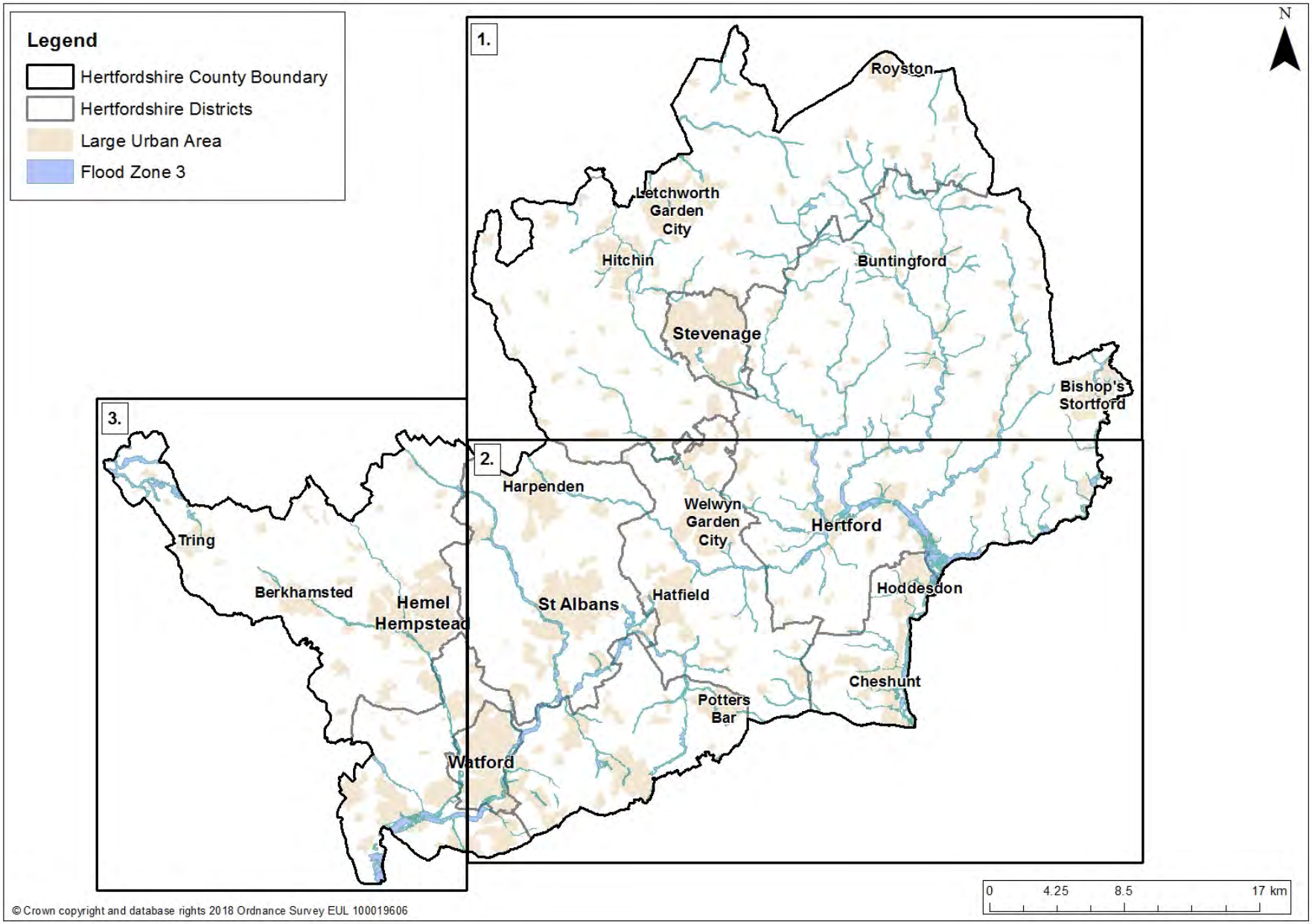
The context to the management of flood risk in the Thames and Anglian Catchments river basin catchments are set out in the respective river basin Flood Risk Management Plans. For the Thames Region the relevant catchments that impact upon Hertfordshire are the Colne, London, the Thame and the South Chilterns and the Upper Lee. Details of these can be found in the following publication:

https://www.gov.uk/government/publications/thames-river-basin-district-flood-risk-management-plan

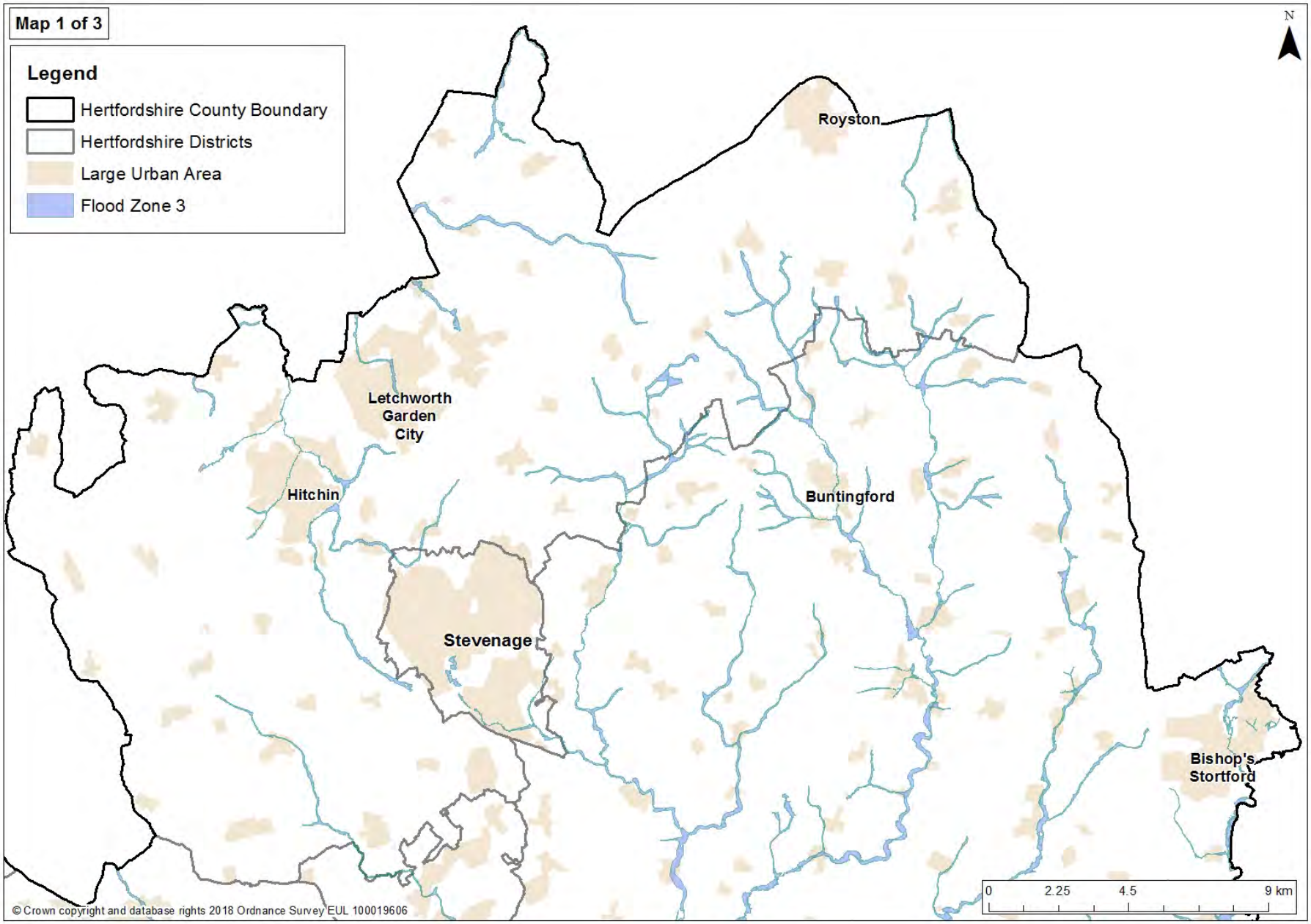
For the Anglian Region the relevant catchments for Hertfordshire are the Upper and Bedford Ouse Catchment together with Cam and Ely Ouse catchments. Details of these can be found in the following publication:

https://www.gov.uk/government/publications/anglian-river-basin-district-flood-risk-management-plan

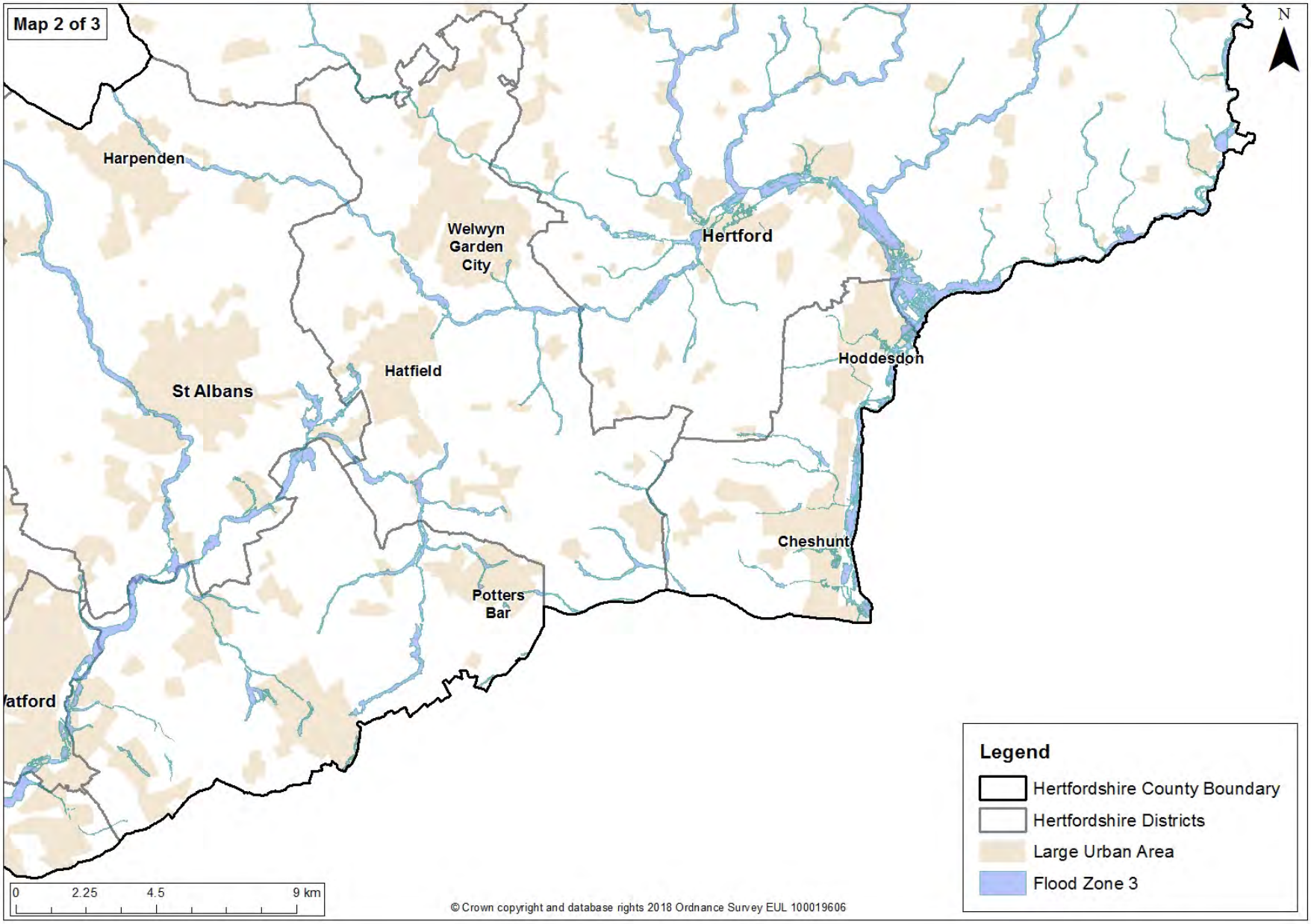
The Environment Agency offers a flood alert and flood warning service to households in areas of high fluvial flood risk.



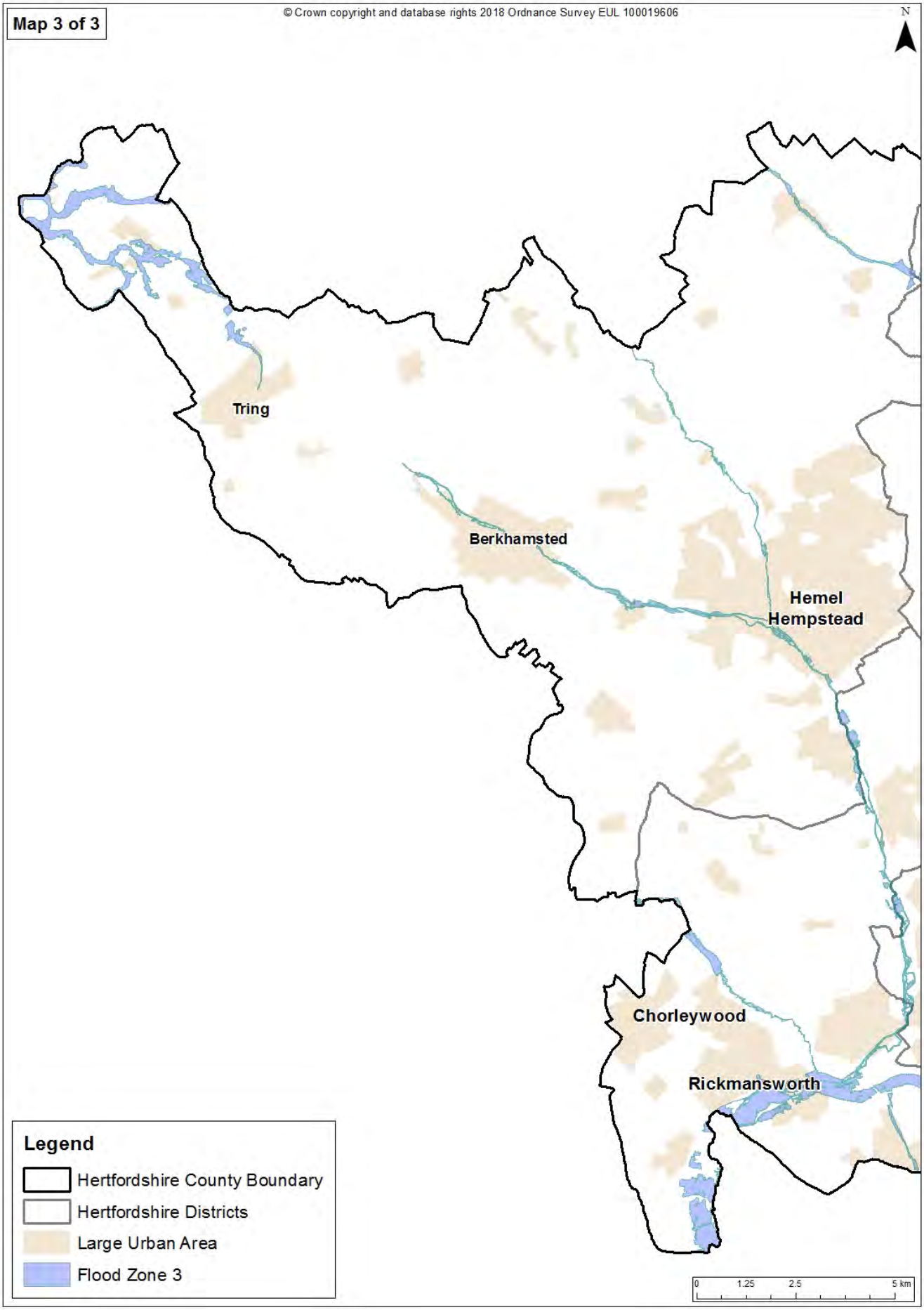
Map 3: Overview Map – Fluvial Flood Zone 3 in Hertfordshire



Map 3a: Map 1 of 3 – Fluvial Flood Zone 3 in Hertfordshire (North)



Map 3b: Map 1 of 3 – Fluvial Flood Zone 3 in Hertfordshire (South)



Map 3c: Map 3 of 3 – Fluvial Flood Zone 3 in Hertfordshire (West)

2.3 Groundwater Flooding

Groundwater flooding occurs when the water held underground rises to a level where it breaks the surface in areas away from usual channels and drainage pathways. It is generally a result of exceptional extended periods of heavy rain, but can also occur as a result of reduced abstraction[2], underground leaks or the displacement of underground flows. Once groundwater flooding has occurred, the water can remain at the surface for extended periods of time.

The presence of the chalk aquifer in Hertfordshire and other under groundwater bearing areas such as the river gravel deposits mean that there is potential for groundwater flooding in Hertfordshire. There are confirmed cases of groundwater flooding in the county ranging from localised emergence affecting single properties to a number of larger events that have impacted at the settlement scale.

[2] Where water is pumped (abstracted) from underground sources, such as the chalk aquifer beneath Hertfordshire, the water table around the pump becomes locally lowered creating what is termed a "cone of depression". If abstraction stops the water table will locally rise which depending on location may lead to an increase in groundwater flood risk.

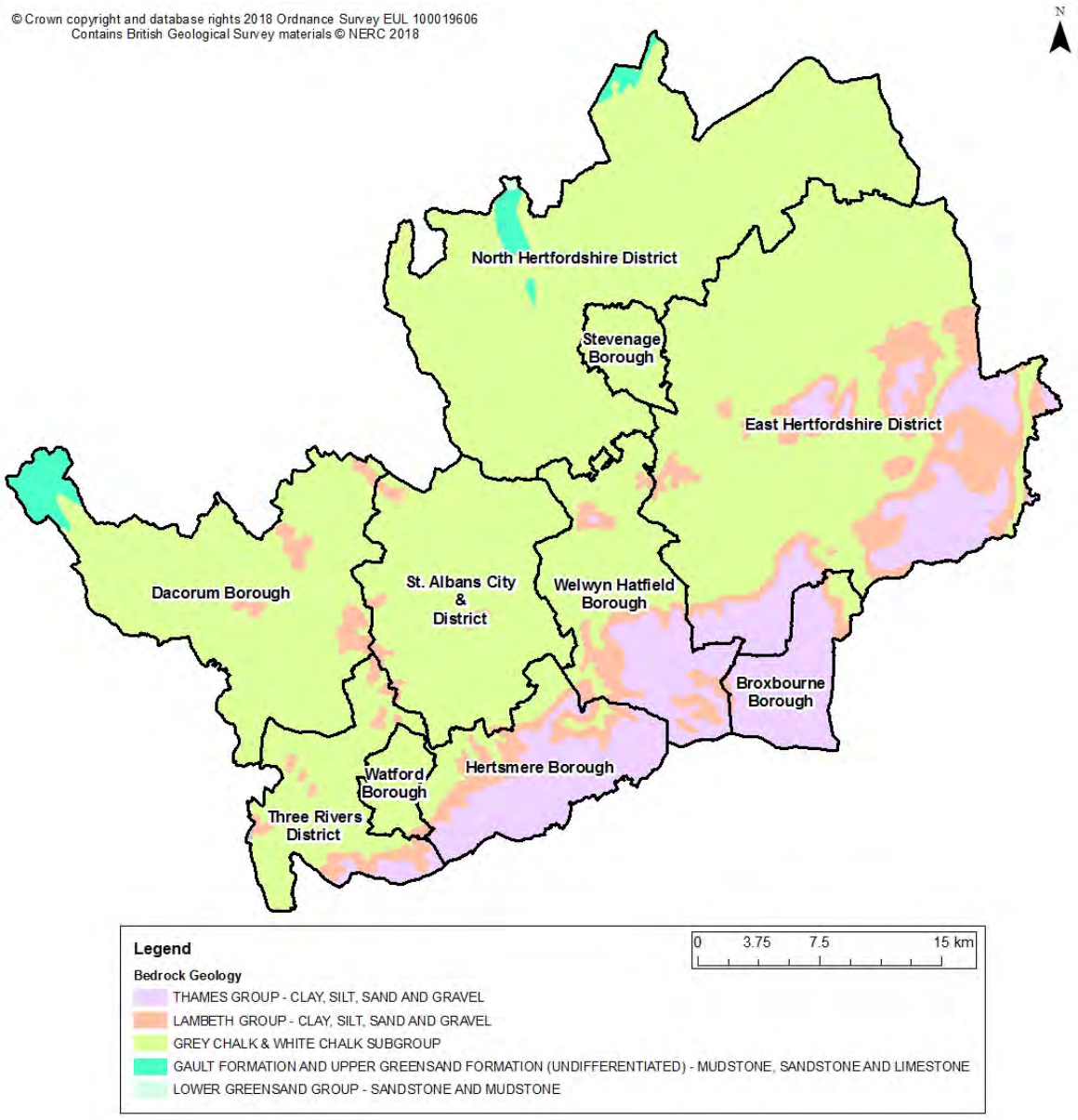
Photograph 7: Groundwater emergence & extensive ponding

Although groundwater flood risk is only a small element of the overall flood risk in the county, where it does occur it can have a significant impact due to the duration of the flooding which can result in extended periods of disruption and significant damage to buildings. Elevated groundwater conditions can also cause issues before water appears on the surface affecting basements and cellars of properties. In addition the infiltration of groundwater into sewer systems and septic tanks can interfere with the disposal of foul water and give rise to issues of sewer flooding. It may also impact on other underground infrastructure.

Groundwater flooding linked to the chalk aquifer, which underlies the county, results from rainfall over an extended period of time and is a factor of both geology and topography. Each groundwater flood event results from a unique rainfall pattern over a number of months (generally extreme as in 2000/1 and 2013/14) so modelling requires a different approach to that used for watercourse and surface water flood

risk where the relevant rainfall is over days and hours rather than weeks and months. At a local level it can be influenced by factors below ground which are challenging to determine, the risk is not routinely profiled in the same way as surface water and fluvial flooding. The extent of the chalk aquifer is shown in Map 4, which shows the Bedrock Geology for Hertfordshire.

It is possible to assess the potential for groundwater flooding drawing on work related to managing and understanding water resources linked to water supply. As part of this work a network of boreholes are monitored which helps give an early indication of rising water levels and by correlating these observations with statistical weather data it is possible to calculate the probability of a range of groundwater levels looking forward a number of months. This data is published monthly as The Hydrological Outlook produced by a collaboration of a number of organisations led by the Natural Environment Research Council's Centre for Ecology & Hydrology (CEH) and involving British Geological Survey (BGS), the Environment Agency (EA) and the Met Office (MO). Accessible: http://www.hydoutuk.net/latest-outlook/

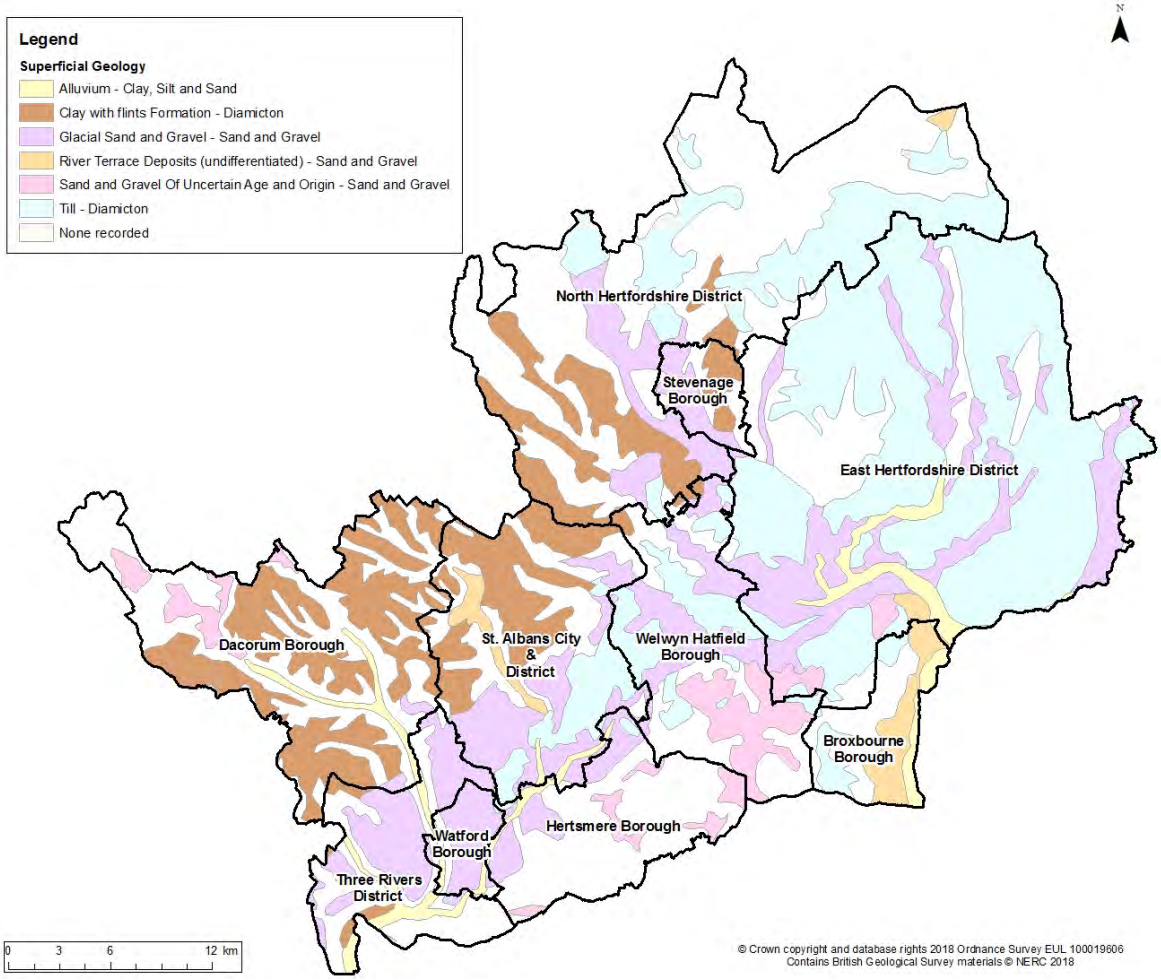


Map 4: Map shows Bedrock Geology of Hertfordshire

As well as clearwater flooding from the Chalk aquifer, more localised groundwater effects can occur across Hertfordshire due to the influence of superficial clay deposits (shown in Map 5) which can create localised (perched) water tables and associated spring lines.

Away from the areas where chalk is predominant in the valley floors groundwater flooding is also associated with bands of sand and gravel overlying impermeable areas. Generally in such area water which infiltrates into the ground will be flowing through the permeable layers, such as sand and gravel, to a point where it joins a

watercourse system or an underlying permeable area. Flooding will occur when the capacity of the area to drain water away is exceeded. The onset is likely to be following heavy rain, more rapid than flooding from the chalk aquifer and also likely to be shorter in duration.



Map 5: Map shows Superficial Geology of Hertfordshire

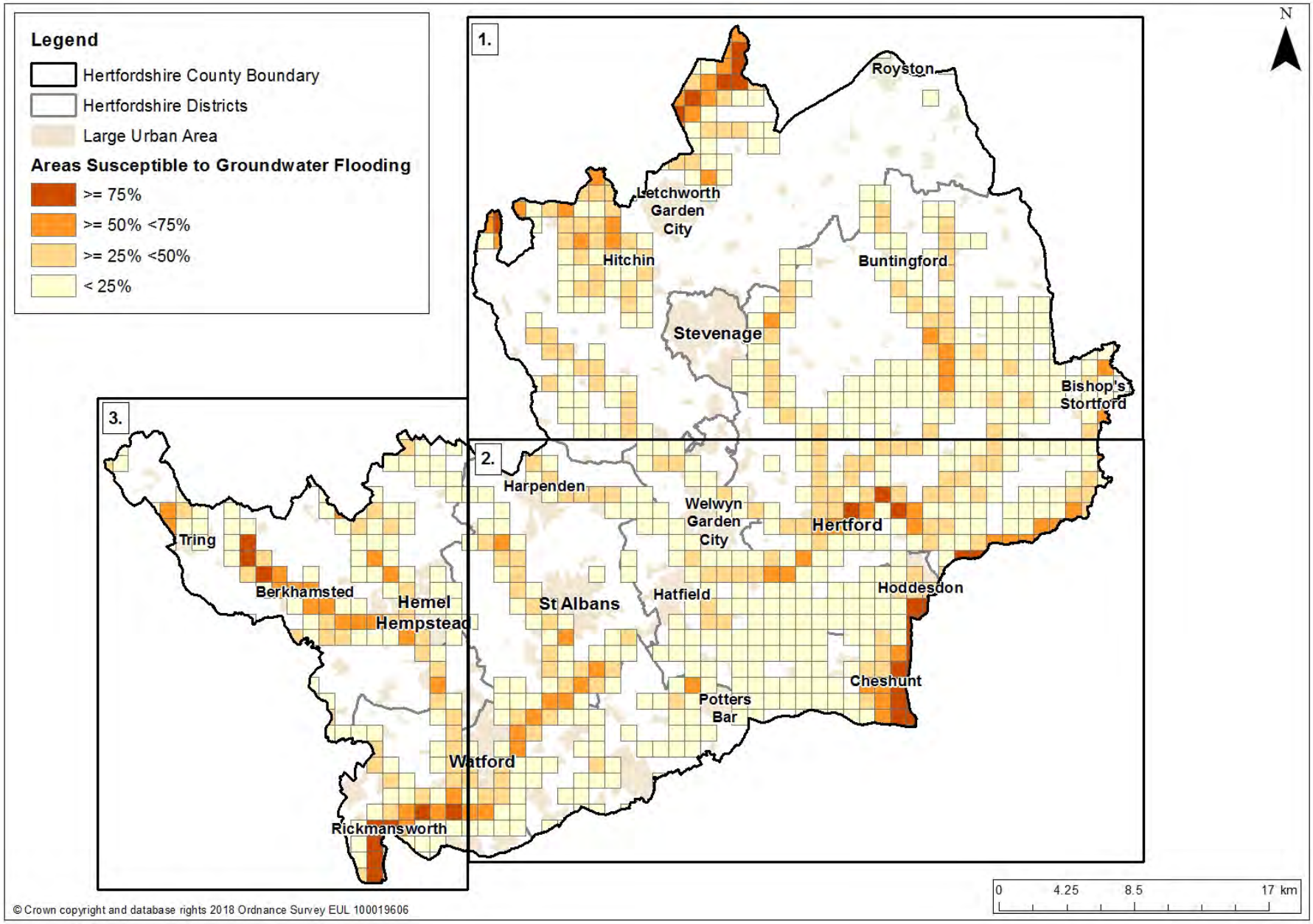
Areas with the potential for groundwater emergence are shown by the Areas Susceptible to Groundwater Flooding (AStGWF) map published by the EA; the extract for Hertfordshire is shown in Map 6. The AStGWF is based on 1 kilometre squares where the percentage of the area where there is the potential for groundwater emergence is above 25%. The majority of Hertfordshire is not shown to be at risk above this level, with very few kilometre squares with a percentage greater than 50%. This data is useful to inform a strategic overview as was done for the

Preliminary Flood Risk Assessment for Hertfordshire first produced in 2011 and updated in 2017.

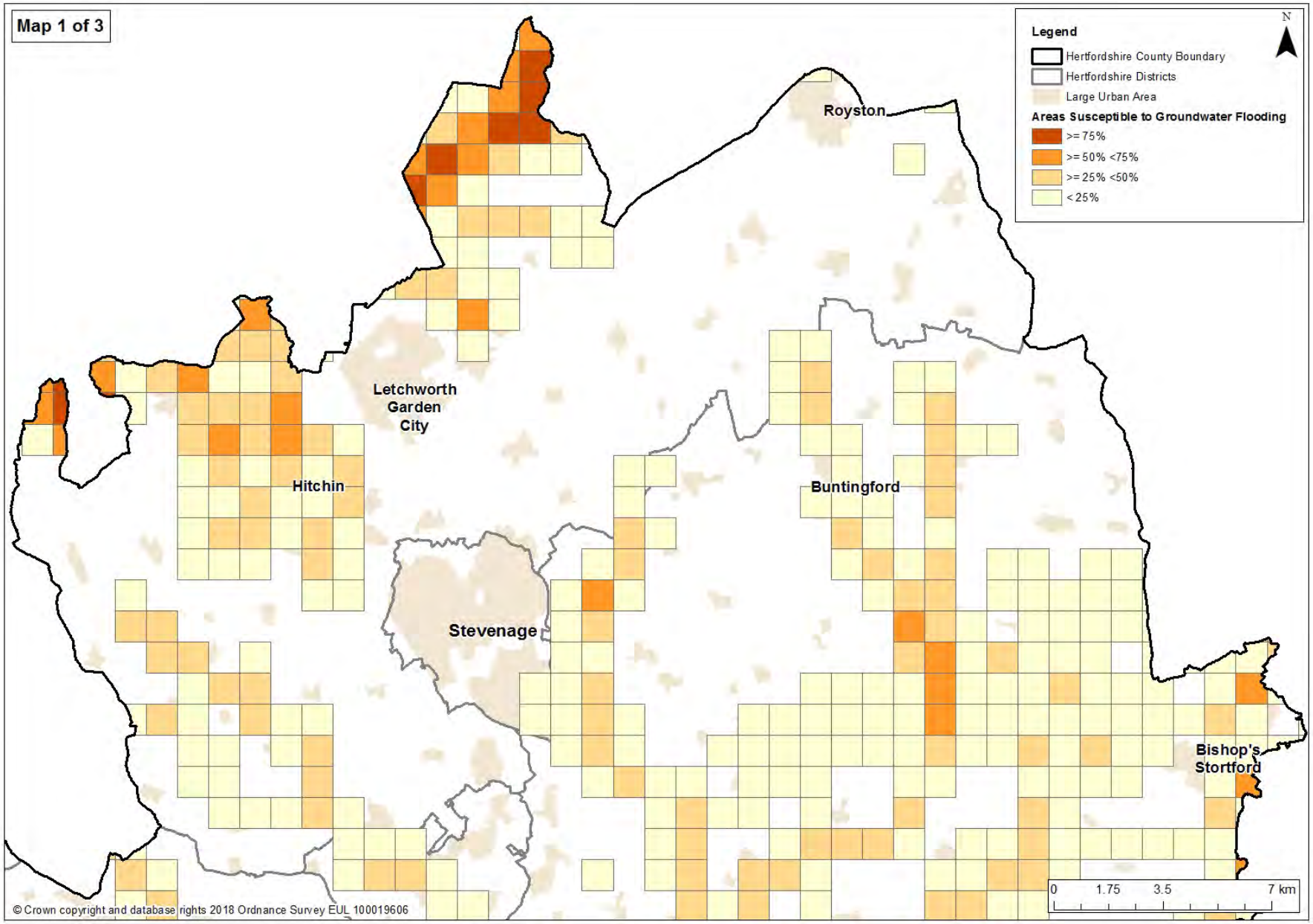
It is possible to identify more specifically locations where there is greatest potential for groundwater flooding based on mapping of geological features in combination with the land surface and water table data. It is low-lying areas such as river valleys and areas of land downstream of springs that are mostly impacted by groundwater flooding. The British Geological Survey publishes a groundwater flooding susceptibility data set based on a 50m grid which was used as the basis for producing the AStGWF mapping.

Understanding of groundwater flood risk is continuing to evolve. A report was published by the British Geological Survey in 2015 estimating the number of properties susceptible nationally to groundwater flooding. It included some suggestions of further refinements that could be made. Regionally the Thames RFCC facilitated funding of work piloting the assessment of groundwater flood risk led by Buckinghamshire County Council.

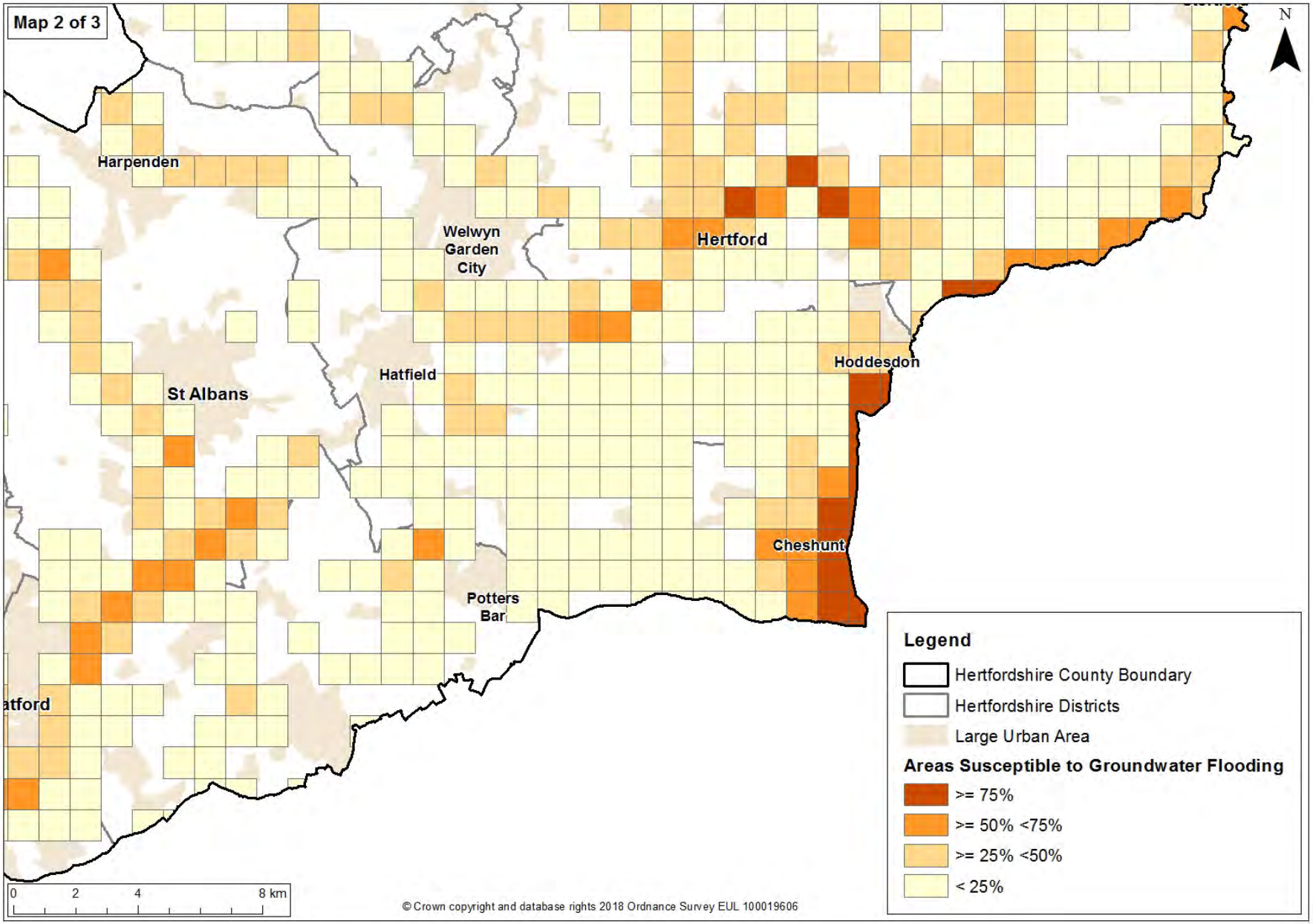
Historical records may give some insight into the impact of groundwater flooding in a location in terms of depth and duration. However they don't help to give a reliable estimate of probability which is also challenging to determine through modelling. Locally a more detailed understanding of the issues involved with this was gained through the modelling work carried out to support the assessment of the potential for managing groundwater flood risk in Kimpton.



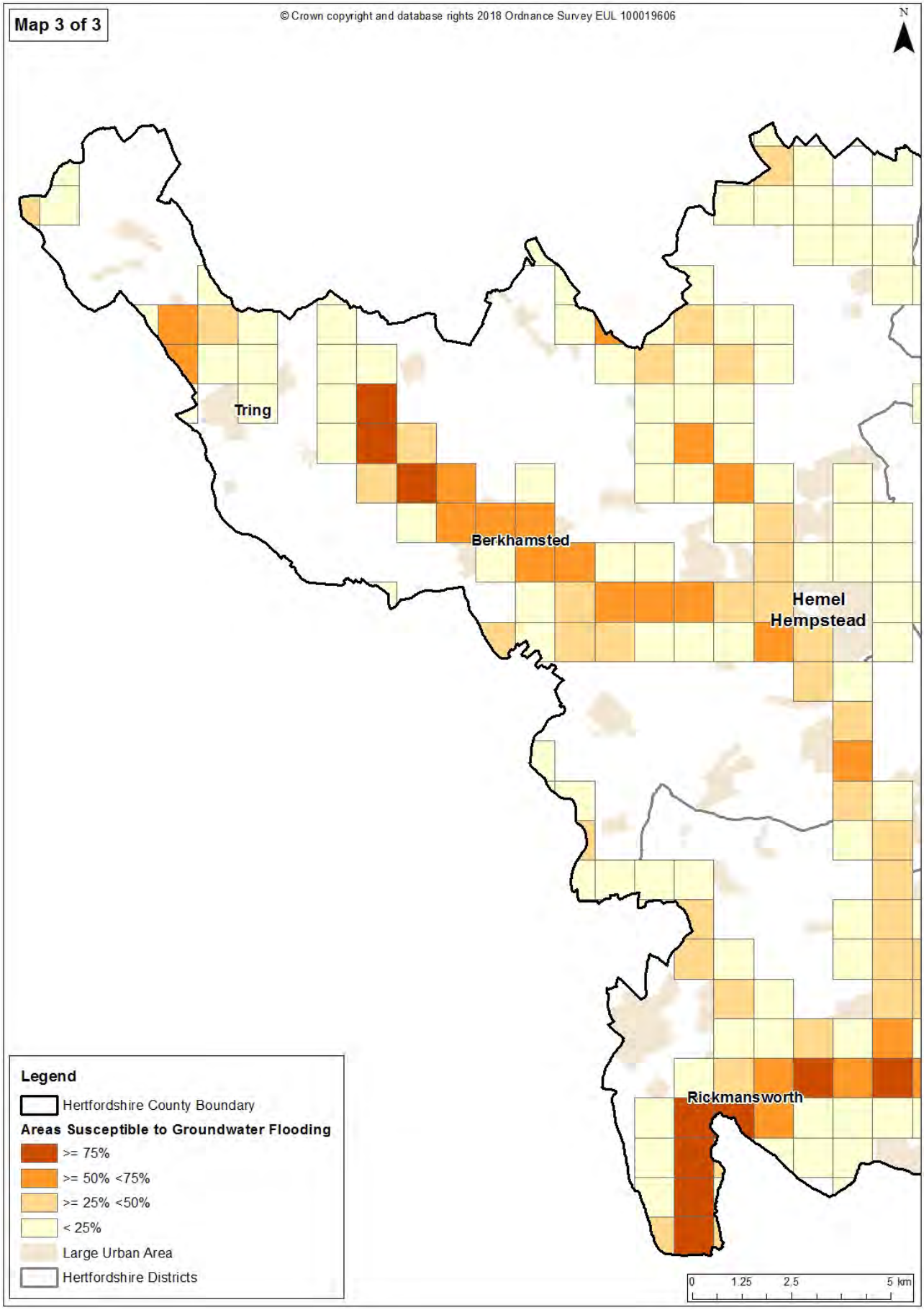
Map 6: Overview Map – Areas Susceptible to Groundwater Flooding in Hertfordshire



Map 6a: Map 1 of 3 – Areas Susceptible to Groundwater Flooding in Hertfordshire (North)



Map 6b: Map 2 of 3 – Areas Susceptible to Groundwater Flooding in Hertfordshire (South)



Map 6c: Map 3 of 3 – Areas Susceptible to Groundwater Flooding in Hertfordshire (West)

2.4 Sewer Flooding

Sewer flooding is caused when a blockage occurs or by excess surface water entering the drainage network, exceeding available capacity. This generally occurs during periods of heavy rainfall when the drainage network becomes overwhelmed.

Water Companies keep a record of property flooding called the Flood Risk register. Between 1997 and 2007 there were 291 records of sewer flooding within Hertfordshire, of which 77 were attributed to surface water and 25 to combined sewers. As the records are only referenced to broad areas by postcode district it is not possible to provide a spatial representation of this.

Photograph 8: A surcharged manhole (the sewer system has reached its capacity and water now escapes via manholes)

2.5 Flooding from other sources

In addition to watercourses and sewers there are some man made features for which water levels can be regulated. This includes reservoirs, canals and aqueducts. The Environment Agency has produced reservoir maps to show the largest area that might be flooded if a reservoir that holds over 25,000 cubic metres of water were to fail. Hertfordshire has 24 reservoirs which hold in excess of 25,000 cubic metres of water. The chance of reservoir failure is very unlikely as reservoirs are regularly inspected and there is an extremely good safety record in the UK with no loss of life due to reservoir flooding since 1925.

Flooding may result from overtopping or breach of the canal network. There are a number of canals within Hertfordshire including the Grand Union Canal, the Lee Navigation and the Stort Navigation. The Canal and Rivers Trust has investigated the potential for flooding from the canal network. Current records indicate only two minor breach events on record within Hertfordshire on the Grand Union Canal. Dacorum Borough Council's Level 2 SFRA includes an assessment of potential flood risk associated with a raised section of the Grand Union Canal. It is considered that there are no significant flood risks associated expressly with the canals.

The New River which runs through Hertfordshire in the Lee valley was built to carry water for the public water supply from springs in the Amwell area into London. It is operated under an Act of Parliament by Thames Water Utilities Ltd. Its main function is as an aqueduct and the volume of water entering at the start can be regulated however it does have a secondary function of drainage in a number of areas.

Burst water mains can also cause disruptive flooding but are outside the scope of this strategy.

2.6 Climate change

As well as looking at flood risk using past events the future risk of flooding needs to be assessed. This is especially relevant because of the need to consider the potentially significant effects arising from climate change. The existing level of flood risk in Hertfordshire is predicted to increase over time. Changing weather patterns associated with predicted climatic change is likely to result in an increased probability of intense summer rainfall. A range of climate change scenarios have been developed and it seems likely that overall flood risk will increase as flooding may happen more often and/or to a greater depth, depending on the flooding source and mechanism.

Predicted climate change is already being taken into account in the planning of new development. Strategic Flood Risk Assessments produced by Local Planning Authorities to support their Local Plans do this at the strategic scale. For major planning applications the LLFA advises planning authorities on the suitability of surface water drainage arrangements and any significant issues linked to local flood risk. Assessments linked to this work are required to take account of the potential impact of predicted climate change.

Changes in climatic conditions can affect local flood risk in several ways; however, impacts will depend on local conditions and vulnerability. Wetter winters and more intense rainfall may increase river flooding in both rural and urban catchments. More intense rainfall causes greater surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and have an impact on water quality. The number of intense summer storms leading to occurrences of flash flooding could increase even in summers which may have less overall rainfall. Therefore the county needs to be prepared for the potential risks.

There is a risk of flooding from water-bearing chalk aquifers across the county. Generally wetter winters would potentially increase levels of groundwater but it is difficult to predict in detail as much depends on the nature of the rainfall as, once the upper levels of the ground are saturated or the intensity of rain exceeds the rate of infiltration, water runs off and is not available for groundwater recharge.

Many drainage systems in the county have been modified to manage water levels and could help in adapting locally to some of the impacts from a future climate on flooding. However the changing intensity of weather patterns may mean that these assets will need to be managed differently. The implementation of sustainable development and the installation of sustainable drainage systems will help the county to adapt to climate change locally and should contribute to the mitigation and management of the risks that could arise from damaging floods in the future.

3. Who's Involved in Managing Flood Risk?

3.1 Risk Management Authorities

In addition to designating Lead Local Flood Authorities (LLFAs), the Flood and Water Management Act 2010 (FWMA) identifies certain organisations as 'Risk Management Authorities' (RMAs) which have specified responsibilities, duties and powers related to local flood risk management. Table 2 sets out the risk management authorities in Hertfordshire and Appendix 1 details their specific roles and responsibilities. The geographical coverage of the risk management authorities is shown in Map 7 (for clarity the local highways network has not been included). Table 3 details the risk management authorities bordering Hertfordshire.

Table 2: Risk Management Authorities in Hertfordshire

Category	Organisations in Hertfordshire
Environment Agency	• Hertfordshire and North London Area • East Anglia Area • Thames Area
Lead Local Flood Authority	• Hertfordshire County Council
District/borough councils	• Broxbourne Borough Council • Dacorum Borough Council • East Hertfordshire District Council • Hertsmere Borough Council • North Hertfordshire District Council • St Albans City & District Council • Stevenage Borough Council • Three Rivers District Council • Watford Borough Council • Welwyn Hatfield Borough Council
Internal Drainage Boards	• Bedfordshire and River Ivel Internal Drainage Board (IDB)
Water and Sewerage Companies	• Anglian Water Services Ltd • Thames Water Utilities Ltd
Highway Authorities	• Hertfordshire County Council • Highways England (motorways and some major roads)

Table 3: Risk Management Authorities bordering Hertfordshire

Type of LLFA	Risk Management Authorities
County Councils o **(with associated district and borough councils)**	• Buckinghamshire o (Aylesbury Vale, Chiltern, South Bucks) • Cambridgeshire o (South Cambridgeshire) • Essex o (Epping Forest, Harlow, Uttlesford)
Unitary Authorities	• Luton • Central Bedfordshire
London Boroughs	• Hillingdon • Harrow • Barnet • Enfield

3.2 Other Key Stakeholders

As well as the RMAs there are a number of other key stakeholders with interests in key infrastructure and service provision. Table 4 sets out those organisations that are seen to be key stakeholders in the LFRMS and a full description of their respective roles and responsibilities is set out in Appendix 2.

Table 4: Key Local Flood Risk Management Strategy Infrastructure Stakeholders in Hertfordshire

Organisation	Infrastructure
National Grid	Distribution network, sub stations, ground level transformers etc.
Transco	Gas pipelines and associated pumping stations
Network Rail	Various rail lines running through Hertfordshire which radiate from London and include the East, West and Midland mainlines.
Affinity Water (Central)	Pumping stations and treatment works throughout Hertfordshire supplying water. A large proportion of supplied water comes from groundwater sources. Anglian Water and Thames Water also supply water as well as the Cambridge Water Company
Canal and River Trust	Grand Union Canal, Stort Navigation Lee Navigation, Tring Reservoirs.
Lee Valley Regional Park Authority	Manages recreation and environmental assets associated with large water bodies in the Lee Valley.

3.2.1 Regional Flood and Coastal Committees (RFCC)

The two Regional Flood and Coastal Committees (RFCCs) covering Hertfordshire (Thames and Anglian Central) are the focus for regional programmes of flood risk management projects funded through national grant, levies raised through local authorities and other local contributions. Map 8 shows where the Thames and Anglian Central RFCCs operate in Hertfordshire.

The Environment Agency must establish and consult with them about flood and coastal risk management work in their region and take their comments into consideration. RFCCs bring together members appointed by Lead Local Flood Authorities (LLFA) and independent members with relevant experience.

3.2.2 Hertfordshire Resilience

Hertfordshire Resilience is the local resilience forum for Hertfordshire. It is a partnership of over 60 organisations including the emergency services, local councils, health services and volunteers.

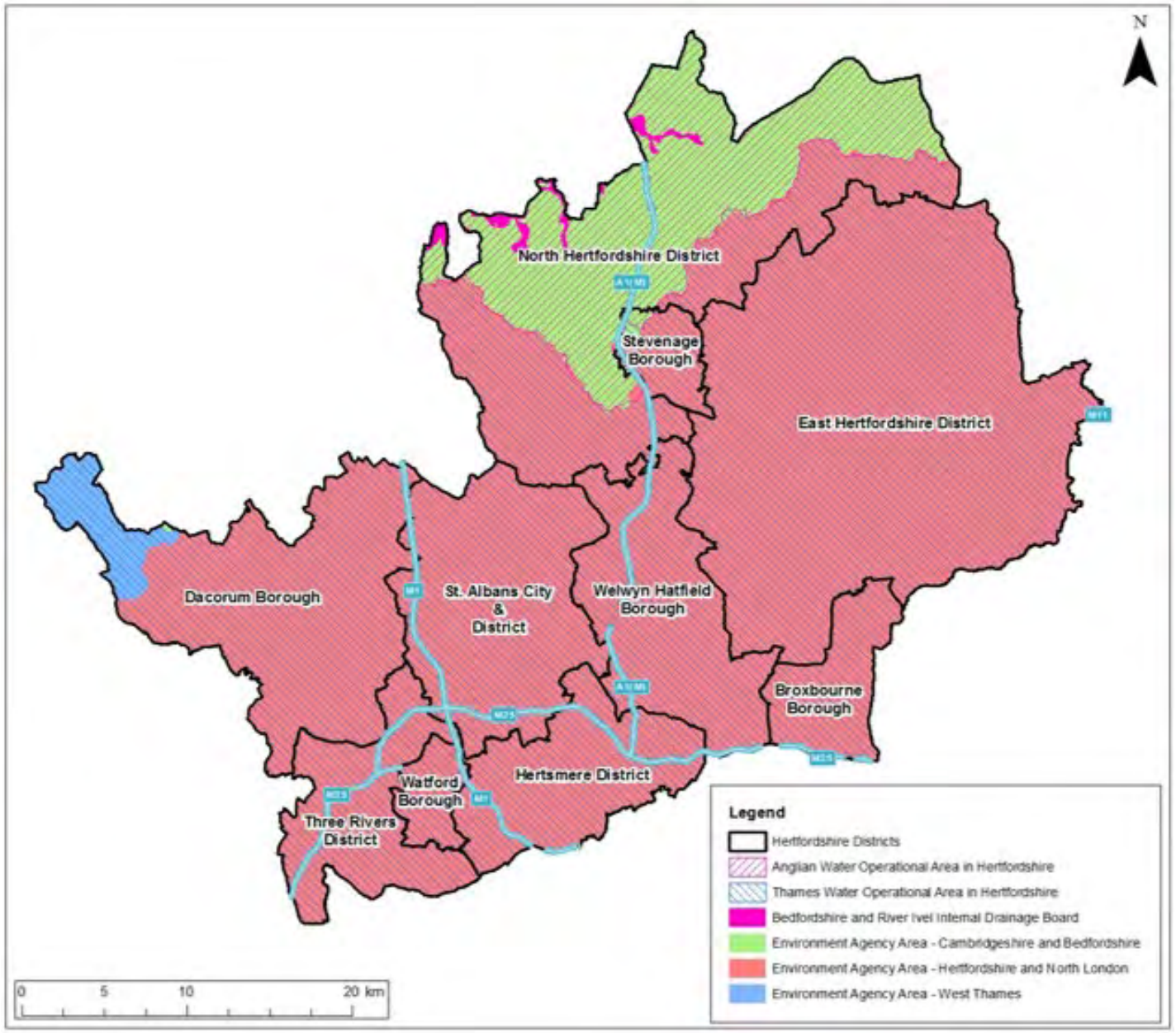
The members of the forum coordinate emergency response to incidents, which includes flooding. Planning is carried out at a number of levels which will be used to guide response depending on the scale and severity the situation.

The local authority members also support businesses and communities to develop resilience so they are better prepared to respond and recover from emergency situations.

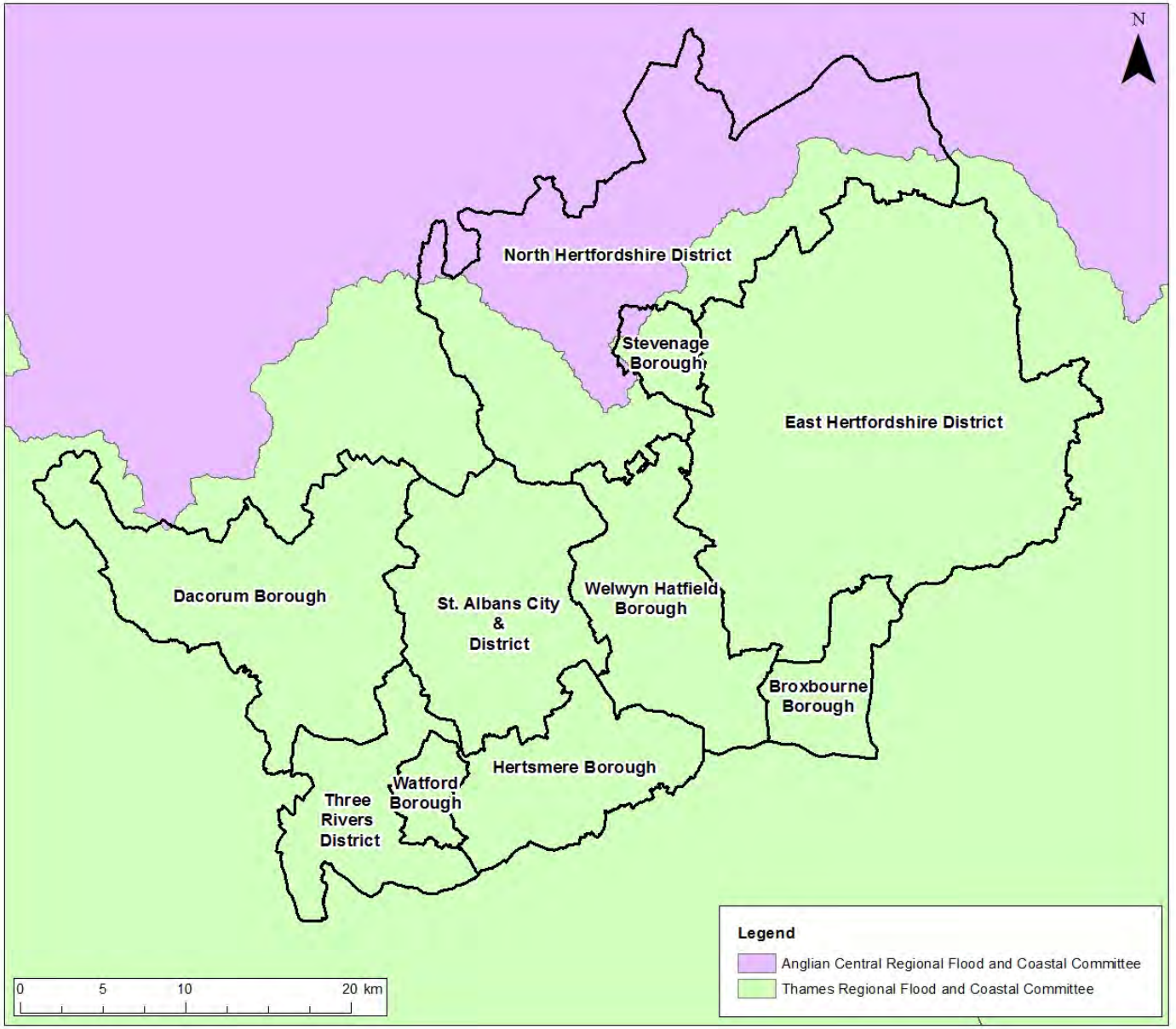
3.2.3 Hertfordshire Local Enterprise Partnership (LEP)

LEPs are partnerships between local authorities and businesses and play a central role in determining local economic priorities and undertaking activities to drive growth and the creation of local jobs. They have responsibility for bidding for central government funding and influencing local funding streams and ensuring that these deliver against the locally agreed priorities.

LEPs are non-statutory bodies. This means they can look and operate very differently from each other, in terms of size, capacity and governance. All LEPs must be chaired by a business person and at least half of the members must come from the private sector.



Map 7: Risk Management Authorities in Hertfordshire



Map 8: Regional Flood and Coastal Committees in Hertfordshire

4. Principles for Flood Risk Management in Hertfordshire

The key principles of the Hertfordshire Local Flood Risk Management Strategy and the aims underlying them are as follows:

1 Taking a risk-based approach to local flood risk management
2 Working in partnership to manage flood risk in the county
3 Improving our understanding of flood risk to better inform decision making
4 Supporting those at risk of flooding to manage that risk
5 Working to reduce the likelihood of flooding where possible
6 Ensuring that flood risk arising from new development is managed

4.1 Principle 1: Taking a risk-based approach to local flood risk management

Aim 1: *Flood risk will be actively managed and we will seek to predict and manage future risk as well as reacting to flood events.*

This is an overarching principle which is fundamental to anticipating and managing the potential for flooding.

4.2 Principle 2 Working in partnership to manage flood risk in the county

Aim 2a: *Opportunities will be sought to work with others to better deliver management of local flood risk in Hertfordshire.*

Aim 2b: *Flood risk measures should be multi-beneficial as far as possible, integrating flood risk management solutions alongside sustainable development and incorporating social and environmental benefits.*

4.2.1 The needs and benefits of partnership working

The range of organisations and functions identified in the Flood and Water Management Act 2010 illustrates that the management of local flood risk does not rest with any one organisation.

The F&WMA 2010 is intended to facilitate the recommendations from Sir Michael Pitt's review of the serious floods in 2007. The ideal being sought is joint action at a strategic and practical level. This is supported in the legislation with a requirement for coordination of activity through a strategy and cooperation between the relevant organisations.

Rainfall runoff can follow a number of pathways the management of which involve a different range of roles and responsibilities for both individuals and organisations. As a consequence flood risk is managed to a range of priorities and standards. As well as being confusing it means that there can be no set standard level of flood risk for any given property. This is outlined in more detail in Table 5.

A further complication is the legacy of drainage arrangements which have evolved over time and would not potentially be constructed in the same way today largely because responsibility for aspects of drainage infrastructure has also changed over this time.

Table 5: Roles and Responsibilities in Flood Risk

Category	Primary Role	Others Involved
Individual properties	Property owner	Thames Water Utilities Ltd Anglian Water Management companies
Public Sewers (Surface Water, Foul and Combined)	Thames Water Utilities Ltd Anglian Water	Districts / IDB Lead Local Flood Authority Environment Agency
Highways	Hertfordshire County Council Highways England	Thames Water Utilities Ltd Anglian Water Districts / IDB
Ordinary Watercourses	Property owner	Districts / IDB Lead Local Flood Authority
Main Rivers	Environment Agency	Property owner

The ability for organisations to take action to reduce flood risk depends on demonstrating that the costs will be proportionate to the benefits. However in many cases there is rarely a single source of funding available and so contributions will need to be combined from a number of sources.

Even where there may be a relatively high level of flood risk the options for management may not be viable due to an unfavourable cost benefit assessment. However in some circumstances it may still be possible to take action to reduce flood risk by delivering flood risk benefit in conjunction with new development or projects being delivered by other organisations.

The limitations of managing flood risk close to where it may impact and concerns about the potential impacts of climate change support a move towards managing flood risk at a catchment level. There are two broad strands to such an approach. In urban areas it is described as “retrofitting SuDS” where elements of sustainable drainage are widely distributed across a catchment associated with buildings and open space in the public realm. In rural areas “Natural Flood Management” (NFM) or “Working with Natural Processes” (WWNP). This will require an integrated approach from the relevant RMAs and working in wider partnership.

4.2.2 Review of LFRMS1 Partnership Working

Within the period covered by LFRMS1 partnership working on flood risk management in Hertfordshire has been undertaken with a practical focus and has made use of the various existing networks and arrangements for coordinating activity amongst the Risk Management Authorities that operate within the county.

The rationale for developing the Surface Water Management Plans (SWMP's) on a district basis was to make the work relevant to local partners and to ensure that any actions that arose would align with the roles and responsibilities of the councils as local planning authorities and as RMA's with their powers to manage flood risk arising from ordinary watercourses.

Experience in developing the SWMPs and the consultation and research carried out for this strategy has shown that all district authorities can identify links to flood risk management activity through their development planning and resilience functions. However although all the districts hold powers to manage flood risk from ordinary watercourses their capability and capacity to carry out such work or manage local flood risk is more variable.

Opportunities for joint working on projects have been explored and used where it would be beneficial. In the current Thames RFCC capital programme the potential to work on managing flood risk jointly with the Environment Agency is being assessed in Watford, Stevenage, London Colney and Rickmansworth. The approach was extended in Watford to include opportunities for collaborative working with Thames Water.

Multi-benefit projects

The potential for joint working extends further than working with other Risk Management Authorities with a focus on reducing flood risk. This can increase the viability of schemes through the pooling of resources or finance. Case study 1 below is a good example of where flood risk management is being facilitated by a highway authority led traffic management scheme. There will certainly be other situations in the future where creation of infrastructure or a particular use of land creates the opportunity for management of flood risk. The challenge will be to create awareness so that such opportunities can be identified and realised.

In a similar way a flood risk led scheme may offer opportunities to realise additional benefits. An area that is kept open to temporarily store water in times of flooding would be available for other uses at other times. This could be for access and recreation and/or the creation of areas for wildlife.

Management of surface water to reduce flood risk gives the opportunity to manipulate the water balance on a site it may be possible to improve drainage so a site is generally drier which would benefit an amenity areas such as sports pitches. A scheme to divert or retain water might allow an area to be kept wetter seasonally or throughout the year which could be of benefit to wetland habitats. In terms of wider sustainability managing flood risk using SuDS will almost certainly help improve water quality and initiatives to protect watercourses from runoff and manage soil erosion are likely to benefit management of flood risk in most cases.

Case Study 1: A120 Little Hadham By-pass and Flood Risk Management Scheme

The new road crosses a river upstream of the village and will be constructed on an embankment to carry it over the valley floor. It presented the opportunity to enhance the construction of the embankment so that it could control flood flows on the river Ash and reduce the risk of flooding.

The A120 passes through the village and a traffic light controlled junction in the centre leads to long delays for traffic at peak flows. In 2007 HCC as the highway authority consulted on a number of options to improve the situation with the Environment Agency assisting by explaining the flood management benefits of each option. A preferred option was agreed and finalised in 2008. The project was then put on hold until sufficient funding could be secured.

The Environment Agency had previously assessed the options to address the flood risk to approximately 70 properties by creating a dam and control structure on the river Ash to hold water upstream of the village under flood conditions. However the substantial construction costs were not proportionate to the benefit that would have provided through the reduction in flood risk and there would still have been a substantial shortfall in funding as the eligible grant would not have covered scheme costs.

Funding became available in 2014 and a scheme incorporating the flood management features was designed and submitted for planning permission in 2016 which was confirmed in January 2017. Funding for additional construction required the flood management elements was secured through the Thames RFCC with a combination of national grant and regional levy. In addition to funding a structure to control flows the RFCC contribution is being used to enhance the embankment to allow it to function as a dam.

The current round of projects funded by the RFCC run until 2020/21 and the current water company's business cycle (AMP6) ends in 2020. Development of the RFCCs next six-year programmes and the yearly programme refresh process together with the Water and Sewage companies preparation for their next five year business planning cycle (AMP7) has helped to give an overview of strategic partnership working to manage flood risk across the county.

Case Study 2: Pix Brook Study showing cross boundary working

A project to assess options for managing flood risk associated with the Pix Brook in the north of the county is an example of cross boundary working with an adjacent LLFA. Anglian Water, the Environment Agency, the Bedfordshire and River Ivel Internal Drainage Board and Hertfordshire County Council are partners in the project which is led by Central Bedfordshire Council. Their aim is to reduce flood risk from the brook to properties in Stotfold and the specific issue in Hertfordshire is the impact of the brook on surface water drainage in Letchworth Garden City. Tackling flood risk as close to the source as possible will bring benefits to both areas.

4.2.3 Proposals for the period covered by LFRMS2

Appropriate partnership arrangements will be developed to support individual project delivery.

Within the authority all those with an interest in managing drainage and flooding are brought together through the Highways Drainage Community. Information is being shared and collated to allow a better understanding of areas where there are issues, how they relate to any planned action and opportunities.

Work with district councils predominately relates to planning and development management and the LLFA is conscious of the need to help develop capacity in these authorities to support their role in helping to manage future flood risk. Links with the planning functions of individual district and borough councils are developing as part of the county council's role advising on the surface water drainage and local flood risk aspects of major planning applications. When a collective view or briefing is required items are taken to the relevant sub group of the Hertfordshire Planning Group which brings together officers representing the planning functions for the Local Planning Authorities.

Authorities and organisations with an emergency planning and resilience role coordinate their activity through Hertfordshire Resilience which is the county's Local Resilience Forum. In addition to work to support resilience in businesses and the community multi-agency planning is carried out to guide response to emergencies which would include major flooding incidents.

Partnerships at a community level would help individuals and communities to become more involved in managing their own flood risk. This could be with established organisations such as town and parish councils or through community based groups that form in response to a flood or as a result of concerns about flood risk. This could help support the work of the LLFA through surveys and monitoring of watercourses and other assets or could be focussed on putting a flood risk management scheme in place.

Action 1: Work with community groups

The potential to work with and support community groups is explored and a number of potential approaches developed as pilots where groups wish to participate.

In the period covered by this strategy work on practical flood risk management projects is likely to increase. The context for development and prioritisation of a programme of flood risk management schemes is set out in section 4.5.6 of this strategy. The individual projects will be supported by partnership working at a local level as is currently the case.

Also significant development is going to be implemented and planned in and around Hertfordshire. Linked to this and the countywide flood risk management programme there will be strategic themes which will benefit from support through a strategic level partnership.

This could be facilitated through an existing group the Hertfordshire Infrastructure and Planning Partnership (HIPP) which brings together local authorities and other organisations and agencies to consider issues that are significant across Hertfordshire.

Action 2: Set up a countywide strategic flood risk partnership

That a countywide strategic flood risk partnership is set up as a sub-group of the Hertfordshire Infrastructure and Planning Partnership (HIPP), this would automatically include all the local authority risk management authorities (RMAs). The Environment Agency, Thames Water, Anglian Water and other RMAs would be invited to attend. There would also be the additional benefit of links to other significant stakeholders in the county such as the Local Enterprise Partnership.

4.3 Principle 3: Improving our understanding of flood risk to better inform decision making

Aim 3a: *Information on sources of flood risk in Hertfordshire will continue to be developed and improved.*

Aim 3b: *Flooding information will be risk based, with areas predicted to be at most significant risk analysed in more detail as part of a prioritised programme.*

Aim 3c: *All reports of flooding will be appropriately investigated so that the historic record of flooding helps to provide a clearer understanding of flood risk in the county.*

Aim 3d: *Information on flood risk will form the evidence base to help focus local resources and funding.*

In order to properly manage flood risk the impacts of both past and future flooding need to be understood. Good understanding and analysis of flood events is vital to develop a sound business case where resources are being sought to reduce the probability and impact of similar events in the future. However this is a reactive approach and in order to actively manage risk, the potential for future flooding needs to be evaluated.

It is easy to be confident about the potential for flooding following a flood event, less so where flooding is predicted but there is no history of flooding. However the lack of history does not mean an absence of flood risk and this may be the case for a number of reasons. Factors influencing the understanding of historical flood risk will include; the local impact of events not being recorded, property only being built relatively recently, records being lost, localised changes in surroundings and the influence of predicted climate change.

Analysis of future flood risk is an iterative process which helps to guide where resources will be used most productively. The detailed modelling required to support the development of a business case cannot be justified for every area of the county so areas for further investigation need to be prioritised based on the best available information at each stage of assessment. As the knowledge base of flood risk in Hertfordshire develops our understanding of the potential for flooding can also be refined.

4.3.1 Risk of Flooding from Surface Water (RoFfSW) mapping

The RoFfSW mapping is a starting point for understanding of local flood risk. It can be used to identify areas where flood risk is potentially greatest either because of the predicted frequency of flooding or the scale of any potential impact. The next stage is then to review these areas in more detail. Where they are available, historical records, incidents logs and other information from local stakeholders can be used to help refine understanding. If it is determined that it would be valuable to investigate the flood risk further, for example, to provide evidence for funding more detailed modelling and surveys, then this may be carried out either as part of a SWMP or scheme development.

The modelling data from more detailed studies can be used to refine the RoFfSW mapping which will help reduce inaccuracies due to anomalies and give more confidence in applying the map. All flood risk modelling commissioned by the LLFA is specified so the outputs can be incorporated in the national surface water modelling. So that this information is widely available it can be submitted to the Environment Agency who will amend the national surface water flood risk mapping which is published online.

Comparison of the flood incident record and the RoFfSW mapping shows good correlation between observed and predicted flood risk. The majority of the reported flooding incidents are in areas of predicted flood flow or ponding for a modelled

rainfall event of a similar probability. However it cannot be an absolute comparison as there are areas of Hertfordshire which have not experienced extreme rainfall conditions in the relatively short period of time that the LLFA has been recording flood events. Similarly it has been found that flooding has not been as severe as predicted in areas that have experienced extreme rainfall. This may be due to an artefact of the modelling or the influence of local drainage conditions. The implications are that the figures in Table 3 are likely to be an overestimate of the number of properties at high risk of flooding. However the figures are an indication of the number of properties where the flood risk needs to be better understood to identify properties where flood risk reduction measures are justified.

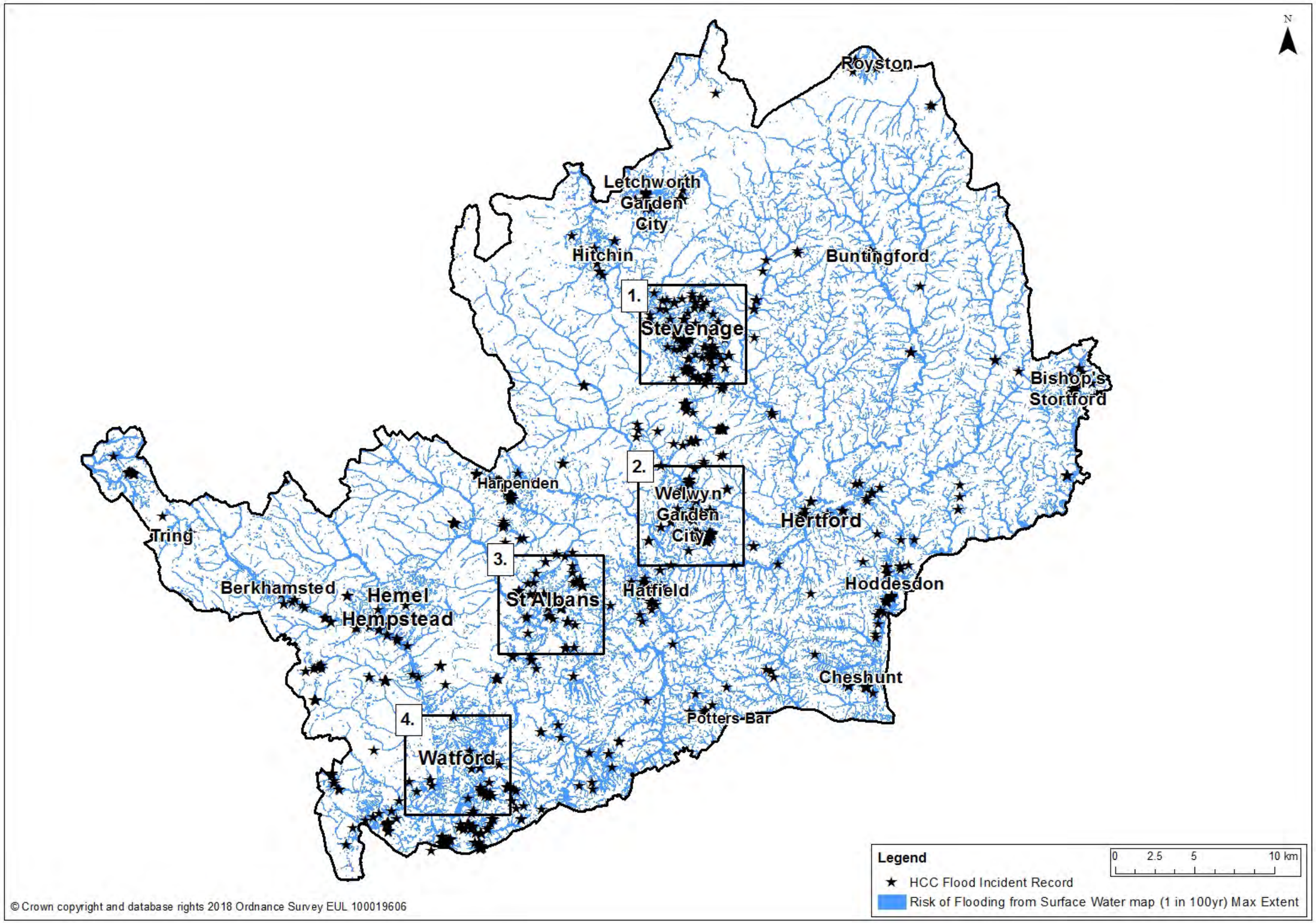
Policy 1: Using the RoFfSW

The RoFfSW map will be used as the starting point for assessing the potential for surface water flood risk.

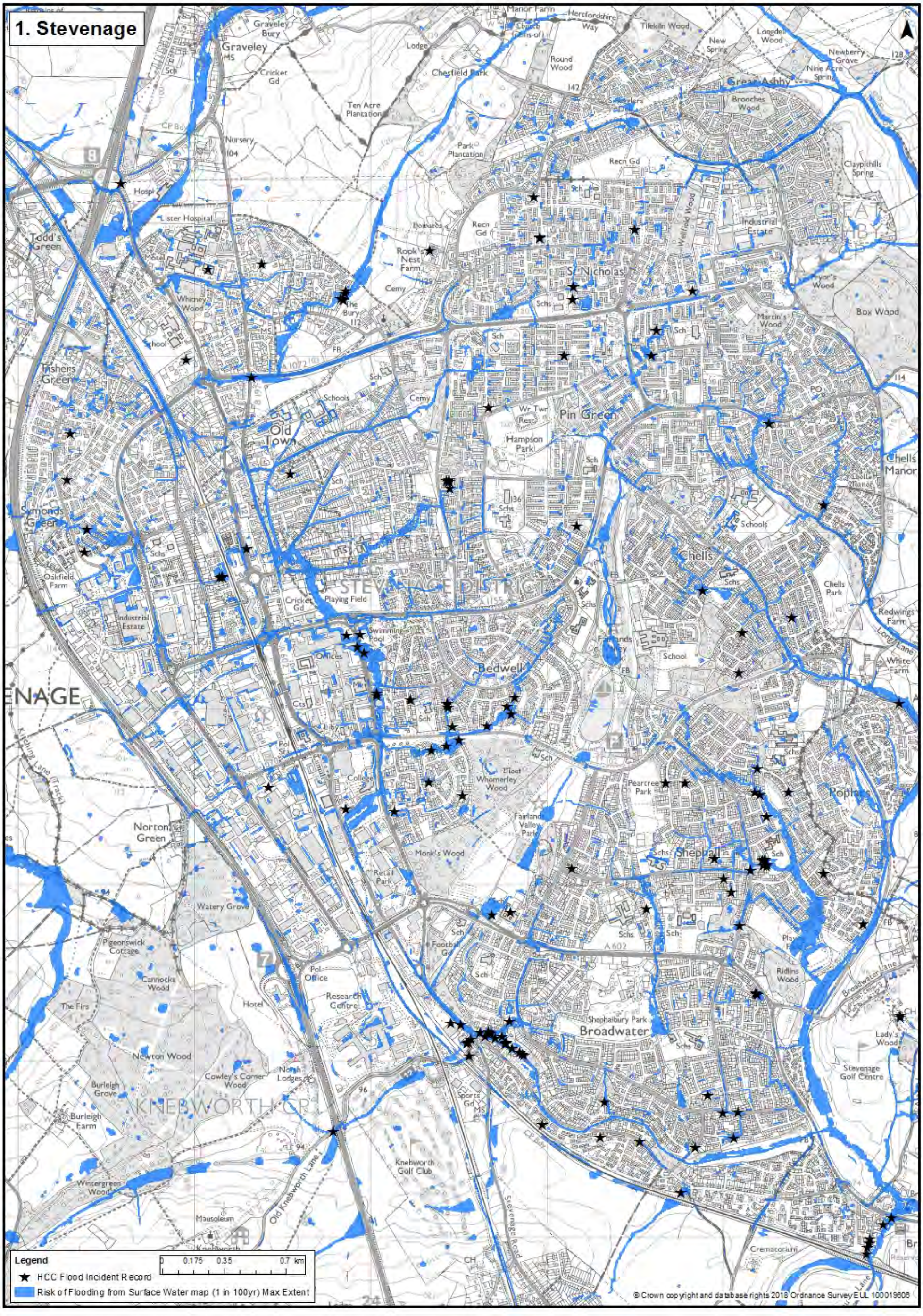
Policy 2: Update the national RoFfSW mapping

To make the best available surface water flood risk data held by the county council publicly available. Locally derived surface water flood risk modelling will be submitted to the Environment Agency to be incorporated as part of the annual updating process of the RoFfSW map.

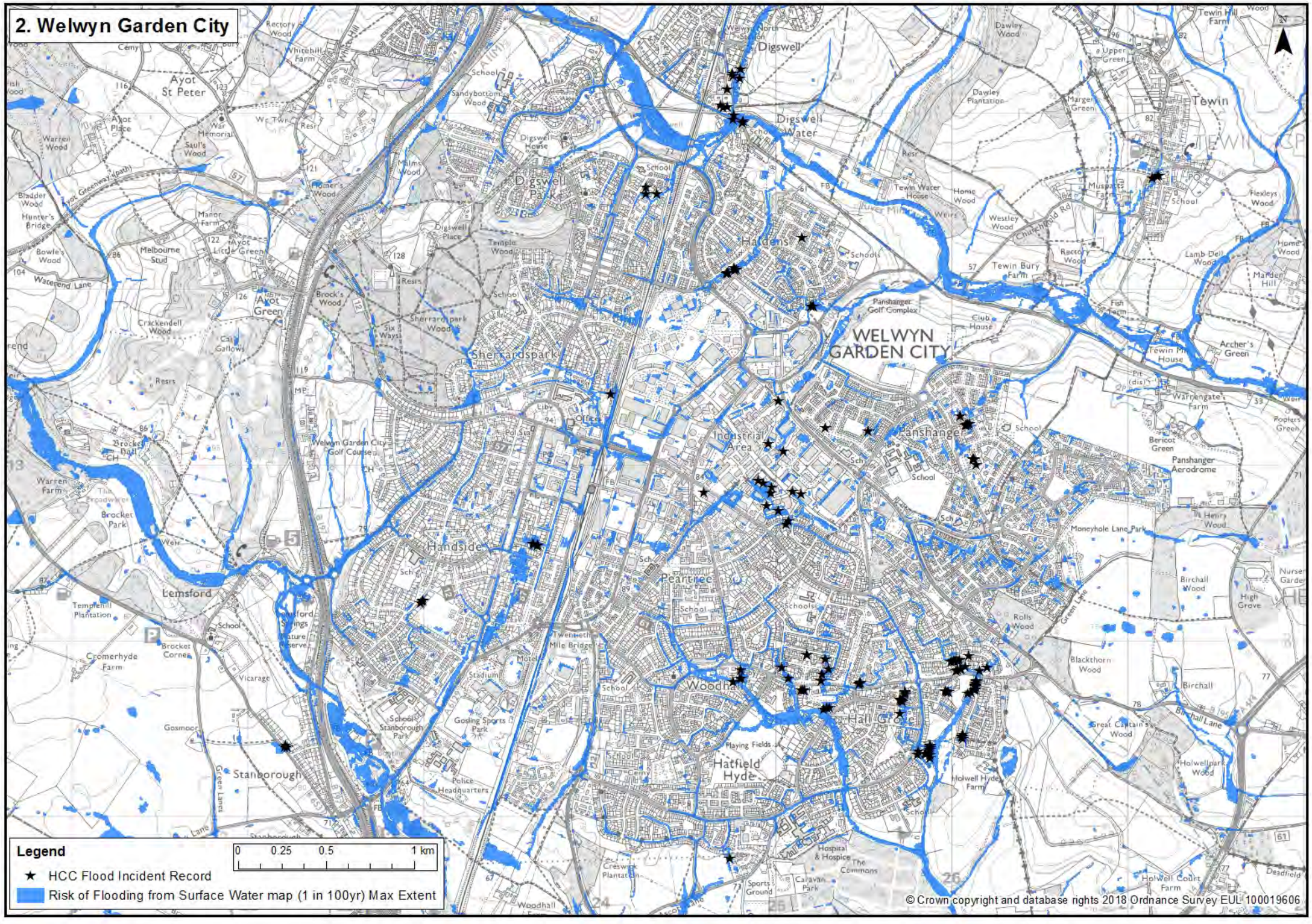
Map 9 and Map 9a to Map 9d show how records of flooding support the validation of predicted flood risk in the RoFfSW map. Map 10 and Map 10a to Map 10d show examples of the RoFfSW map being used to identify areas for further study (Surface Water Management Plan Hotspots).



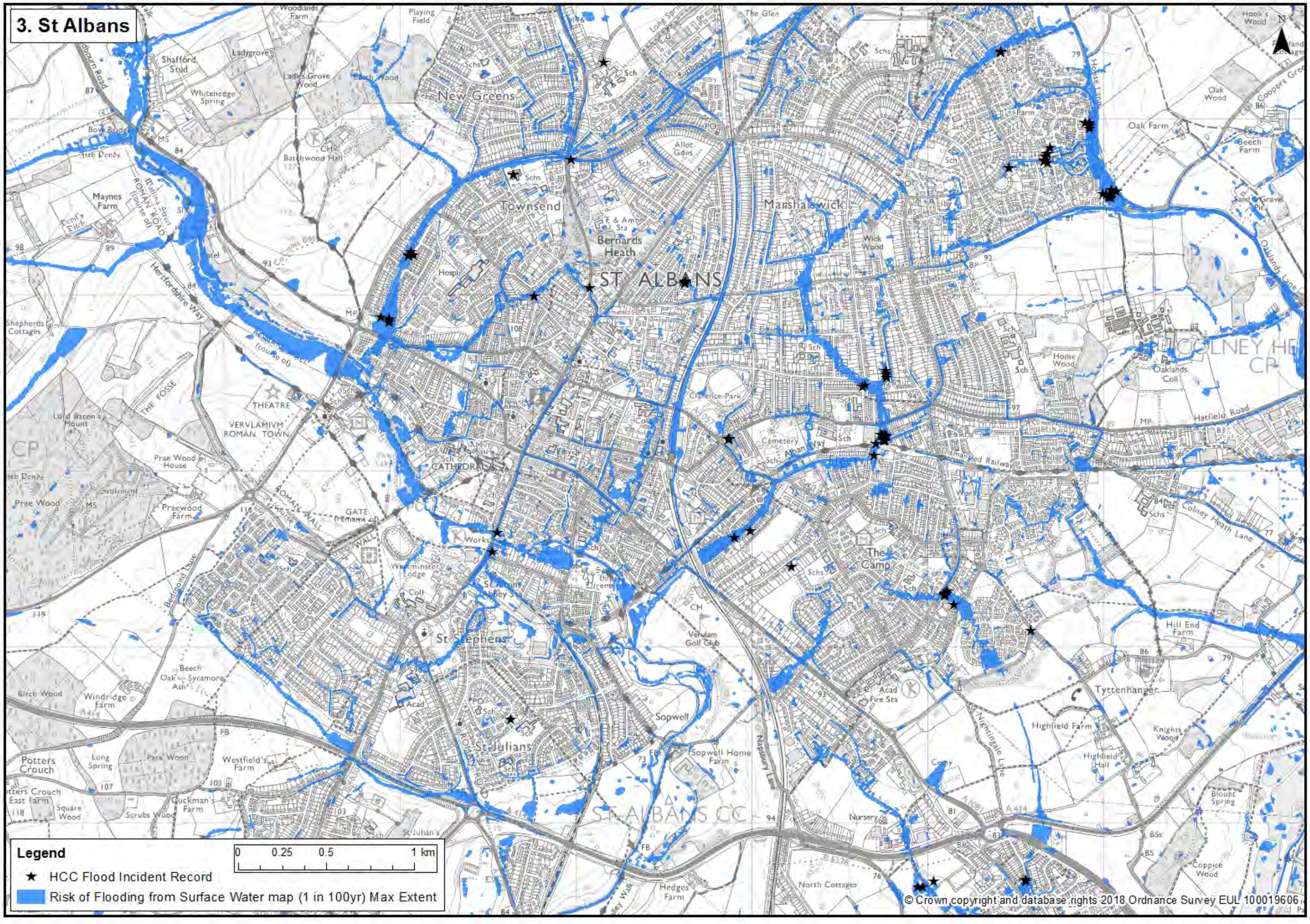
Map 9: Overview Map – Flood Incident Record and the Risk of Flooding from Surface Water map (1% AEP event) for Hertfordshire



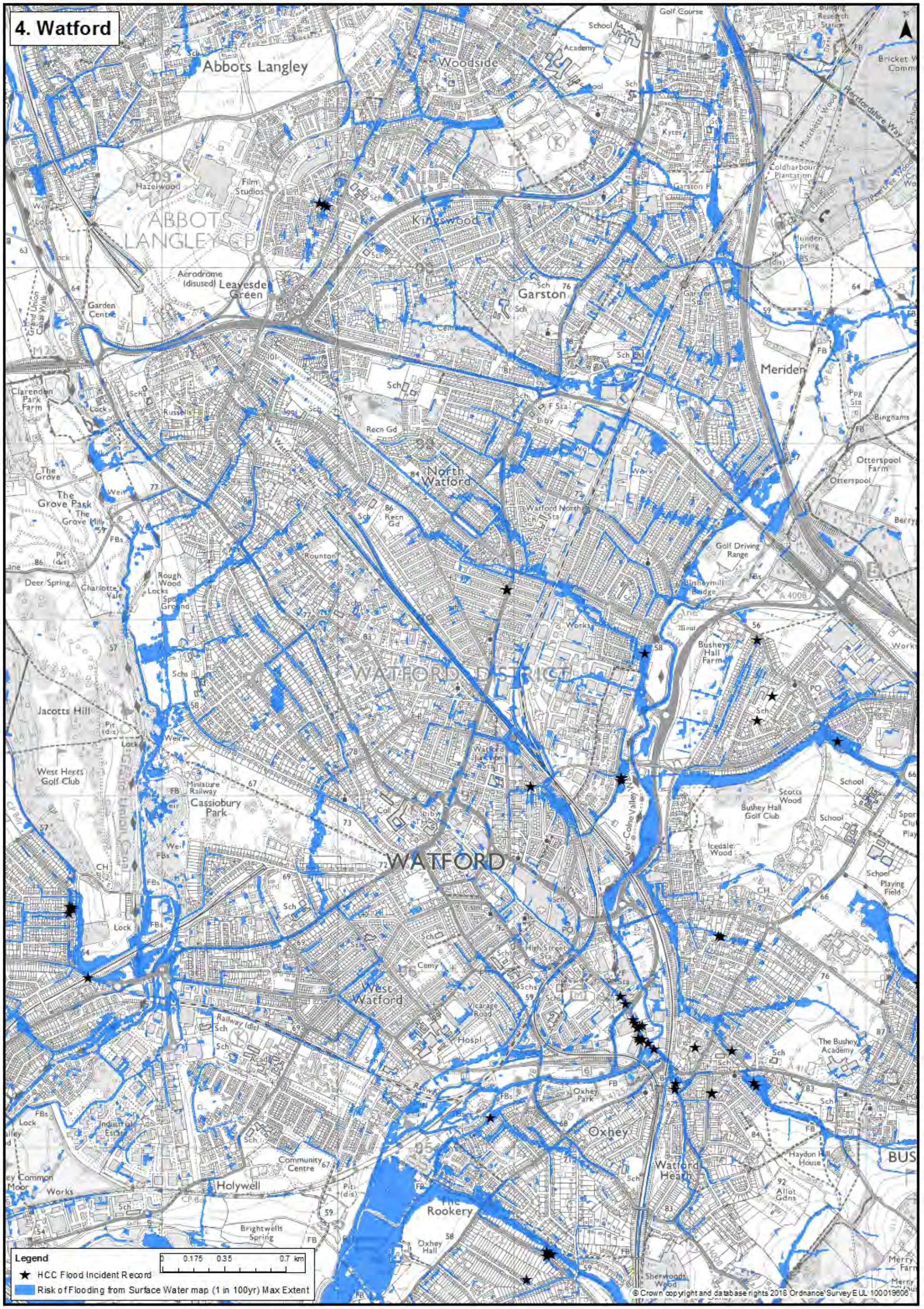
Map 9a: Map 1 of 4 – Flood Incident Record and the Risk of Flooding from Surface Water map (1% AEP event) for Stevenage



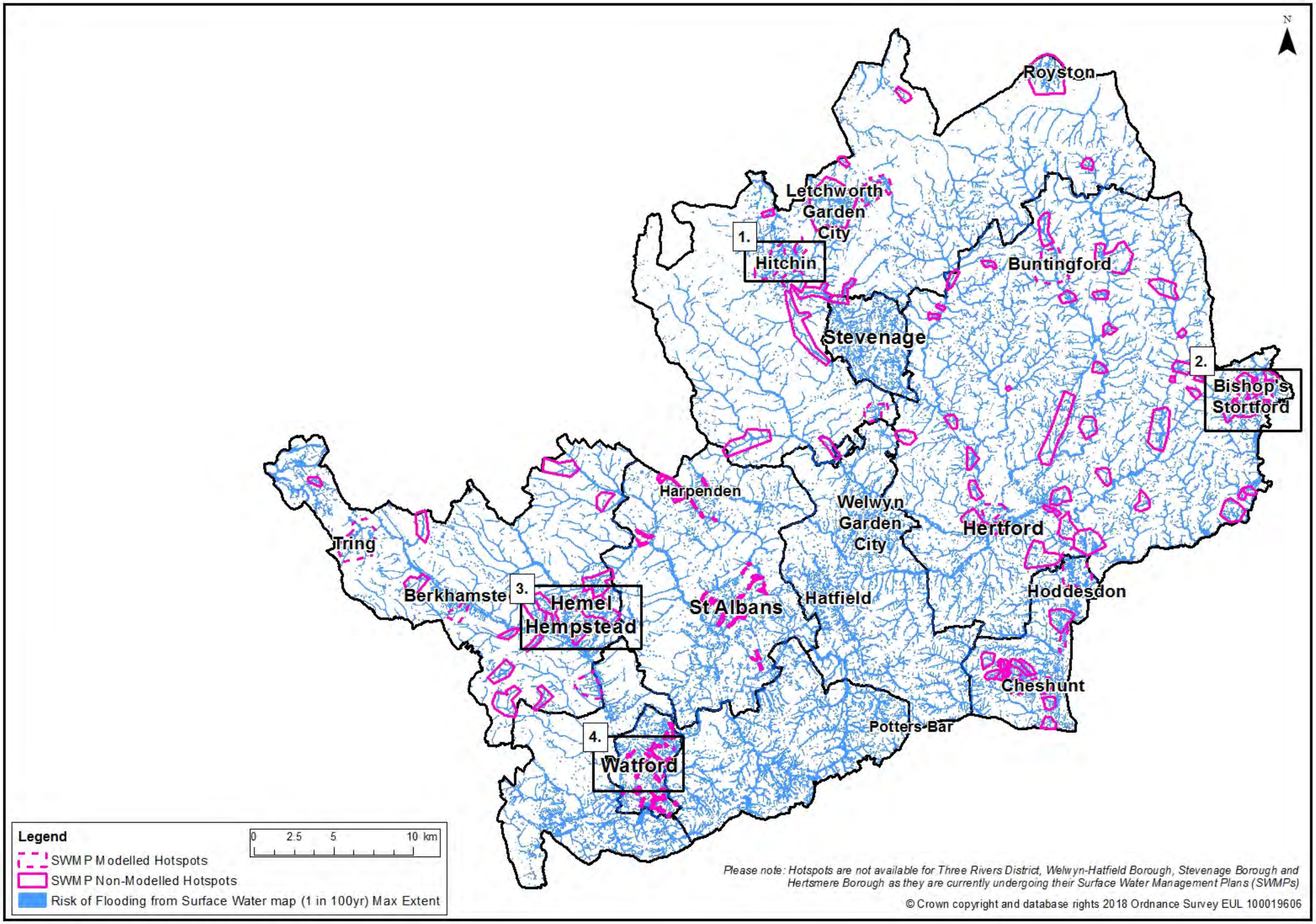
Map 9b: Map 2 of 4 – Flood Incident Record and the Risk of Flooding from Surface Water map (1% AEP event) for Welwyn Garden City



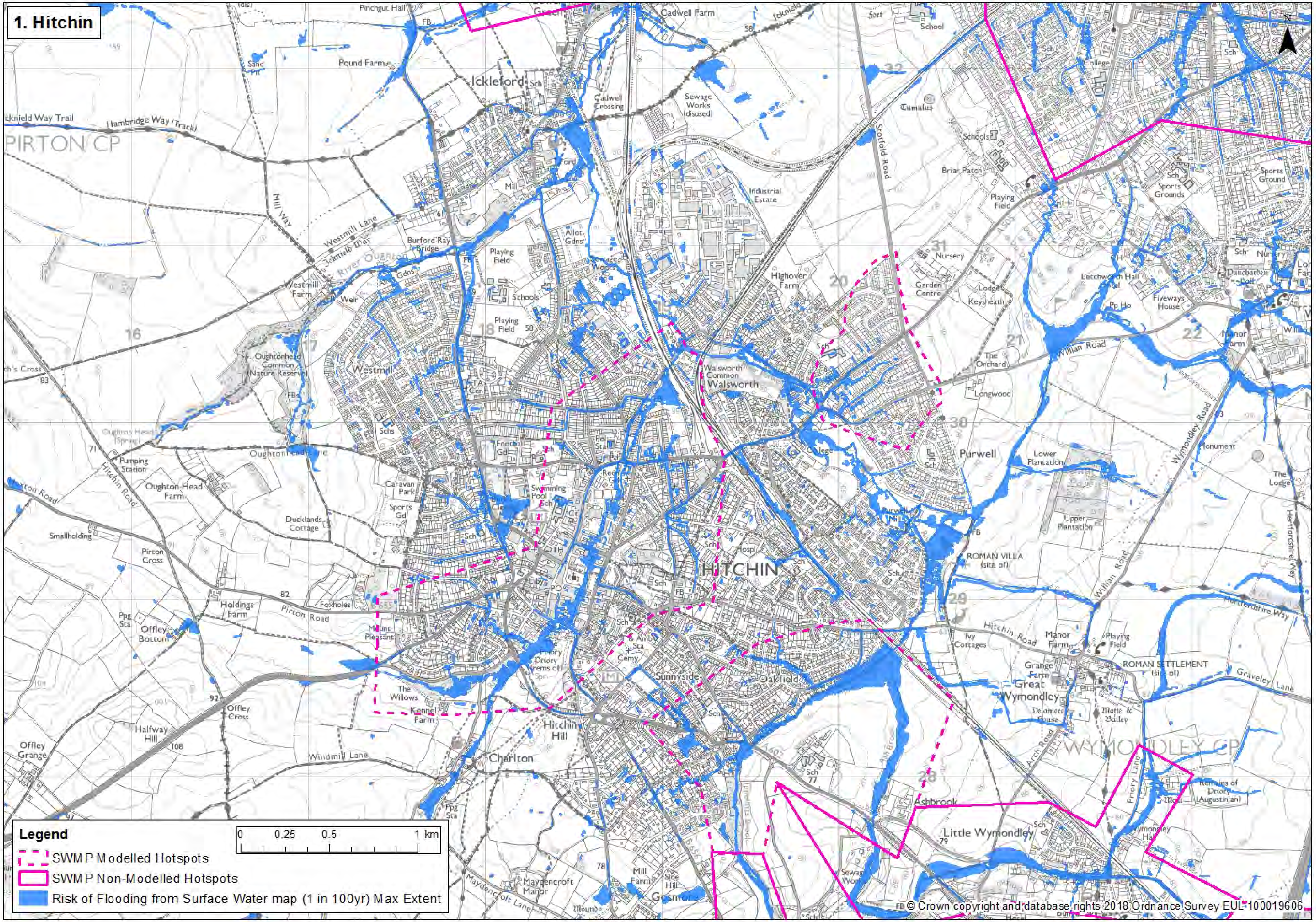
Map 9c: Map 3 of 4 – Flood Incident Record and the Risk of Flooding from Surface Water map (1% AEP event) for St Albans



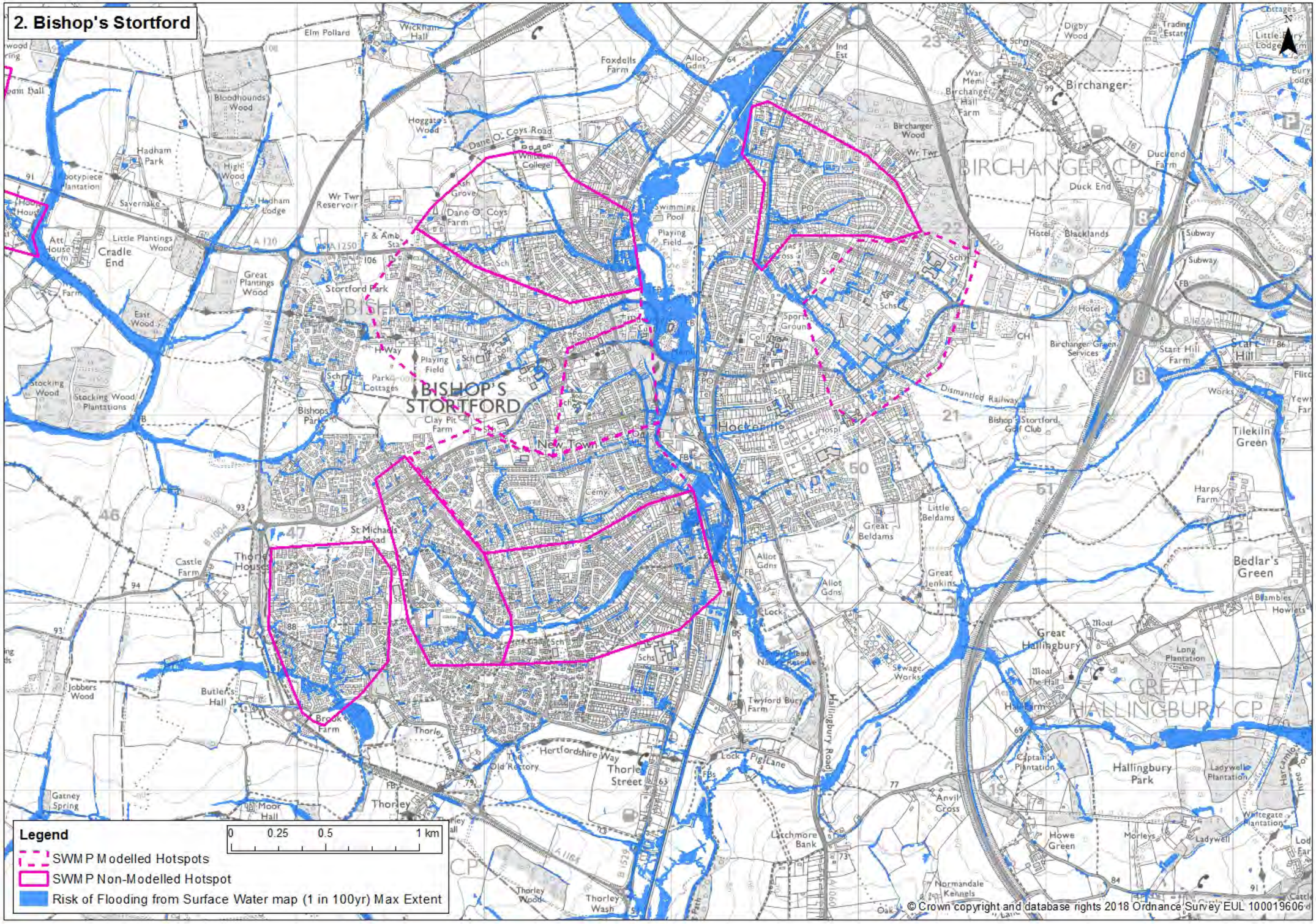
Map 9d: Map 4 of 4 – Flood Incident Record and the Risk of Flooding from Surface Water map (1% AEP event) for Watford



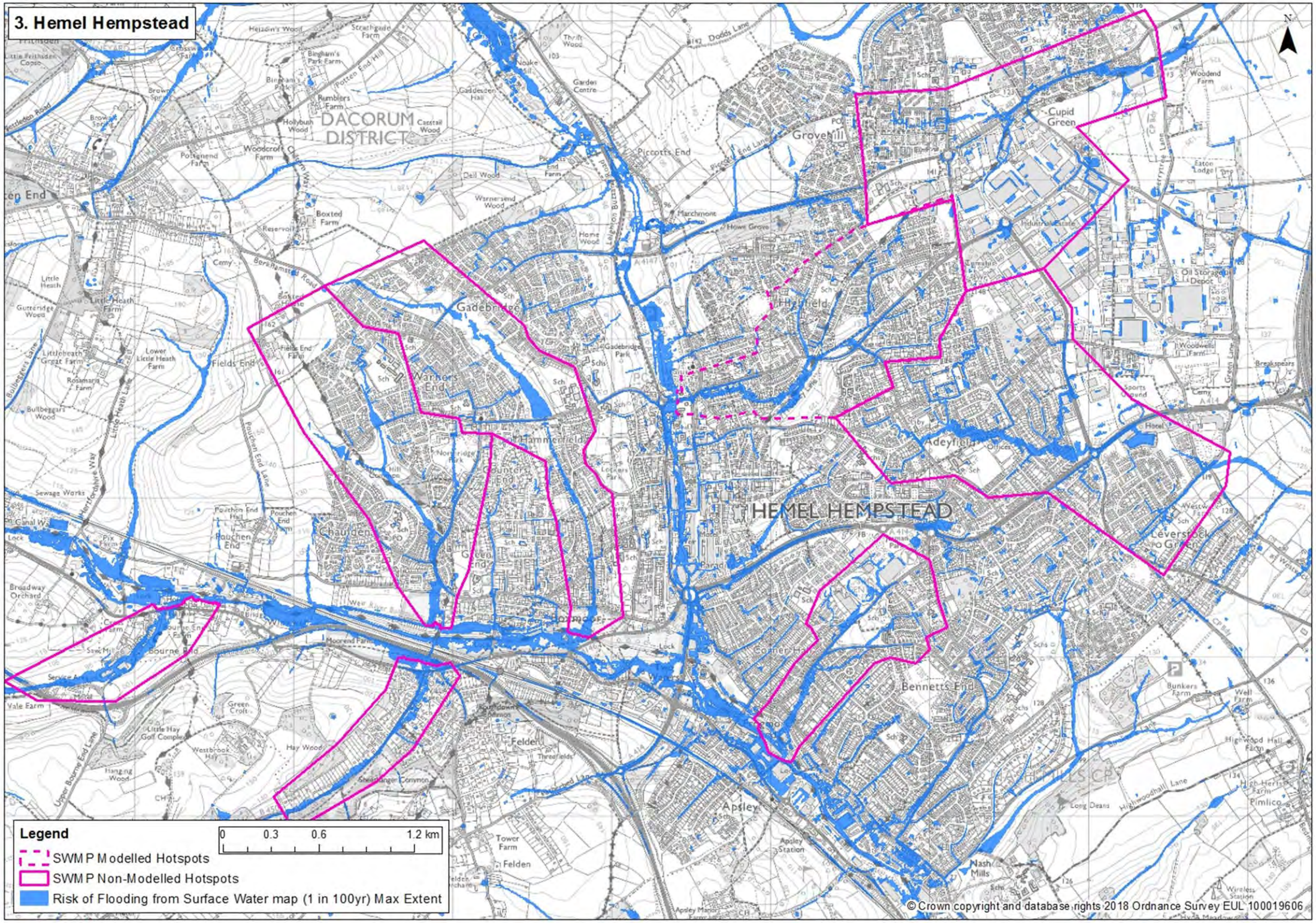
Map 10: Overview Map – SWMP Hotspots and the Risk of Flooding from Surface Water map (1% AEP event) for Hertfordshire



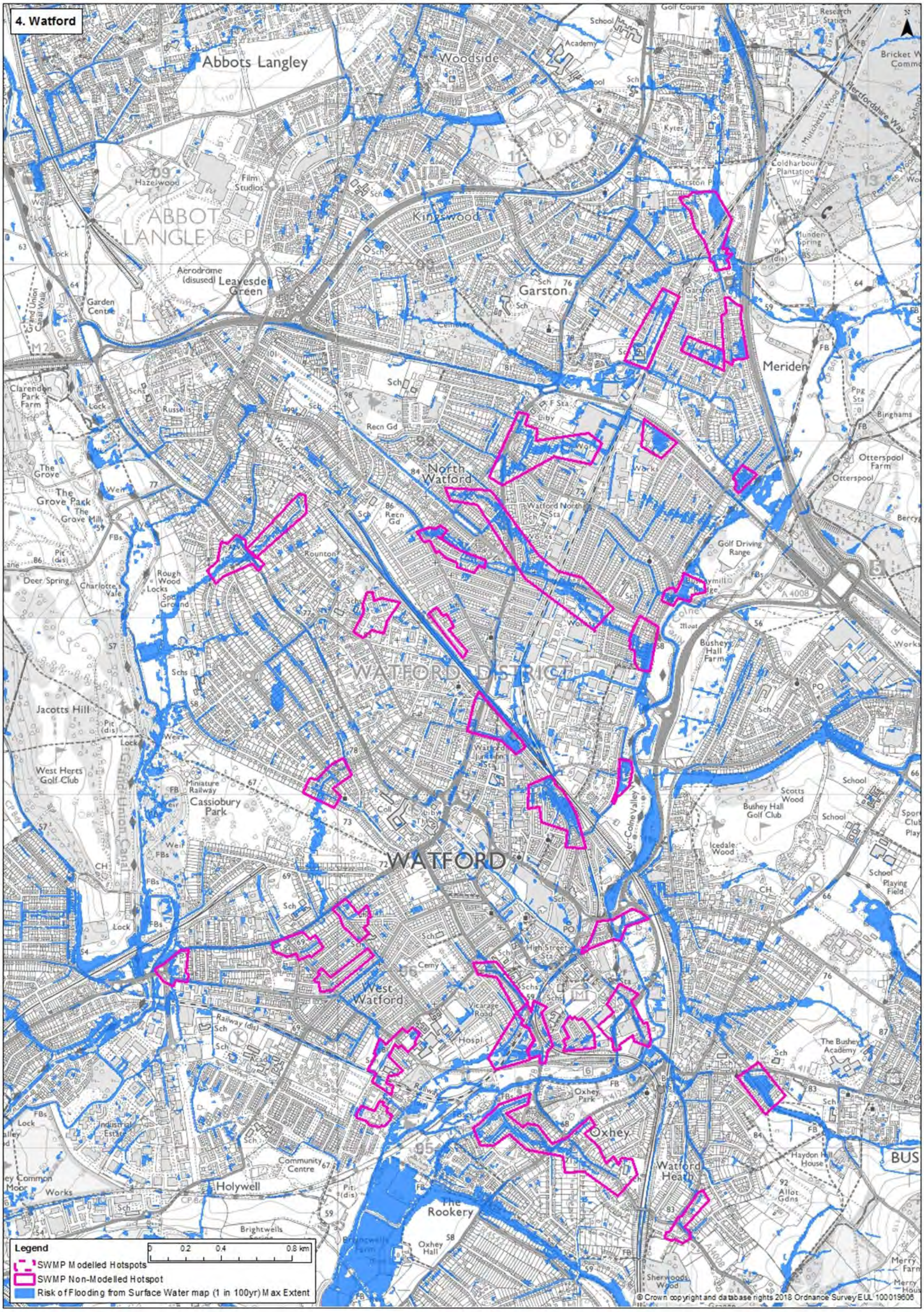
Map 10a: Map 1 of 4 – SWMP Hotspots and the Risk of Flooding from Surface Water map (1% AEP event) for Hitchin



Map 10b: Map 2 of 4 – SWMP Hotspots and the Risk of Flooding from Surface Water map (1% AEP event) for Bishop's Stortford



Map 10c: Map 3 of 4 – SWMP Hotspots and the Risk of Flooding from Surface Water map (1% AEP event) for Hemel Hempstead



Map 10d: Map 4 of 4 - SWMP Hotspots and the Risk of Flooding from Surface Water map (1% AEP event) for Watford

4.3.2 Groundwater

Where there is groundwater emergence it may be the sole cause of flooding or in some cases it may contribute to the severity of flooding from other sources.

Management of flood risk from groundwater presents different challenges to those of flood risk from surface water or watercourses.

The potential for groundwater flooding is dependent on rainfall over an extended period of time and its interaction with geology and features below ground as well as the general landform, buildings and other infrastructure. This means it is not practicable to model and define groundwater flood risk in the same way as that from watercourses and surface water.

Understanding of groundwater flood risk will continue to be refined with reports and information collated from flood investigations and planning applications.

All reports of flooding received by the LLFA are assessed to determine the likely cause of flooding. All reports are recorded even when there is no property flooding or s19 investigation, as particularly in the case of groundwater flooding a report of long term flooding in a garden gives a valuable insight into groundwater emergence.

Photograph 9: Groundwater emergence in a residential garden

The potential to actively manage groundwater flood risk is limited by the lack of available data and that in many cases it would not be possible to prevent groundwater emergence. It is impracticable to accurately map groundwater flood risk across the county so that it could be applied confidently at a property level because of the variability in localised ground conditions across Hertfordshire.

Flood barriers may not be effective in preventing water from entering properties, as depending on the type of construction, groundwater may rise from underneath the property as well as outside. Where the water table is rising beneath properties considerable pressures can be exerted which has structural implications for basements; can cause solid floors to lift and disrupt underground drainage such as septic tanks.

Photograph 10: Extensive groundwater flooding

Because of the volumes of water involved, pumping at an area level to lower groundwater levels is not feasible. At a property level measures to manage groundwater will be property specific and need the input of a structural engineer. Where water tables are seasonally high, measures such as tanking of basements and draining under floor voids using pumps may already have been put in place by property owners.

Management of groundwater flood risk by the LLFA will for the time being be limited to raising awareness of the potential for groundwater flooding during extended periods of rainfall and minimising the creation of new flood risk linked to development.

The potential impact of groundwater flood risk on new development will be considered as part of the LLFA statutory consultee role on planning applications for major development.

Where historical abstraction of groundwater is reduced or discontinued which may be linked to restoring flows in chalk rivers or where an aquifer becomes contaminated flood risk could increase.

Action 3: Ensure the LLFA is consulted on any proposals to reduce groundwater abstraction

The LLFA will ask to be consulted by the Environment Agency and water supply companies on any proposals to reduce groundwater abstraction as this could have an impact on flood risk linked to groundwater for areas in the vicinity.

4.4 Principle 4: Supporting those at risk of flooding to manage that risk

Aim 4a: *Communities should understand the information available to them on flood risk.*

Aim 4b: *The support available to communities should aid flood preparedness and resilience.*

Aim 4c: *Information on local flood risk will be made available to assist in preparing for flood events.*

Aim 4d: *The cause of flood events will be effectively investigated and published.*

Aim 4e: *The roles and responsibilities of the various organisations involved in managing flood risk before, during and after in a flood event will be clear.*

4.4.1 Impacts on people

Floods do not only pose a risk to property and infrastructure, but also to health. There are a range of potential health impacts from floods. These can be divided into immediate risks, delayed or secondary risks, and long term risks (Du, Fitzgerald, Clark, & Hou, 2010).

4.4.2 Immediate risks to health.

About two-thirds of deaths from flooding occur as a result of drowning (World Health Organisation, 2017). Other immediate risks to health from flooding include injuries; electrical risks; burns or explosions; driving related injuries from driving too fast through flood water; and hypothermia (Du, Fitzgerald, Clark, & Hou, 2010). Examples of potential injuries are those caused by contact with debris and other objects in floodwater, or falling into hidden manholes.

4.4.3 Secondary risks to health

Secondary effects of flooding include contamination of water supplies leading to diarrhoeal, vector and rodent borne diseases; respiratory diseases; chemical contamination; or carbon monoxide poisoning. Carbon monoxide poisoning may be caused by use of unventilated gas-powered electrical generators or other equipment used due to power-cuts from flooding.

Health services may be disrupted due to flooding, and this may lead to individuals being unable to access essential health care or medication. This is particularly pertinent if medication has been lost in the flooding and needs to be replaced (Du, Fitzgerald, Clark, & Hou, 2010) (World Health Organisation, 2017).

4.4.4 Longer-term risks

More severe injuries sustained as a result of flooding can lead to long term disabilities. The loss of property as a result of flooding can be highly stressful, and cause financial strain, in particular to those who do not have adequate insurance. Flooding may result in either temporary or permanent relocation which can be stressful and traumatic, and lead to a loss of a supportive social network. Flooding of commercial property, in particular of small single-handed businesses can lead to a loss of livelihood. All of these factors can precipitate mental health problems. It is important to remember that mental health problems can be long lasting, and having experienced a severe flood to the home environment can lead to recurrent anxiety when there is a perceived risk of further flooding, for example during heavy rainfall (Du, Fitzgerald, Clark, & Hou, 2010) (World Health Organisation, 2017).

4.4.5 Groups vulnerable to the health risks posed by flooding

Clearly, a flood has the potential to impact anyone who is in proximity to the flood, or who has property, family, or a livelihood affected by a flood. However, there are some groups of people who are more vulnerable to the health risks of flooding. These are (World Health Organisation, 2017) (UK Government, 2014):

- Children may be unaware of some of the risks posed and therefore at higher risk of electrocution, drowning, and drinking contaminated water. Young children and infants in particular are at increased risk as they are unable to protect themselves from drowning, and are more vulnerable to infections.
- Pregnant women are more susceptible to contracting infections than other adults, and infectious diseases often pose a risk to the unborn child.
- Elderly people may be physically less mobile and therefore less able to remove themselves from danger. They are often at a greater risk of falls than other adults, and these risks will be exacerbated by water. As with young children and pregnant women, they are at a greater risk of infections, and of developing more severe infections.
- People with disabilities may be unable to remove themselves from unsafe flooded areas. Those with hearing or visual impairments may not be aware of hazards, and therefore may inadvertently put themselves in danger.
- Unwell people may be less mobile and able to remove themselves from danger. They may be more susceptible to contracting infections. Loss of medication in flooding, or damage to healthcare facilities may mean that they are unable to receive the treatment that they require.
- Those living in poverty are at a greater risk as they are more likely to live in substandard housing which is at greater risk of flooding. They also have less financial buffering in the event of a flood, so loss of property is of greater significance and may not be replaced if they have inadequate insurance. This poses an important risk to mental health.
- Refugees and some groups of immigrants may be at greater risk due to the risks associated with poverty as discussed above, and due to language barriers. Some refugees and immigrants may understand little English, and therefore may not understand warnings about impending flood risks, and how to prevent harm from floods. They may also be less aware of sources of help and support following a flood. Refugees are more likely to already have mental health problems, and these can be further exacerbated as a result of experiencing flooding.
- Inhabitants of highly populated urban areas are at greater risk due to the more rapid spread of infection which occurs in overcrowded areas.

4.4.6 Mitigating health risks from floods

The best way to minimise the health risk from flooding is to prevent floods from occurring. However, this is not practical or possible in many cases. Therefore, those who are deemed at a higher flood risk should be made aware of the potential risks to health should a flood occur, and how to prepare for these. Public Health England has published information leaflets providing advice on how to be safe in a flood, which can help those in high risk areas to prepare.

In the case of a flood occurring, information should be given to residents informing them how to stay safe from the immediate, delayed and long term health risks of flooding. This may be in the form of verbal or written advice, or online sources. Information should be available on what health problems may occur, how to recognise these, and who to contact in the case of them occurring.

Vulnerable people, as described above, should be identified, and more intensive follow-up should be considered.

Professionals attending flood sites should be made aware of the health risks, both in order to provide advice to those they are visiting, and so that they can stay safe themselves.

4.4.7 Resilience and Response

Resilience and response is best considered in the context of the flood risk management cycle below in Figure 1. It is an intrinsic aspect of managing flood risk as there will always be some level of flood risk that cannot be removed.

Figure 1: Flood Risk Management Cycle

Investigate

It is known that there is potential for flooding in Hertfordshire. Sections “4.4.8: Investigations” and “4.5.1 Surface Water Management Plans” in this strategy describe the work that is being carried out to investigate and form a better understanding of flood risk.

Manage

Once there is an understanding of flood risk options to manage it can be developed appraised and implemented where they are found to be feasible. Sections “4.5.5 New flood risk management schemes” and “4.5.6 Prioritising investment” in this strategy set out the approach that is being taken to manage flood risk in Hertfordshire.

Prepare

There will always be a risk of flooding somewhere in Hertfordshire whatever action may be taken to put physical structures in place to manage flood risk.

Information is available which predicts the areas where there is potential for surface water flooding in Hertfordshire. Although this is not reliable in all cases simple low cost steps can be taken to appraise and reduce the risk posed from flooding.

Where there is more confidence about the potential for flooding actions to make a property more resistant or resilient to flooding can be considered.

As well as such preparation at an individual property level, authorities, agencies and other organisations will plan what action they will take in response to flooding. In the case of a few isolated reports individual services will be prioritising attendance and response.

Where there is a significant event affecting many properties, transport links, other infrastructure and properties plans for a coordinated response have been developed at a district and county level.

Respond

The Environment Agency issue flood alerts and flood warnings for areas susceptible to river and in some instances groundwater flooding.

In some cases action can be taken to reduce the potential for flooding of property or key infrastructure through the deployment of measures such as mobile barriers and pumps.

However this would not apply for the majority of flood events that occur in Hertfordshire due to a number of factors such as an inability to reliably predict surface water flooding and that flood risk is dispersed over a large number of small areas.

There is a level of expectation that the emergency services and local authorities will respond and protect every property at risk of flooding. However when there are many instances there would not be sufficient resources to be able to respond effectively to every incident. Also in the case of surface water flooding, by the time that there is a response in many cases it will be too late and the majority of damage will have happened. The response from the emergency services will be prioritised to safeguard life and vulnerable groups. So when flooding is likely to occur or is happening owners and occupiers will need to take steps themselves to protect their property.

Photograph 11: Fire & Rescue Service responding to property flooding

Even if the resources could be found, a reactive approach by authorities and other services could not be relied on as a way of managing flood risk as there is generally little warning of surface water or minor watercourse flooding. Although weather forecasts can generally indicate the potential for surface water flooding days and hours before an event, in many cases it is not possible to give a more reliable forecast for a specific location more than an hour or two in advance. Uncertainty about rainfall coupled with the limitations of the current surface water mapping mean that it is currently impracticable to forecast the potential for individual properties to flood with any degree of certainty. This is an issue when no one is available to take action which may be for large proportions of the day when people are out at work or asleep.

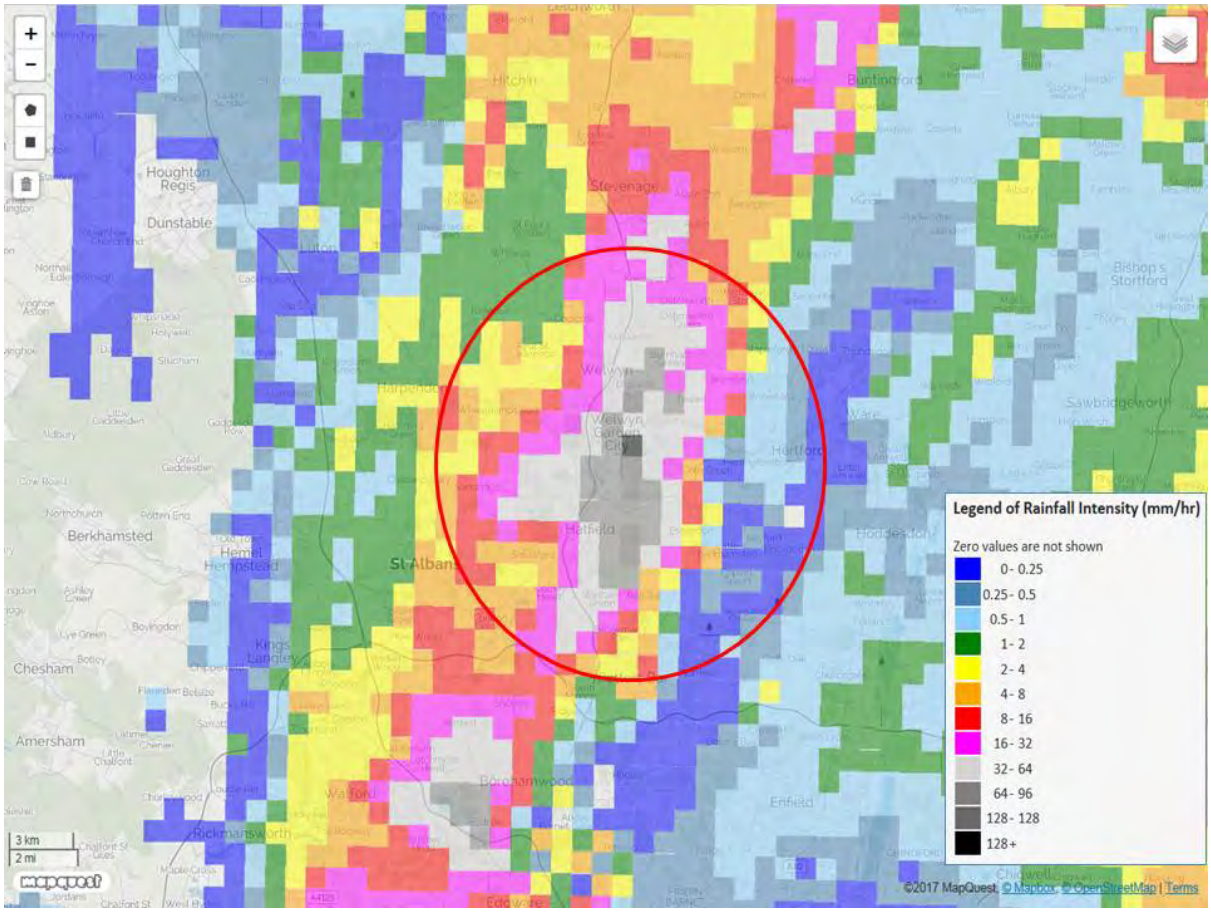


Figure 2: Rainfall Radar showing localised intense storm

Response to a major flooding incident will be coordinated through the members of Hertfordshire Resilience (the Local Resilience Forum) which includes the emergency services, local authorities, the Environment Agency, health agencies and voluntary bodies. Activities will include setting up reception centres, managing transport links, safeguarding key infrastructure, evacuation and rescue.

Recover

The time taken for recovery can range from a few hours to many months. In a resilient property where there was preparation for a flood, recovery may simply consist of washing and disinfecting walls and floors and moving furniture and other items back into place. Where properties are of a vulnerable construction and no

preparations have been made it can take many months to repair the fabric of the property and replace furniture and fittings.

Photograph 12: Clear up following internal property flooding

Recovery may be further hampered by a lack of insurance. Households which do not have insurance are also unlikely to be in a position to install property level measures.

The disproportionate impact of flooding on some households has been recognised by the government with a higher payment being calculated for contributions to flood risk schemes in areas which are ranked in the bottom 20% and 40% of the index of multiple deprivation.

The importance of being able to insure against flood risk has been considered by the government which set up FloodRe, a reinsurance scheme to ensure that even people living in high flood risk areas should be able to get insurance.

Investigate

When flooding occurs the circumstances will be investigated to varying degrees. Depending on the circumstances this may be by individual organisations, as part of an investigation carried out by the Lead Local Flood Authority or as part of the debrief and review following a major response. These findings will then feed back into the cycle to improve future management of flood risk.

Action 4: Make up-to-date information readily available for individuals and communities

Individuals and communities will be made aware of the role that they have to play in managing their flood risk and up to date information about flood risk is made available to help inform their decisions.

This will be supported with published information, campaigns and work with the members of Hertfordshire Resilience. Consideration will be given to what support needs to be given to those groups which would be most significantly impacted by flooding.

4.4.8 Investigations

The aim of flooding investigations will be to help people understand why flooding occurred and which organisation can advise on how the risk might be managed in the future.

The LLFA has a duty to carry out flood investigations under Section 19 ("s19") of the FWMA and a flood investigation is carried out to provide an overview of a flooding incident, identifying which organisations hold powers relevant to managing the associated flood risk.

As well as setting out the respective roles of the Risk Management Authorities the investigation reports are also a means to highlight the roles and responsibilities of other organisations and individuals including individual property owners.

In some cases where the cause of flooding is uncertain or the impact has been very severe a more detailed investigation of a flooding incident is required. This level of investigation also gives the opportunity to consider what actions could be taken to reduce flood risk in the future. The decision to carry out a detailed investigation has to be proportionate to the incident and may need to be further prioritised as the resource capacity to carry out such investigations is limited.

S19 investigations are only the start of the LLFA's process of flood risk management as in themselves they do not bring an increased level of protection for properties. This will come as a result of any follow up actions by the relevant risk management authorities. The investigation reports are not binding on any authority and powers to manage flood risk are discretionary.

Detailed s19 investigations help the LLFA assess the potential for managing flood risk where it has been caused by surface water and groundwater by identifying options for intervention. However experience of investigating flood events has confirmed that in most cases where the cause of flooding is easily identifiable, detailed investigations for small numbers of properties have limited value. Where less than ten properties are affected by flooding, the cost and benefit assessment for the construction of any mitigation options usually concludes that they are not viable.

Any recommendations are likely to be restricted to actions at a property level except from those cases where there may be a need to repair or maintain assets.

Photograph 13: Surface water flooding in residential gardens.

Where the flooding is due to a source other than surface water or groundwater or is affecting the highway it is important that the flooding incident is reported to the appropriate organisation by the resident / customer as other Risk Management Authorities have their own processes to evaluate their response to flooding. The Water and Sewerage companies rely on customer reports of flooding to prioritise their response, where flooding is not reported they are restricted in what action they can take. The Highway authority has a fault reporting system that is used to prioritise response and future investment.

Risk Management Authorities and major infrastructure providers all have processes for assessing and managing flood risk that are relevant to their operations and flooding investigations should complement and not duplicate this work.

Detailed flooding investigations should only be carried out where they have the potential to make a difference to future outcomes. This would include such considerations as justification for a flood risk management scheme, fostering cooperation between Risk Management Authorities or identification of a management responsibility.

When flooding is believed to have happened the LLFA will make enquiries to determine the impact of the flooding and record the findings.

Policy 3: Flood Investigation Criteria

Flood investigations under F&WMA 2010 s19 powers will be carried out in line with the criteria below.

Where property has been flooded and the cause is uncertain the LLFA will investigate sufficiently to identify the source(s) of flooding so that the relevant risk management authorities can be identified.

Where a single Risk Management Authority holds the relevant powers the investigation will conclude with a brief description of the flooding and a summary of the action that the Risk Management Authority has already taken and/or proposes to take.

A more detailed investigation will be carried out where more than one Risk Management Authority is identified as holding relevant powers and the following criteria are met:

Internal flooding has occurred at a property on more than one occasion in a ten year period.

Internal flooding of five or more properties has occurred during one flooding incident.

Internal flooding of a business property.

External flooding of land adjacent to a property has occurred more than five times in a ten year period.

A critical service has been affected by flooding.

Roads and railways have been impassable for over ten hours due to flooding.

Flooding potentially posed immediate, direct and real risk to life.

A property will not be recorded to have flooded unless this is confirmed by the owners or occupiers. In some cases people are reluctant to confirm internal flooding however the advantages of reporting flooding will outweigh any perceived disadvantages. Accurate information means that investigations are more likely to determine the level of flood risk and confirmation of internal flooding helps to secure resources for management. The sensitivity around this information is understood, individual properties will not be specifically identified in investigation reports, however owners and occupiers are legally required to disclose this information to insurers and prospective purchasers.

A flow chart of the investigative process is set out at Figure 3. This shows how the s19 investigation process is used to confirm the cause of the flooding so that the relevant Risk Management Authority can be identified and have an opportunity to

describe how it has used or intends to use its relevant flood risk management powers. Where the relevant Risk Management Authority is the LLFA further studies may be commissioned to follow on from the s19 investigation if it is felt to be necessary to examine options for flood risk management in the flooded area. In some cases this further action will be limited to recording the incident or identifying assets to be considered for inclusion on the register of structures and features.

Investigations have an important role in providing a focus for individuals and communities to understand how they can manage their flood risk. This includes informing decision making

To date s19 investigations have taken between 9 and 15 months to complete and at this point, they may then be the start of further investigation or submission of a bid for funding to develop a project. In other cases the investigation confirms that there is unlikely to be potential for a scheme and any reduction in flood risk will be limited to what can be achieved at a property level. Table 6 shows the number of internally flooded properties per s19 investigation.

Table 6: Number of internally flooded properties per Section 19 Investigation

Section 19 Investigation	Number of properties flooded internally
Chorleywood	0
Robbery Bottom Lane	6
Long Marston	5
Little Wymondley	5
Redbourn	15
Knebworth	14
Whitwell	2
Stevenage	2
Hunsdon	1
Hatfield	8
St Albans	4
Harpenden	27
Stevenage	2
Ware	4
St Albans	7
Radlett	1
Hoddesdon	2
Aston	0
Welwyn Garden City	48
Northwood	14
Bovingdon	12
Bushey	9
Bishop's Stortford	4

A prolonged investigation maintains uncertainty and raised expectation and in some cases has led to unproductive studies. A change in approach is proposed in that investigations will be detailed enough to determine with reasonable certainty the flood mechanism(s) and identify the relevant Risk Management Authorities. The relevant Risk Management Authorities would then need to consider what if any action they would take to manage the risk in the area affected by flooding.

In the case of the LLFA where flooding is due to surface water (and by association ordinary watercourses) or groundwater any further analysis of the flooding and development of options would be put forward to be considered for an initial assessment. The decision to carry out this assessment would be subject to a prioritisation exercise within the scheme development programme.

The advantage of this approach would be:

- Quicker identification of the Risk Management Authority with the powers to manage the flood risk associated with an incident.
- More certainty earlier on in the process about the potential to manage the flood risk.
- In the case where the LLFA was the relevant RMA follow up work would be programmed and people would know the indicative timescales for work to be carried out.

Policy 4: Investigation scope

Investigation work will be detailed enough to identify with reasonable certainty the flood risk mechanisms and relevant RMAs. Any extended investigative work and assessment will be at the discretion of the relevant RMA(s).

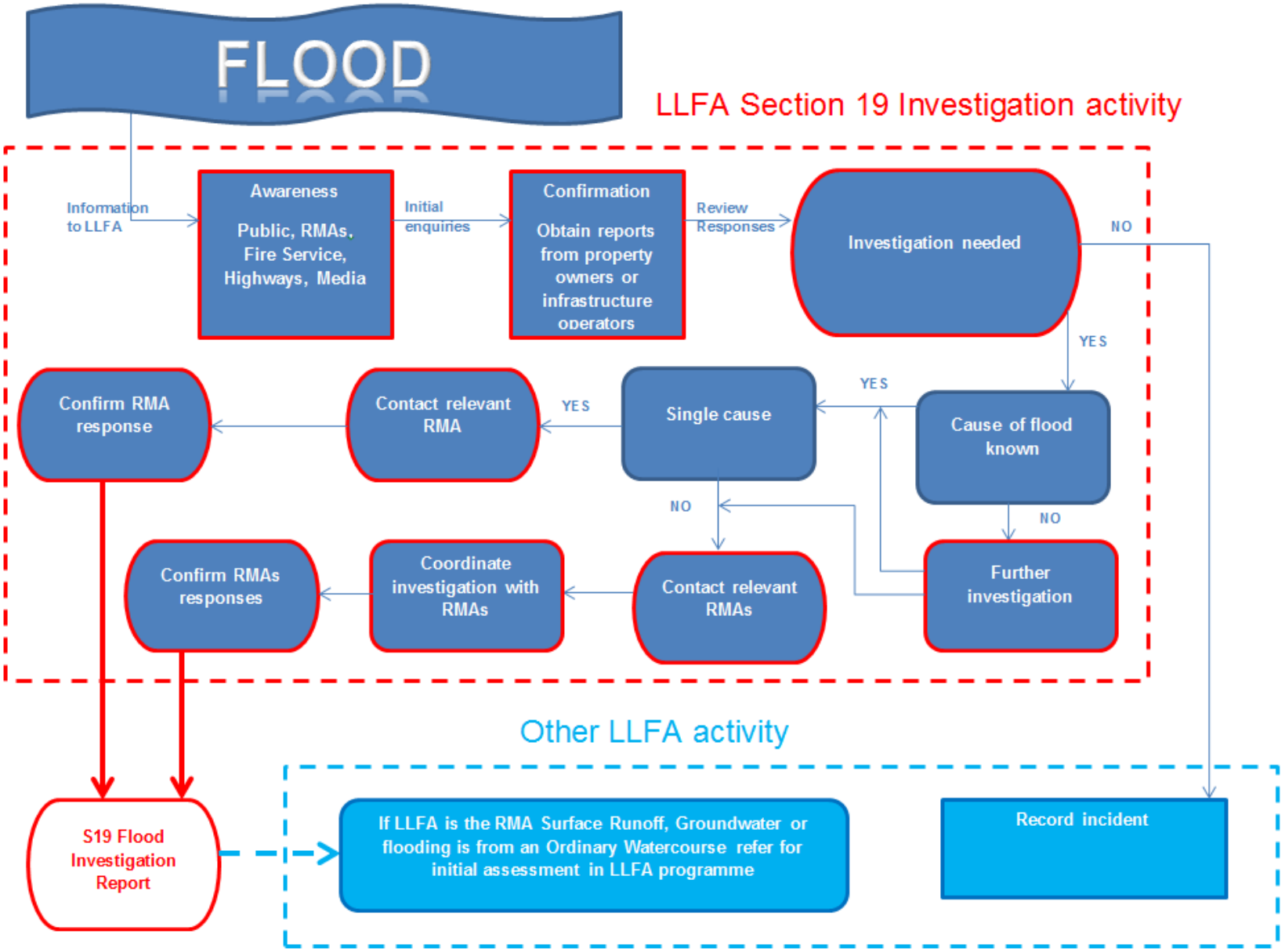


Figure 3: Section 19 Flood Investigation Flow Chart

4.5 Principle 5: Working to reduce the likelihood of flooding where possible

Aim 5a: *Flood risk management funding is directed to areas most at need or where solutions will be most effective, and flood risk management will guide other funding decisions and be appropriately prioritised alongside other needs.*

Aim 5b: *Information on local flood risk will be used to allow informed decisions to be made on the level of funding allocated to flood risk management resources within Hertfordshire.*

Aim 5c: *Structures and natural features such as watercourses which have an impact on the management of local flood risk should be identified, appropriately monitored and maintained.*

Aim 5d: *Potential funding for flood risk management projects will be prioritised according to cost-benefit and a range of weighting factors to take into account the evidence of flooding and sustainability of the proposed solution. This will ensure that resources are dedicated in areas where it will be most effective.*

This section sets out a range of activity that will help achieve the aims listed above. The potential to manage flood risk is being assessed through Surface Water Management Plans which are district level investigations and help to understand the extent of flood risk and the options for managing it. Before building new schemes it is important to ensure that function of watercourses and other existing assets that make a contribution to reducing flood risk are understood and are in suitable condition. When investment is made in new schemes it needs to be allocated to the areas where it will have best effect.

4.5.1 Surface Water Management Plans

The strategic overview of flood risk is being developed through district based plans (Surface Water Management Plans) which consider the potential for future flooding. The prediction of the potential for flooding in the future is complemented with flood event records and further studies that result from their investigation.

A Surface Water Management Plan (SWMP) is a plan that outlines the preferred long term strategy for managing surface water in a particular location. It aims to develop a better understanding of surface water flooding in a given area and further develop partnership working. Surface water flooding is described as flooding from sewers, drains, groundwater, and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.

Outputs will include: development of a sound evidence base including a detailed risk assessment; mapping of vulnerable areas; and an action plan which explores the most cost effective way of managing surface water flood risk in the long term. SWMPs will help identify and prioritise practical actions to mitigate flood risk and will also have other applications e.g. for planners and others involved in the development process. Individual plans are being developed on a district/borough wide basis. This is considered to be appropriate in Hertfordshire as it links to their role in local planning allocation and provides connections with any other local RMAs.

All of the SWMP's take advantage of the EA's RoFfSW maps which were published in December 2012. From observations of the surface water flooding that occurred in Hertfordshire during the winter 2013/14 and in July 2015 it is evident that the maps reasonably predict surface water flow pathways. A programme of plans covering the 10 districts in Hertfordshire are being developed using the following methodology below:

1 Identification of hotspot sites within each district/borough that are bound by common flooding mechanisms posing risk to individuals, property, the economy, roads, critical infrastructure and the environment.

2 Following identification of hotspots, discussions are held between stakeholders and other RMAs. Ranking is undertaken to identify the top five hotspots within each district/borough.

3 The top five ranked hotspots from each district/borough are taken forward for more detailed analysis. This involves computer modelling of surface water flooding. The modelling adds more detail at the street scale, such as survey information on kerb heights or property thresholds. This enables a better representation of the overland surface water flow paths and provides more detail than is available from the EA's Risk of Flooding from Surface Water maps. The flood modelling is undertaken for a range of different probability flood events in order to understand the magnitude of events affecting each hotspot location.

Photograph 14: Surveying of property threshold levels for use in flood modelling

4 Modelled results are assessed in terms of flood damages; this is the estimated damage to each property if it is impacted by flooding.

5 Options are identified for mitigating flood risk within each hotspot.

6 The understanding gained of flood damages for each hotspot means that any options identified for mitigating flood risk can be understood in terms of cost-benefit. This cost-benefit analysis provides the basis upon which the LLFA can be proportionate when looking at flood risk sites and assists in determining where to focus future funding.

7 An action plan is produced as a final output for the SWMP; this is used as a base for further studies and to focus the future work of the LLFA in flood risk areas.

Assessments have been completed for six districts: Broxbourne, Dacorum, East Herts, North Herts, St Albans and Watford

Figure 4: Illustrating completed Surface Water Management Plans in Hertfordshire

The remaining four assessments (Hertsmere, Stevenage, Three Rivers and Welwyn Hatfield) are underway and are programmed to be completed in 2019

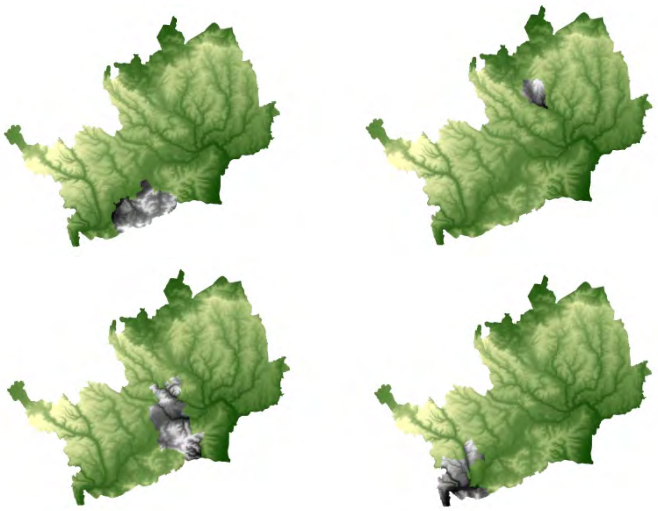
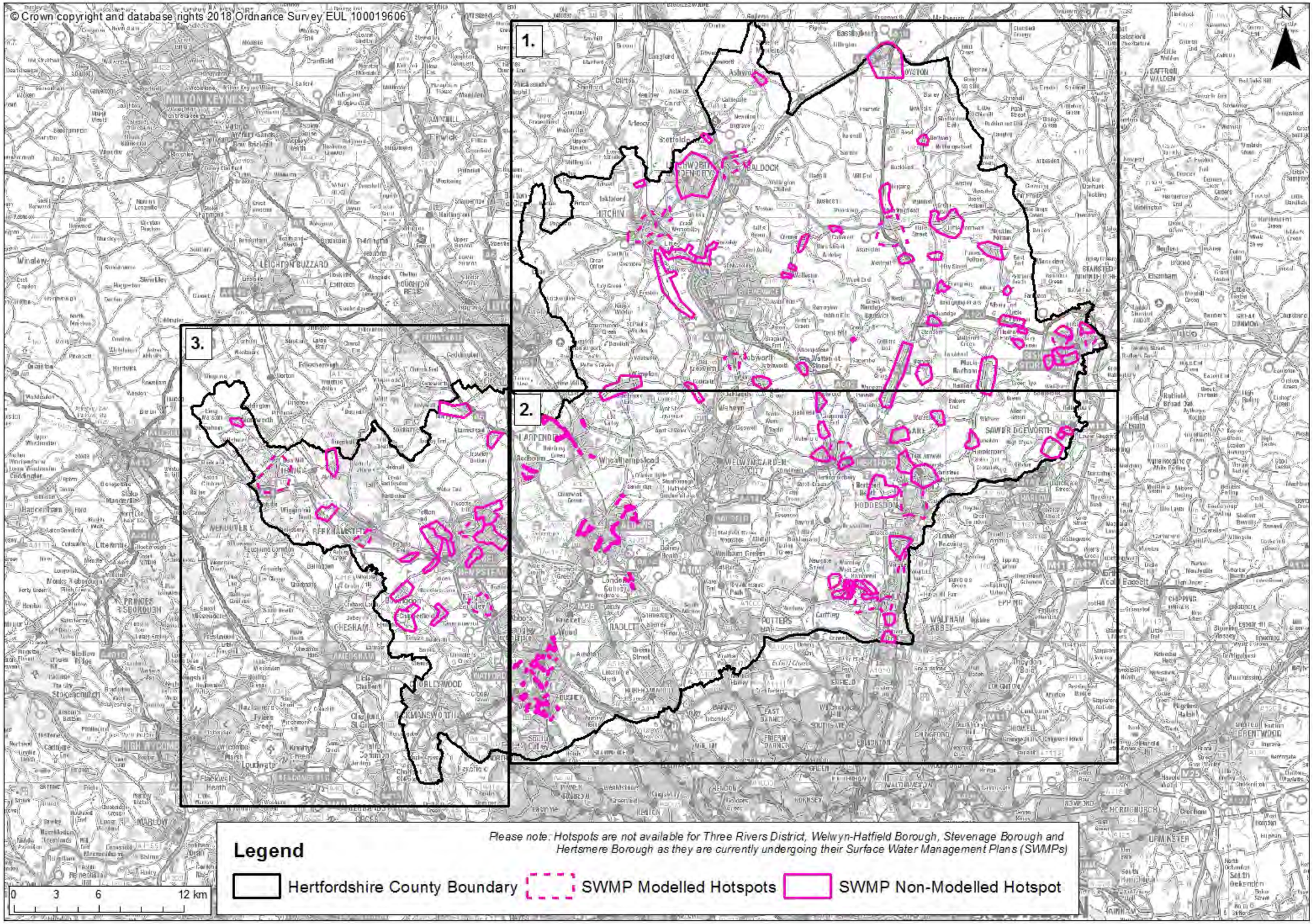
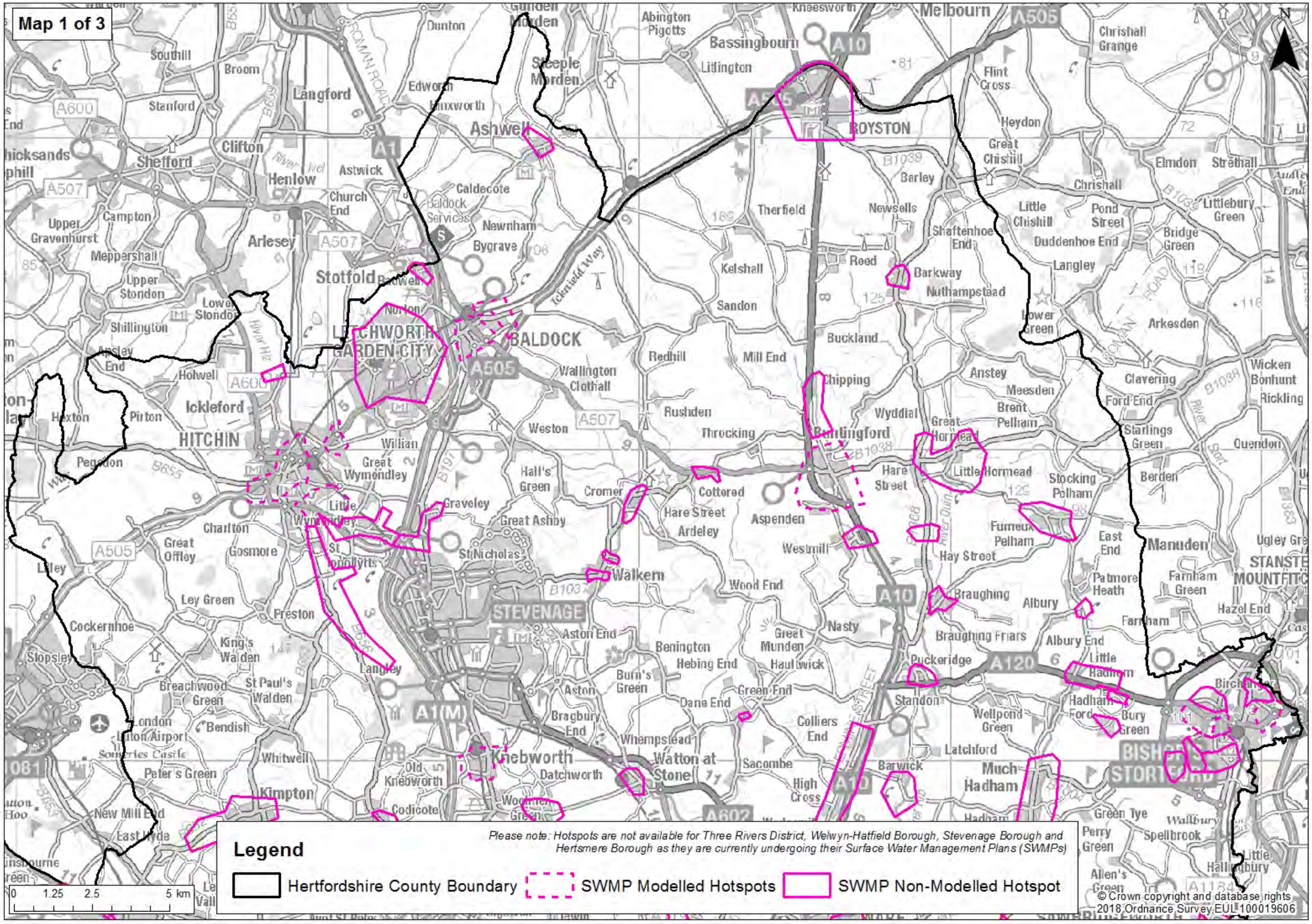


Figure 5: Remaining Surface Water Management Plans in Hertfordshire

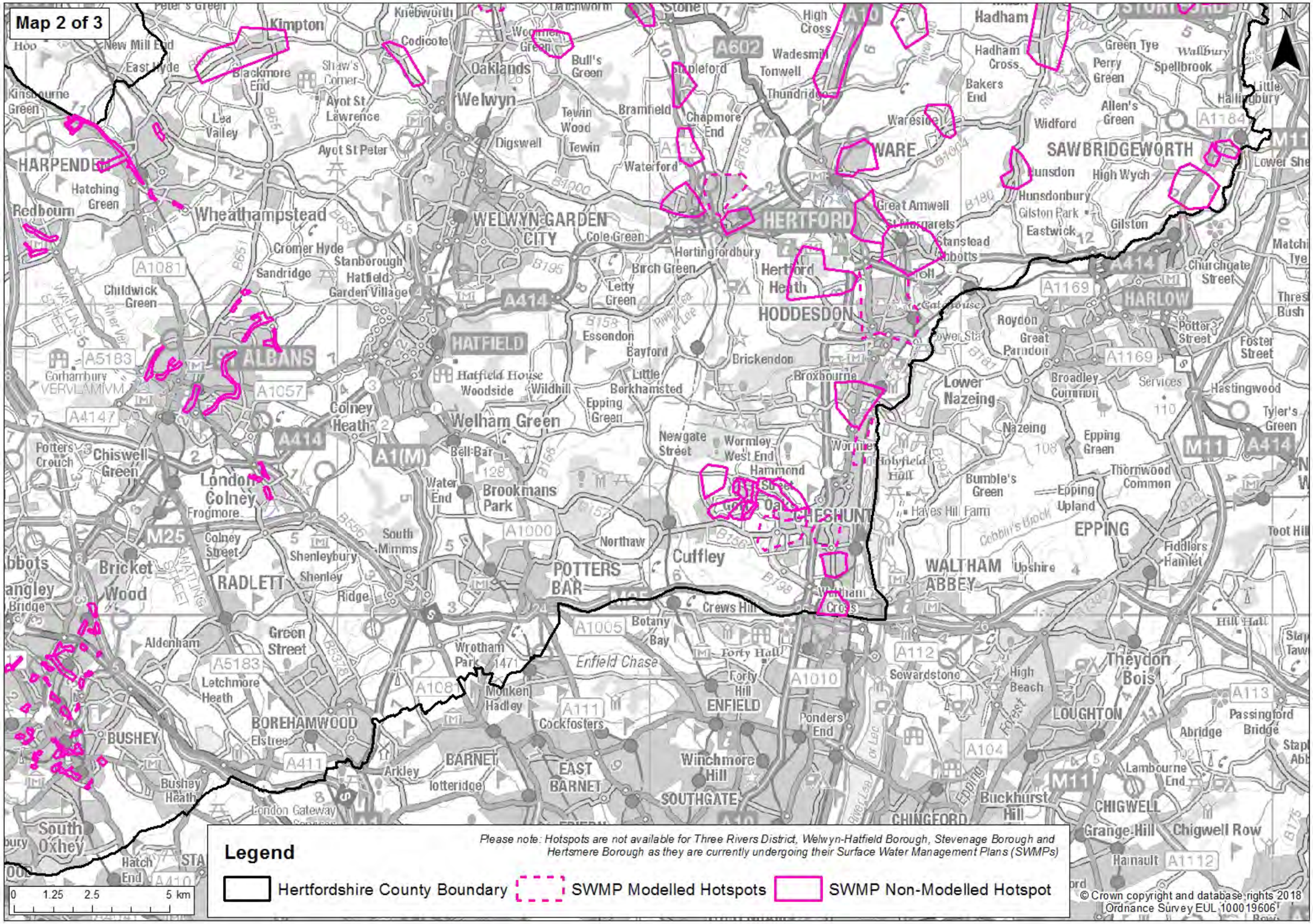
Map 11 shows the areas researched during the production of the SWMPs.



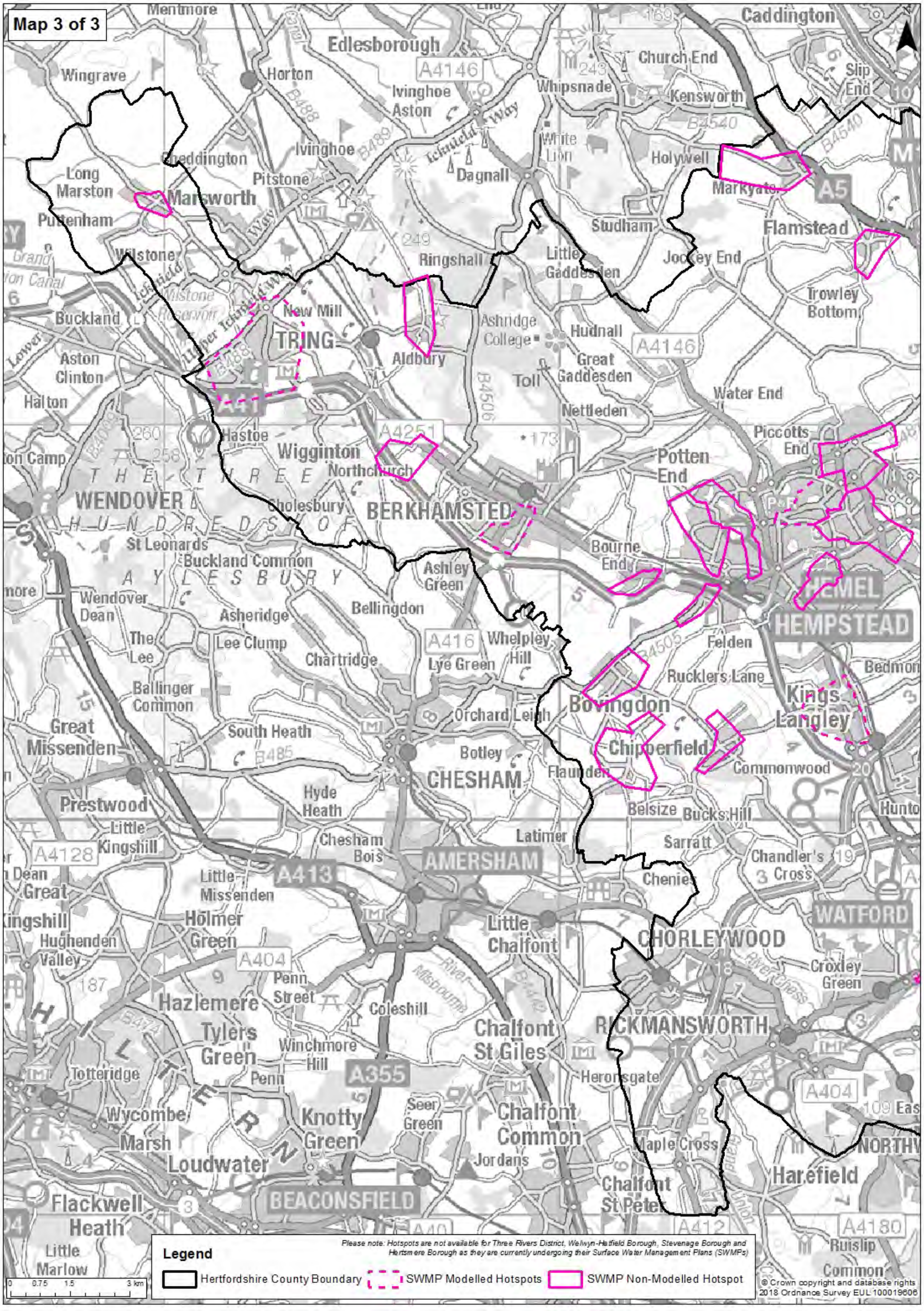
Map 11: Overview Map – Surface Water Management Plan (SWMP) Hotspots for Hertfordshire



Map 11a: Map 1 of 3 – Surface Water Management Plan (SWMP) Hotspots for Hertfordshire (North)



Map 11b: Map 2 of 3 – Surface Water Management Plan (SWMP) Hotspots for Hertfordshire (South)



Map 11c: Map 3 of 3 – Surface Water Management Plan (SWMP) Hotspots for Hertfordshire (West)

4.5.2 Ordinary Watercourses

These are generally smaller watercourses which form an important part of the overall drainage network. As well as having drainage function many watercourses also have benefits for amenity and wildlife.

The number of ordinary watercourses in Hertfordshire and their importance to the management of the surface water justify the need to monitor, inspect and manage the activities within and near ordinary watercourses.

The LLFA has been the regulatory body since April 2012, with powers relating to the management of ordinary watercourses in Hertfordshire. These cover ordinary consenting and enforcement of activity relating to ordinary watercourses, as per sections 23, 24 and 25 of the Land Drainage Act 1991 (LDA 1991).

The transferred powers now held by the LLFA cover the County apart from a small area that is covered by Bedfordshire and Ivel Internal Drainage Board (IDB).

Ordinary Watercourses Inspection

All mapped ordinary watercourses in Hertfordshire have been assessed and allocated a predicted indicative risk score. A risk score has been assigned from high, medium and low and this gives an indication of the probability and severity of flooding arising from an ordinary watercourse to properties, roads and other critical infrastructure. The length of ordinary watercourses and their risk classification are detailed in Table 7.

Table 7: Length of ordinary watercourses and their risk classification

District	High risk score Length of ordinary watercourses (km)	Medium risk score Length of ordinary watercourses (km)	Low risk score Length of ordinary watercourses (km)
Broxbourne	6.19	21.27	53.24
Dacorum	2.04	15.26	32.80
East Hertfordshire	23.39	102.66	385.46
Hertsmere	2.01	18.12	72.47
North Hertfordshire*	7.64	67.75	200.19
St Albans	2.96	22.74	22.29
Stevenage	1.64	3.15	2.08
Three Rivers	1.85	23.97	27.94
Watford	1.56	2.41	2.92
Welwyn Hatfield	2.85	31.71	117.05
Total (km)	**52.113**	**308.50**	**916.44**
Total (%)	**4.08**	**24.16**	**71.76**

*excludes ordinary watercourses falling within the IDB area

The inspection and monitoring plan for ordinary watercourses was developed with the main purpose of validating the risk score of the watercourses and also to assist the completion of the asset register, required by the FWMA 2010.

The adjustment from predicted risk to assessed risk score allows for a realistic perception of the condition of the ordinary watercourses. It also highlights areas that may require additional or less frequent inspections.

Based on experience from the first round of inspections the OWC service standards relating to inspection frequency have been reviewed and revised. Watercourses

which initially had the highest indicative risk score were programmed to be inspected every two years but this has not been found to have had any significant demonstrable benefit. However there will always be a requirement to maintain a baseline audit which can be used as evidence to demonstrate where unconsented works have been carried out. The following inspection regime will still achieve this and give flexibility for resources to be targeted where they will be most effective.

High risk – 5 years

Medium risk – 7 years

Low risk – Inspected on notification of issue (most low risk stretches needing validation will be covered by their proximity to high and medium risk stretches)

Photograph 15: Neglected and unsuitable structure in an Ordinary watercourse

Mapping of Ordinary Watercourses

Hertfordshire County Council as the LLFA publishes a map of all ordinary watercourses that are currently recorded. It is acknowledged that there are still some watercourses that are not recorded and that some of the watercourses shown on the map are not correctly depicted. The map will be amended as information comes to light through commenting on planning applications, scheduled inspections, investigations and enforcement cases or research for the s21 asset register.

OWC Regulation

Hertfordshire County Council, as the Lead Local Flood Authority, is the consenting and enforcing body for works on ordinary watercourses in the county (except in IDB areas) and will use the available powers to promote the contribution of ordinary watercourses to the management of flood risk.

Policy 5: Securing effective operation of ordinary watercourses

Any works proposed to be carried out that may affect the flow within an ordinary watercourse will require the prior written consent from the Hertfordshire County Council under Section 23 of the Land Drainage Act 1991. This includes any permanent and or temporary works regardless of any planning permission.

Enforcement against structures in watercourses constructed in contravention of, or without consent under, section 23 mentioned above can be led by Hertfordshire County Council under Section 24 of the Land Drainage Act 1991.

Hertfordshire County Council holds the powers to require works regarding the maintenance of the flow in the channel of an ordinary watercourse under Section 25 of the Land Drainage Act 1991.

The monitoring and inspection aspect of the ordinary watercourse regulation allows the Hertfordshire County Council to have an appropriate knowledge of the county network in order to properly and effectively use its regulatory role, including in consenting and enforcing procedures.

The monitoring and inspection aspect of the ordinary watercourse regulation is based on an indicative risk score for each stretch of ordinary watercourse. The risk score reflects its interaction with infrastructure and flood zones and is derived by correlating a range of datasets.

Further details on how the risk score is defined and how it guides the inspection routine are set out within the Hertfordshire County Council Ordinary Watercourse Service Standards.

Policy 6: Inspection regime of ordinary watercourses

Hertfordshire County Council will undertake an inspection regime of the OWC network, based on a proportionate and risk based approach to ensure the effectiveness and efficiency of the network in regard to its drainage function in managing flood risk.

Hertfordshire County Council, in its role as the Lead Local Flood Authority, and as a statutory consultee of the planning process, has an opportunity to improve the ordinary watercourse network to meet the Water Framework Directive targets for water quality and ecological purposes.

Conservation and enhancement of the natural environment are an important part of planning and consenting for any new developments.

Each consent process represents an opportunity to restore the ordinary watercourse to its natural state and characteristics.

The applicant must seek the most natural approach, when proposing to modify an ordinary watercourse. This is also applicable for any ordinary watercourse that runs through a planning application site.

LLFA will give preference to open channel watercourses.

Further details on how to comply with the obligations of the Water Framework Directive are set out within the Hertfordshire Water Framework Directive Guidance.

Policy 7: Works to ensure betterment to ordinary watercourses

Any works carried out within an ordinary watercourse must not have a detrimental impact to the water quality and the ecological status of the watercourse with regards to the Water Framework Directive.

When there is an existing culverted ordinary watercourse section betterment of the situation should be sought, such as re-opening or diverting the channel.

If not achievable, the applicant must provide evidence as to why betterment is not viable.

Where watercourses have been culverted access needs to be retained as far as possible to allow them to be adequately maintained and refurbished or repaired in the future if required.

Policy 8: Construction near to culverts

In principle, no construction works should occur on the top of a culvert.

Any works taking place within and/or over the culvert or within 3 m of the top of the bank of the ordinary watercourse will require prior written consent from Hertfordshire County Council regardless of any planning permission.

4.5.3 Asset register

The LLFA is required to keep a register of structures and features which may significantly affect local flood risk. The structures and features are recorded on an Asset Register which is publicly available on the county council website. The register identifies the location and type of asset. In addition the LLFA must also maintain a linked record which has details of ownership and condition.

Significance is determined using the same criteria as for investigations and the prioritisation of schemes. If it is known or predicted that failure or removal of assets would lead to flooding of property or infrastructure they are identified as candidates for inclusion on the register.

Some assets may be significant as part of a network rather than having obvious individual significance. In such cases a catchment may be benefiting from a number of assets. If any one were to fail the impact would not in itself be significant, but if a number were to fail the collective impact would be much greater.

In theory this could include infrastructure such as a highway drainage system or surface water sewer networks. However these structures are not routinely being included on the register as they are already subject to a risk based management regime by the respective RMAs.

When the register was first compiled all district councils were contacted to gather details for assets to be included, this was supplemented with assets that had been identified by the LLFA. It was planned that the register would then develop over time as more information became available during investigations and assessments. Currently there are 23 entries on the asset register and a further 18 entries waiting to be processed.

Photograph 16: Investigations and CCTV surveys of culverts

Recording assets helps to determine if they are in a serviceable condition and being maintained. The value of developing the register has become evident as significant

assets have been identified which have not been managed for a number of years. This may be due to a number of reasons; in some cases ownership cannot be determined as the asset is not registered and if there is an owner, they may not be taking an active interest in managing the land in their ownership. In other cases ownership can be established but the presence of the asset and its function is not recognised and therefore no maintenance is being carried out.

The EA manage and oversee a large number of assets associated with main rivers and the coast. Details are held on a national database which has been developed to help structure inspection, maintenance and associated investment. In 2016 the target for EA monitored assets in the Hertfordshire and North London area was for 99.3% of them being in a suitable condition and asset management performance was monitored against this target.

Currently there is no similar LLFA target for the condition of assets on the register or other performance measures such as there being there being a maintenance / refurbishment plan in place.

Photograph 17: Taken from CCTV survey of a cracked & failing asset

Unless the asset is on an ordinary watercourse, failure would cause a blockage and the owner is known there is no facility to require it to be maintained. In some cases it may be in the owner's interest to manage a structure to reduce flood risk and it may be possible to get them to carry out any necessary work.

The implications of an asset not being maintained need to be considered. The consequences of failure should already be understood and a suitable inspection will give an understanding of the potential for the asset to fail. This will also inform a view on how long the asset should continue to provide benefit if it is maintained. If the asset were to fail the assumption would be that the potential to repair or replace it would then be considered in the same way as any other flood risk management project.

Investment to maintain the asset and the benefit that brings can be balanced against the consequences of no maintenance and the potential increase in flood risk. Modest investment in repair and refurbishment extending the life of an asset may offer better

value for money than waiting for the asset to fail and then having to make the case for extensive refurbishment or replacement.

Where there is a willing asset owner suitable maintenance could be incentivised using contributions from a small projects fund on the understanding that responsibility for the asset remains with the owner

If an asset owner cannot be identified or is unable to manage an asset RMAs have discretionary powers available which would allow an asset to be managed. If these powers were used ongoing responsibility for managing the asset is likely to fall to the RMA.

Investment in maintaining or replacing an asset should be prioritised in the same way as for projects being put in place for the first time.

Policy 9: Using the asset register to manage failing assets

The LLFA will use the production of the asset register as a means to identify and promote management of assets that are in failing condition or which are not being adequately maintained and could significantly affect local flood risk.

Action 5: Performance indicators linked to the asset register

In support of Policy 9, the LLFA will develop suitable performance indicators linked to the asset register considering aspects such as target condition and an inspection programme.

The potential benefit of assets that are significant to local flood risk may be lost through neglect or lack of maintenance but their function could also be lost through

alteration. As set out in A1. Appendix 1: Responsibilities of Risk Management Authorities, risk management authorities have protective powers to designate assets which have a significant impact on local flood risk. The effect of designation is that the asset owner cannot alter a structure or feature without first consulting the designating body. Awareness of the function of the asset is maintained as the designation is registered as a land charge and so raised each time that the ownership of the property is transferred.

To date the authority has not used these powers. However recent experience has highlighted cases where the use of designation would help to remove uncertainty in securing the function of some critical assets. These include:

- Cases where new owners are unaware of the existence and/or function of assets on their land.
- Assets linked to new development which reduce flood risk to adjacent properties from surface water passing through the site.
- Enquiries about flood risk features linked to conveyancing of properties are optional and only carried out in a minority of cases.

Policy 10: Designation of structures and features that have a significant impact on local flood risk

Designation will be considered where there is uncertainty about the continuing existence of structures or features which meet the criteria for inclusion on the asset register and one or more of the following criteria are met:

- *Urgent intervention is needed to prevent loss of the asset;*
- *Change of ownership could prejudice understanding of the function of the asset; and*
- *A similar outcome to designation cannot be achieved through other means.*

As a LLFA which is a county council Hertfordshire County Council only holds powers to designate assets which are relevant to managing flood risk from groundwater and surface runoff. The powers relating to Main Rivers are held by the Environment Agency and for ordinary watercourses rest with district and borough councils. Ordinary watercourses are offered some protection by sections 23, 24 and 25 of the Land Drainage Act 1991 however particularly in the case of watercourses in confined urban areas there can be benefit in raising awareness of a feature when ownership changes. The potential for the LLFA to use these powers will be explored as part of the work relating to Action 7: Ordinary watercourse powers.

4.5.4 Small projects fund

There are situations where it would be anticipated that the LLFA make use of their available powers. This may be taking enforcement action to require maintenance of watercourses, designation of assets to safeguard their flood risk function or developing capital schemes to reduce flood risk to properties and infrastructure.

Management of flood risk does not rest solely with authorities, organisations and agencies. Property owners have the responsibility for managing the flood risk to their property and in addition may have riparian responsibilities to manage watercourses and drainage features on their land.

There are scenarios that fall between these two sets of roles and responsibilities. The LLFA has no available powers to require the maintenance of structures and features on private land unless they are associated with watercourses. A number of cases have arisen during ordinary water course enforcement where the riparian ownership could not be determined.

If no action is taken in cases such as these the flood risk associated with the third party assets or the watercourses will increase. Without carrying out detailed modelling it would not be possible to determine what the precise local impact would

be. So in such a case the LLFA would not be able to confirm the increase in flood risk for those property owners potentially affected. They in turn would not be able to take a fully informed decision to take steps at a property level to manage the flood risk to their properties.

Rather than do nothing or simply carry out modelling there is an option for the LLFA to intervene and repair, renovate or improve failing assets. Where this is small scale work it is unlikely to be eligible for national or regional flood risk management funding requiring extensive business case justification. So it would be possible for the LLFA themselves to take the decision to fund low cost low risk schemes without the need for a detailed appraisal which would likely be a disproportionate percentage of the total cost.

The value of such an approach could be recognised and formalised through the creation of a small projects fund. As well as an opportunistic response as issues are discovered through investigations, it could also be used to fund or partially fund schemes and improvements proposed by community groups which could not be achieved through another means.

Securing future maintenance of any schemes would need to be a consideration. Where this could not be assured thought would have to be given to the value of taking on a project and whether the LLFA should take on responsibility in the interim or longer term.

The LLFA powers allow it to take on the management of structures for flood risk from surface run off and groundwater. The situation relating to management of structures linked with ordinary watercourses could be reviewed as part of the work with district and borough councils to develop a consistent approach to ordinary watercourse regulation which is linked to the same powers.

Action 6: Small Projects Fund

That the LLFA establishes a projects fund to facilitate small flood risk projects which would have a positive impact on local flood risk. The criteria for eligibility would be kept as simple as possible on the basis that the projects would be low cost, low risk and not justify extensive investigation or appraisal.

Action 7: Ordinary watercourse powers

In cases where it is felt to be advantageous for the fund to be applied to manage flood risk associated with ordinary watercourses. If after consultation with the relevant district or borough council, it is felt more appropriate for the LLFA to carry out the work then it will be proposed that the district or borough council delegate the relevant powers as provided for in s13 of the Flood and Water Management Act 2010.

Policy 11: Application of a Small Projects Fund

The fund is only applied to projects where ownership and or responsibility for maintaining the asset cannot be reasonably established.

4.5.5 New flood risk management schemes

In addition to neighbourhood scale surface water management projects and structures, alternative means to manage flood risk need to be explored. The dispersed nature of flood risk in Hertfordshire has an effect on the ability to manage it through the development of schemes just as it has an impact on the ability to respond to flooding events.

Experience from flood investigations has shown that in the majority of locations although flood risk to property has been demonstrated there is no potential to

develop a neighbourhood scale scheme to manage the flood risk. In some cases schemes did not meet basic cost benefit requirements in others the balance between scheme costs and eligibility for grant contributions mean that it is unlikely that all the required funding could be raised locally.

The case study below illustrates how the cost and benefits of a range of options will be evaluated to determine the potential for public funds to be invested in a flood risk management scheme. This is required when applying for funding and follows a methodology compliant with Treasury funding guidelines. Costs and benefits which will be realised over a number of years are standardised as their present value and compared against baselines of no investment and continuing maintenance.

The potential to attract grant funding can be calculated based ion the number of properties that would benefit from the scheme and the level of risk reduction. The difference between the scheme costs and potential grant can be calculated. In the Flood Defence Grant in Aid process this is then expressed as a “partnership score” showing the percentage of the total cost that grant will cover. For option 6 in the case study below 81% of the scheme costs would have to be raised locally over £260K which is equivalent to £24K per property benefiting from a reduction in flood risk.

Case Study: Example of figures needed to calculate funding for a flood risk management scheme from a site in Welwyn and Hatfield borough.

Category	**Do Nothing**	**Do Minimum**	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**
Scheme Design Life (years)	-	100	50	100	100	50	50	50
Total PV Damages (£k)	1,516	1,481	1,319	1,330	1,448	1,487	1,487	1,147
Total PV Cost (£k)	-	35	395	535	130	229	229	329
Total PV Benefits (£k)	-	35	197	186	67	29	29	368
Benefit Cost Ratio against Do Nothing	-	1.2	0.5	0.3	0.5	0.1	0.1	1.1
Number of properties moving band	-	2	6	7	3	2	2	11
Partnership funding score (%)	-	0%	10%	6%	9%	3%	3%	19%

Do Minimum: Current maintenance regime.
Option 1: Flood protection wall surrounding at risk properties.
Option 2: Increased diameter culvert with increased highway drainage capabilities.
Option 3: Modification and provision of consistent kerb.
Option 4: Realigned channel downstream of the bridleway culvert with increased floodplain volume.
Option 5: Flood storage area downstream of the bridleway culvert.
Option 6: Property Level Protection up to 0.5m on properties at risk.

Glossary of Terms:

- Scheme Design Life - The anticipated lifespan of the scheme.
- Present Value (PV) - Present value refers to the value of any cost or monetary benefit over the design life of the scheme at its equivalent cost in the present day. Total PV Damages - the sum of the anticipated damages to property over the proposed lifetime of the scheme, discounted to the present value.

- Total PV Cost - the sum of the capital investment to design and build the scheme and the anticipated maintenance costs over the scheme's design life, discounted to the present value.
- Total PV Benefits - are calculated as the reduction in PV damages over the design life of the proposed scheme when compared to the Do Nothing scenario.
- Benefit Cost Ratio (BCR) against Do Nothing - A value greater than 1 indicates that the benefits outweigh the costs.
- Number of properties moving band - the number of properties that as a result of the scheme are at a lesser risk of flooding.
- Partnership funding score - the percentage of the capital investment that is eligible for funding through the FCRM GiA programme.

- The ongoing maintenance within the catchment should be continued to ensure optimal performance of the existing drainage systems as this has been shown to be cost beneficial through the Do Minimum scenario.
- Options 1-5 do not provide sufficient benefits to outweigh their costs and are not deemed feasible to take forward to a more detailed economic assessment for the preparation of an OBC. This is due to the relatively low number of properties benefitting from them and the high anticipated implementation costs due to the space constraints within the urban catchment.
- The above conclusion indicates that a large scale flood mitigation scheme, capable of reducing the risk of flooding to all properties in the low point of the site, is unlikely to be cost beneficial and eligible for funding through the FCRM GiA program in this catchment.
- Option 6, Property Level Protection, is shown to be cost beneficial with a ratio of 1.1, this leads to a potential partnership funding of 19% of the scheme costs. For an application to be submitted, the additional 81% of the scheme costs would need to be funded from alternative sources. However, given the low cost: benefit ratio it is unlikely that the scheme proposals would be successful in attracting funding when compared to other potential schemes which are likely to offer better value for money for the available public funds. A combined Property Level Protection scheme led by the Lead Local Flood

Authority (LLFA) is therefore not deemed feasible to be taken forward to further assessment and preparation of an OBC.

- Based on the positive cost: benefit ratio achieved by Option 6, it is recommended that individual property owners look at ways of protecting their properties and improving their resilience during future flood events.

The current process means that, prior to any potential scheme implementation, a better understanding of risk is needed, and this means that hydraulic modelling needs to be undertaken. For most sites, modelling work can ensure a better understanding of flood risk. However, that modelling work may not lead to scheme development. This means that the money put towards modelling could be put towards property resilience measures instead; arguably, where used appropriately and with judgement, a better use of the money. To date, no property resilience measures have been implemented by the LLFA; it has been left as a decision for individual property owners.

Because of the dispersed nature of flood risk in the county the LLFA will need to explore alternative approaches to large surface water projects and schemes. This will include:

Natural Flood Management
This is an approach based on generally small scale projects aimed to slow flows in surface water catchments and watercourses.

Catchment wide property level flood risk initiatives
Aggregating small scale flood risk across a catchment and seeking funding to support owners to reduce the flood risk to individual properties.

Photograph 18: Boundary wall and flood gates

Retrofitting SuDS

A similar approach to NFM but in more developed catchments. Again likely to be small scale projects each making a contribution to managing surface water across a catchment rather than as a single measure to reduce flood risk to specific properties.

Action 8: Implementing new flood risk management schemes

The potential for Natural Flood Risk Management to be applied in Hertfordshire will be explored by the LLFA through the project supported by Thames RFCC which is initially based on two pilot areas in Long Marston and Harpenden.

The LLFA will explore with the RFCCs the potential for funding schemes that could be used to support action by individual property owners in areas where larger engineered structures are not viable.

Working with Thames Water Utilities Ltd and Anglian Water Services the LLFA will seek to identify areas for the retrofitting of SuDS where there is insufficient capacity in the sewerage system.

4.5.6 Prioritising investment

Funding will need to be sought from a variety of sources in order to deliver projects. For larger schemes the funding will almost certainly be sought from the national grant scheme FCERM GiA. It can be used for a variety of projects from initial feasibility studies to the construction of substantial defences. Most sources of flooding are eligible other than those that are the responsibility of water and sewerage companies who have alternative means of funding projects.

The grant is based on a partnership funding approach which is outcome focussed, providing funding in a formula based manner depending on benefits to households, other whole life benefits to businesses, agricultural productivity and infrastructure and environmental outcomes. Providing cost benefit requirements are satisfied, grant is available for all schemes, however the level of funding depends on the outcomes delivered through the scheme, for example the number of properties which have reduced flood risk. Depending on the balance of costs to the grant awarded against outcomes, schemes can be eligible for funding ranging from an eligibility in excess of costs which means they will be fully funded or the grant may be a minor proportion of total cost requiring other funding to be sought.

The details can be seen at: https://www.gov.uk/guidance/flood-and-coastal-defence-funding-submit-a-project

Allocation of funding is through the 6 year investment programmes which are coordinated by the Environment Agency for approval by the relevant Regional Flood

and Coastal Committee (RFCC). Hertfordshire falls in the areas covered by the Thames RFCC and Anglian Central RFCC.

In addition to providing access to the national grant the committees collect an annual local levy from the Lead Local Flood Authorities in the RFCC area to use for flood and coastal risk. The levy can be used to fund or contribute to any of the projects in the committee's area. It is considered to be a local contribution so it may be used to top up the funding for schemes which have been partially funded through the national grant.

It is likely that most schemes will receive a percentage of the required funding through the national grant, and other contributions will be needed from a regional or local source and/or cost savings found to ensure the project is fully funded and can proceed. For surface water schemes proposed for relatively small numbers of properties experience to date for viable schemes meeting cost benefit requirements has found the proportion of funding from FCERM GiA is generally between 25% and 50% of the total scheme cost.

Beyond FDGiA and local levy, funding can be sought from a variety of sources. Some of these may be directly linked to management of flood risk for example direct contributions from a Risk Management Authority. Where a scheme will deliver benefits in addition to flood risk for example for wildlife or access, funding may be available towards delivering these benefits which would support the overall scheme also delivering flood risk benefits.

Hertfordshire's flood risk partners will need to determine how to prioritise schemes put forward, whether to focus on only developing schemes that will qualify to be fully funded or whether to supplement or seek contributions for schemes that will be partially funded through national grant.

Partnership work with the Water and Sewerage Companies will be developed further in the period of this strategy. Where the WaSCs can demonstrate that their customers will benefit from flood risk management schemes and it is in line with their approved business plan they are able to make contributions to costs. As part of the planning for their next business plan cycle (AMP 7) the LLFA has been exploring with Anglian Water and Thames Water the potential for partnership funded schemes from 2020.

Local contributions are not mandatory and a decision can be taken by the partnership on whether to collect contributions. It will need to be decided how to raise the additional money, taking into account partners involved, those likely to benefit and the ability to pay a contribution. The process for collecting local contributions can also be lengthy. However, the use of local contributions is likely to be considered favourably by other funding sources and allows a local influence on schemes which are taken forward; where there is the will to pay or local backing for a project.

A prioritisation methodology has been developed in conjunction with RMAs and other key stakeholders. It is based on the methodology set out in the previous LFRMS and has been modified based on experience from assessing potential schemes over the period 2012 - 2017. This methodology, as well as considering property related flood risk, takes into account aspects such as the vulnerability of people affected and criticality of services and infrastructure. Figure 6 shows this as a decision tree.

Other factors such as loss of transport links and relative scale of impact on a community have also been considered. The potential of a scheme to secure national funding has also been included within the priority scoring; which has been weighted accordingly. Benefits of flood schemes which are difficult to define in financial terms

such as environmental, social realm and health have also been taken into account. They cannot however, be prioritised over actual flooding.

Action 9: Appraising schemes – additional benefits

Linked to Aim 2b, when appraising schemes for implementation, benefits that could be delivered in addition to flood risk objectives will be considered, and potential partners made aware of the potential for funding or contributions in kind.

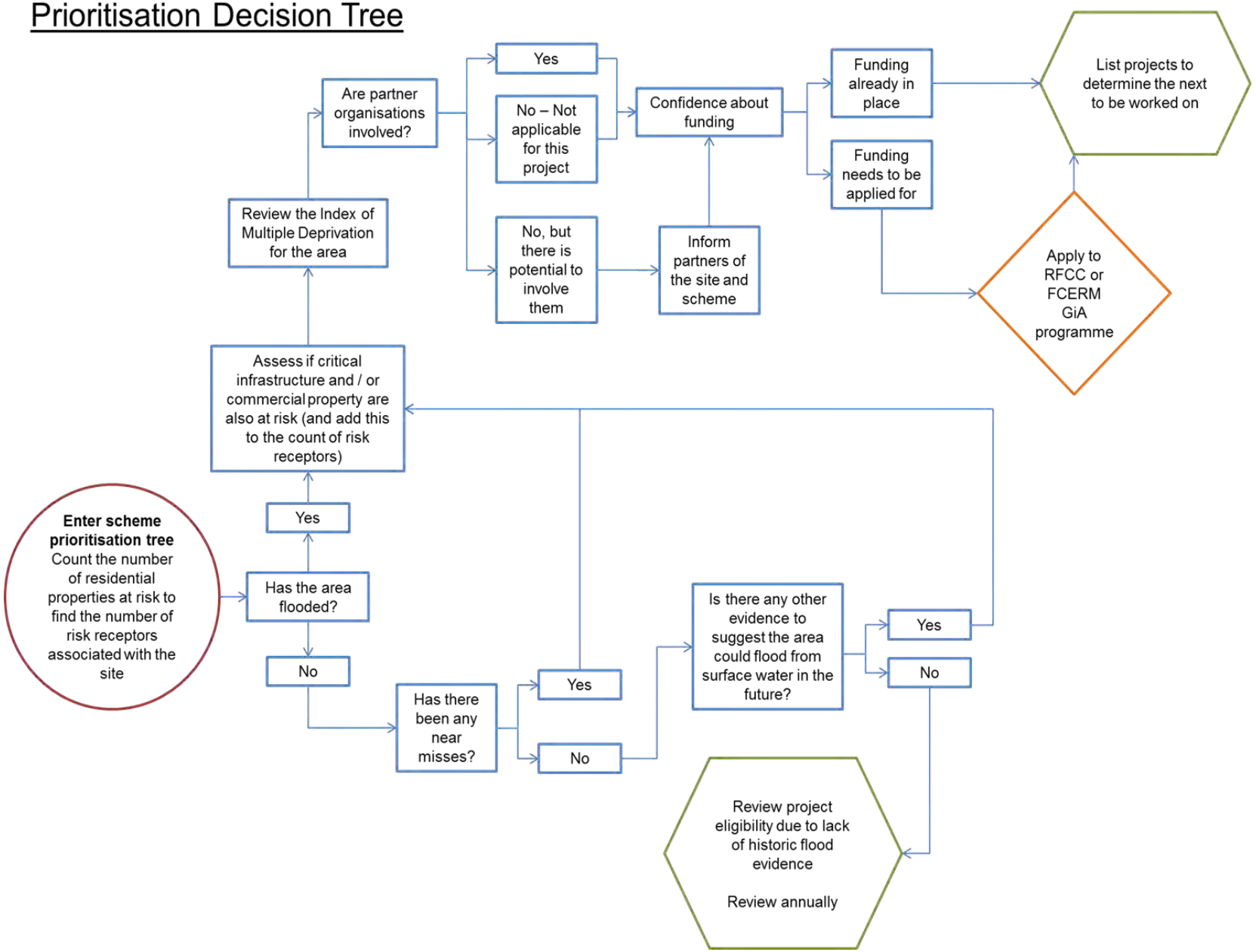


Figure 6: Prioritisation Decision Tree

The methodology must aim to provide transparent and clear reasoning for the prioritisation and justification for the feasibility and viability of the project. Prioritisation of local projects is necessary as it must be recognised that taking into account all funding sources, it will still not be possible to fund all flood risk management projects identified.

Once potential projects have been identified in areas at risk of flooding from local sources, either through the Surface Water Management Plan (SWMP) process or through another technical study, the projects will be ranked initially by using the proposed criteria in Table 8. The implementation of schemes that have been prioritised will depend on the availability of funding, which is likely to have to be drawn from a number of sources. Some funding may be restricted to a particular area of benefit or a specific community, but where there is discretion the criteria in Table 8 will be used to help determine which projects should benefit from local funding sources.

This prioritisation process will build up a picture over time of the most beneficial flood risk management projects within the highest risk areas, allowing Hertfordshire County Council and its partners to focus efforts on funding local projects. However it must be recognised that it is possible for projects to advance more quickly than the initial prioritisation if local funding becomes available which would ‘unlock’ a project’s potential for moving forward. In this way local communities and organisations could consider investing in raising local contributions as beneficiaries of a proposed scheme in order for it to be realised.

The methodology used to prioritise investment is outlined in Figure 6. It is flexible in order to take account of opportunistic schemes, as they become available. Examples of such opportunistic schemes include partnership working with other RMAs, such as where flooding occurs from a range of sources (fluvial and pluvial). Where this is the case, a scheme would involve partnership working with the Environment Agency

and/or Thames Water/Anglian Water. Partnership working could also include cross county border working with other LLFAs, where flood risk is shared.

Policy 12: Prioritising Investment

Flood risk management schemes will be prioritised based on a published methodology and criteria.

Table 8: Criteria and associated score for prioritising flood risk management schemes in Hertfordshire

No.	Criteria Description	Low Count	Low Score	Moderate Count	Moderate Score	Significant Count	Significant Score	Maximum Score
1	Number of people at risk of flooding. Residential buildings within the RoFfSW map (Risk of surface water flooding from a rainfall event with a 1% (or 1 in 100) chance of occurring in any one year)	0 to 25	5	26 to 84	10	> 84	15	15
2	Number of critical infrastructure at risk of flooding	0	0	1	5	> 1	10	10
3	Number of historic flooding incidents (including multiple events at one property)	0 to 10	5	10 to 50	20	> 50	35	35
4	Number of partners agreed that a site is a priority flooding location or A partnership project becomes available, which is opportunistic for the LLFA.	0	0	1 to 2	10	> 2	15	15
5a	Funding (a) Funding already in place or Local contributions realised	<50%	0	≥50%	2.5	100%	5	5
5b	Funding (b) Ability of funding to be realised	< 10	0	≥ 10	2.5	≥ 20	5	5
6	Index of Multiple Deprivation	> 40%	0	20 to 40%	5	< 20%	10	10
7	Time-bound opportunities	0	0	1	2.5	> 1	5	5
8	Urgency of delivery							
	Total							100

4.6 Principle 6: Ensuring that flood risk arising from new development is managed appropriately

Aim 6a: *New development must manage its own flood risk, not contribute to flood risk in the local area and must take into account the effects of climate change.*

Aim 6b: *New development must make appropriate arrangements for the management and maintenance of features put in place to manage local flood risk.*

Aim 6c: *Where possible, new development should contribute to reducing any existing flood risk within the local area.*

The statutory consultee role the LLFA has in relation to major planning applications aims to ensure that all new major[3] development does not contribute to increased flood risk from surface water and that surface water arising from the development site is managed in a sustainable way prioritising the use of sustainable drainage systems. The assessment undertaken is based on the non-statutory technical standards produced by the Department for Environment Food and Rural Affairs (DEFRA) in partnership with industry stakeholders.

[3] "major development" means development involving any one or more of the following—
(a) the winning and working of minerals or the use of land for mineral-working deposits;
(b) waste development;
(c) the provision of dwellinghouses where —
(i) the number of dwellinghouses to be provided is 10 or more; or
(ii) the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (c)(i);
(d) the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more;
(e) development carried out on a site having an area of 1 hectare or more;

The role of advising LPAs on major planning applications is a relatively new service that has only been operational since April 2015. It is new for both the LPA and the LLFA and processes are still bedding in and developing.

It should be noted that whilst the LLFA has to provide this advice to the LPAs it is only advice. There is no requirement on the LPAs to heed that advice and they could choose to disregard it. However, experience from when the provision of this new service started suggests that this is rarely the case as the objective is to work collaboratively with LPAs and developers until a satisfactory solution can be achieved. This outcome has been arrived at in the majority of applications for which the LLFA has been consulted. Solutions are usually agreed prior to the planning decision being made with final details being handled through the use of planning conditions.

During the early implementation of the new requirements for sustainable drainage there was a distinct lack of understanding from LPAs, developers and consultants as to the changes and what they meant for development proposals. These changes have brought consideration of site surface water drainage up-front during the planning process with many issues that would previously have been dealt with through planning conditions now having to be thought through earlier and resolved at the application stage. This gives more scope to accommodate any necessary changes to site design and layout for a more satisfactory outcome for surface water drainage arrangements..

Whilst the LLFA is required to provide advice about the suitability of the arrangements made for the management of surface water, the body responsible for assessing whether the maintenance and operational arrangements that are proposed are suitable for the lifetime of the development remains the LPA. There is no national guidance in relation to this issue and it remains a significant problem as to how to ensure that drainage systems will be maintained during their lifetime when operated privately either through management companies or local charitable trusts.

At present any enforcement of this issue is expected to be undertaken by the LPA; however it remains unclear as to how this will happen and who will do it if and when problems are reported.

The delivery of sustainable drainage still requires a considerable amount of cooperation from the developer and for the LPA to be robust in their requirements for above ground solutions in order to minimise the risk of system failure. For an area like Hertfordshire with 11 separate LPAs delivering a consistent approach is difficult especially as there is not a single approach across all of the local plans to this area of development management. For the same purpose, the LLFA tries to work consistently with the key stakeholders as part of the assessment of the proposals. This is done through regular correspondence and meetings with the Environment Agency, the water companies and Highways authorities.

Relationships between planning officers at the LPAs and the case officers within the LLFA are developing. The need for closer working to ensure that the advice is understood and represents the needs of the LPA is critical. In addition with the day to day relationship with planning officers, training/briefing sessions will be regularly arranged in each district to better provide understanding in the sector about changes and requirements. Working together with the key players as defined earlier (Environment Agency, the water companies and Highways authority) also helps give more clarity and transparency on the duties and thereafter, the expectations of each of the stakeholders.

Further development of these working relationships is anticipated in the lifetime of this strategy. The pre-implementation version of Sewers for Adoption 8th Edition (SfA8) sets out a potential role for WaSCs to adopt SuDS elements of surface water drainage systems. Although this document may change before it is implemented in mid 2019 it is likely to be on points of detail rather than the broad principle.

The efficiency of the pre-application advisory service has been demonstrated. This service gives the LLFA the opportunity to be proactive with developers and consultants. As part of the strategy the LLFA would promote this service as far as possible, as the results observed are encouraging and early engagement is proving effective at maintaining relationships throughout the process.

As well as calculations required to take account of climate change and changing patterns of rainfall, urban creep should be considered. The best way to apply this factor and a clear definition of when it would be required must be sought and reflected in the updated guidance. The urban creep would reflect the conversion of permeable surfaces to impermeable over the lifetime of the development.

The LLFA is a statutory consultee in relation to surface water management and flood risk arising from major new development only. As such the LLFA would not normally be consulted on minor applications, however there may be circumstances where to secure betterment to existing flood risk issues it would be beneficial for all forms of new development to manage surface water appropriately. In these situations the LLFA will encourage the LPA to secure the management of surface water utilising SuDS for all planning applications. This will be progressed as part of the service improvements that will be required as a result of the overall strategy approach set out within LFRMS2.

Action 10: Working with LPAs on minor applications

The LLFA will explore with the LPAs how best to define areas where it would be desirable to consult the LLFA on minor applications and what information should be secured from the applicant.

4.6.1 Run-off Destination (disposal hierarchy)

The non- statutory National Standards and guidance specify a preference hierarchy for runoff destinations, and set out conditions under which a less preferred route may be allowable. Further details on the specific requirements are set out within the HCC Guidance for SuDS in Hertfordshire.

Policy 13: Discharge hierarchy for SuDS

Proposals for SuDS must follow the discharge hierarchy as set out in the non-statutory technical standards for sustainable drainage systems.

The discharge hierarchy should be appropriately assessed and the selected discharge point for proposed SuDS must be justified in accordance with the SuDS standard requirement for runoff destination using a methodology acceptable to Hertfordshire County Council and the Local Planning Authority.

To support the drainage strategy, approval for discharge should be sought from the owner/operator of the receiving system. This should include permission to cross the land adjacent to the site and/or land in third-party ownership to secure access to the proposed connection point.

4.6.2 Peak Flow and Volume Control – Greenfield Sites

The introduction of impermeable areas as a result of development will lead to an increase in rate and volume of runoff. Significant changes to greenfield runoff characteristics as a result of development will not be acceptable.

Policy 14: Runoff rates for greenfield sites

For greenfield sites, the peak runoff rate from the development for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must not exceed the peak greenfield runoff rate from the whole site for the same event.

The runoff volume from the developed site in the 1 in 100 year, 6 hour rainfall event must not exceed the greenfield runoff volume for the same event.

4.6.3 Peak Flow and Volume Control - Previously developed sites

It is accepted that that rate and volume of runoff from previously developed land will be higher than on equivalent greenfield sites, however the redevelopment process presents opportunities for redesign of drainage to restore greenfield runoff characteristics.

HCC Guidance for SuDS in Hertfordshire provides an approach for meeting peak flow rate and volume requirements on previously developed land, in particular by requiring betterment of existing runoff conditions where Greenfield runoff cannot be achieved. Flow rate and storage volume calculations should be presented in a manner that is acceptable to the LLFA. For further guidance on the calculations that should be provided; please see HCC SuDS Guidance document**.**

Policy 15: Runoff rates for previously developed sites

Previously developed sites should aim to discharge at the original pre-development greenfield rate for the whole site area where possible. If not, a significant reduction in the current rate of discharge should be achieved and evidence provided as to why greenfield rates are not viable.

The volume of attenuation storage that would be required for the site should be based on the 1 in 100 year critical storm duration with an allowance for climate change and the allowable discharge rate.

4.6.4 Flood Risk Within & Outside the Development

The design of the SuDS must demonstrate:

a) The management of water falling directly on the development site by SuDS.
b) The management of runoff produced by the site to prevent increase in flood risk downstream.

It is essential that the drainage scheme proposed protects the development site from flooding and does not increase flood risk to the development or surrounding area. Any drainage scheme must manage all sources of surface water, including exceedance flows and surface flows from offsite, provide for emergency, ingress and egress and ensure adequate connectivity.

Policy 16: Flooding on and from development sites

Flooding must not occur on any part of the site for a 1 in 30 year rainfall event except in areas that are designed to hold and convey water.

During a 1 in 100 year plus climate change rainfall event no flooding should occur in any part of a building (including a basement); utility plant susceptible to water (e.g. pumping station or electrical sub-station) or on neighbouring sites.

If there is flooding during 1 in 100 year plus climate change rainfall event, this should be indicated on plan showing extent and depth. Flows that exceed design criteria must be managed in exceedance routes) that minimise risks to people and property both on and off the site.

4.6.5 Managing Overland Flow Routes

Where a site or its immediate surroundings have been identified to be at flood risk, all opportunities to reduce the identified risk should be explored. New development should be designed to take full account of any existing flood risk, irrespective of the source of flooding. This includes any existing or predicted flow routes entering the site.

The information should indicate areas for flood storage and/or exceedance and the volumes that need to be managed. These volumes can be accommodated within the drainage system itself or within other designated areas within the site for conveyance and storage.

Policy 17: Development sites along natural flow routes and in existing flood risk areas

Where a development alters the natural flow route and/or is located in an area with existing flooding issues or a high risk of potential flooding; proposals must demonstrate the management of any existing and predicted overland flows entering the site from adjacent areas for all rainfall events up to and including 1 in 100 year plus climate change event.

4.6.6 Maximise Resilience and Source Control

SuDS should be provided above ground where possible in line with the SuDS hierarchy. For Greenfield sites, the proposed SuDS features should be above ground. Underground attenuation in Greenfield sites are considered unacceptable and a technical justification should be provided for its usage.

Where it is necessary to provide underground drainage measures, more regular and extensive inspection and maintenance will be required.

Current figures that should be applied for climate changes and urban creep can be found in HCC SuDS Guidance document.

Policy 18: SuDS to be designed at or near the surface

Proposals must demonstrate that the SuDS have been designed at or near the surface in line with the SuDS hierarchy. Underground attenuation features will only be acceptable where it is proven that alternate surface based methods are not appropriate or feasible.

The design of the drainage system must account for the likely impacts of climate change and changes in impermeable area over the design life of the development. Appropriate allowances should be applied in each case.

4.6.7 Management of drainage during construction period

It is necessary to provide appropriate temporary infrastructure on site to deal with surface water during the construction period. This includes providing appropriate attenuation and water quality control water for surface water that would collect within the construction site.

If a proposed development is to be delivered in phases, a commitment should be made for a site-wide SuDS scheme to be delivered with the first phase of development, designed to be capable of accommodating the runoff from each of the subsequent phases. If this is not possible, the runoff from each separate phase must be controlled independently. Whichever approach is taken, the control of surface water runoff during construction should be considered.

Policy 19: During construction arrangements

There should be appropriate arrangements for surface water drainage during the construction phase of a development site. A construction management plan to address all surface water runoff and any flooding issues during the construction stage should be submitted at detailed design stage.

4.6.8 Maintenance, Structural Integrity & Construction

It is important to ensure that all SuDS features are constructed as designed so that they perform as intended and are easy to maintain. Drainage components should have a design life compatible with that development. Therefore materials used should ensure the structural stability of the features and construction should comply with appropriate standards.

Maintenance requirements should be considered at all stages including during design and construction. It is essential that suitable access is provided to be able to facilitate monitoring and works. For further guidance, please see HCC SuDS Guidance document.

Maintenance is a key issue throughout the planning process and information will need to be provided to demonstrate that SuDS are designed with easy and affordable maintenance. The LPA will need to be satisfied that arrangements are in place for the long term maintenance of SuDS.

Policy 20: SuDS to have a design life compatible with the development and to include a management and maintenance plan

Drainage components should have a design life compatible with the development. Design should be based on actual site levels, ensuring that the construction of any other infrastructure and services does not compromise the final construction of the SuDS.

Proposals for SuDS must include a management and maintenance plan for the lifetime of the development which shall include arrangements for adoption and any other arrangements to secure the operation of the scheme throughout its lifetime.

4.6.9 Sustainability and additional design criteria

In addition to the National Planning Policy Guidance and non- statutory Standards, more detailed local design guidance is set out on the HCC SuDS Guidance document**.**

The wider benefits that are appropriate will depend on the site and its particular context in terms of local plans, strategies and policies, and physical environment factors. These are likely to be similar to those that are required to be addressed as part of the development management process i.e. linked to wider landscape and biodiversity objectives. Other benefits may also be sought where appropriate to the scheme and its wider context.

Policy 21: SuDS to have wider benefits

In accordance with relevant local plan policies and guidance, proposals for SuDS must maximise wider benefits as appropriate, which include consideration of:

- *Safeguarding Water Quality*
- *Designing for Amenity and Multi-Functionality*

4.6.10 Development and Watercourses

In two tier local authority areas an artefact of the Flood and Water Management Act legislation resulted in powers relating to ordinary watercourses being divided between the LLFA and district or borough councils. The LLFA holds the powers of consenting and enforcement under sections 23, 24 and 25 of the Land Drainage Act 1991 and district or borough councils hold the powers to manage flood risk from ordinary watercourses under section 14A of the act.

Although the district councils are all subject to the same duties and have the same powers available to them, they do not operate to a standardised structure. Differences in scale, geography, demographics, economy and administration mean that each have different pressures and priorities. As a result there is not a uniform level of flood risk management activity linked to ordinary watercourses across the county.

Only activity within a watercourse can be regulated under the powers available to the LLFA through sections 23, 24 and 25 of the Land Drainage Act. Works above or adjacent to a watercourse that could have a potential impact may be regulated through by-law provision or if the works required planning consent. So the LLFA does not itself have the available powers to deliver Policy 8. The powers are held by district or borough councils but in practice there are capacity limitations as matters relating to ordinary watercourses tend to be delegated to an individual as part of a much wider remit.

Only three of the ten districts in Hertfordshire have taken up the powers to develop by-laws for the operation of ordinary watercourses. The LLFA does not routinely advise on minor planning applications and there are no policies specific to operation of watercourses in district Local Plans.

To support this, the LLFA would need to work with district and borough councils to determine how they could assist using their land drainage powers and development management procedures. There would also be the option to use powers under Section 13 of the FWMA which allows a Risk Management Authority to make arrangements for a flood risk management function to be exercised on its behalf by another Risk Management Authority.

Action 11: Ordinary watercourse regulation

That the LLFA works with district and borough councils and other relevant RMAs to develop a consistent framework across the county for the regulation of activity relating to ordinary watercourses.

5. List of Policies

6. List of Actions

7. Indicative Work Programme

7.1 Local Flood Risk Management Strategy Indicative Work Programme 2019 - 2024

Actions / Topics	Short Term 1 – 2 years	Medium Term 2 – 5 years	Long Term 5 years plus
Local Flood Risk Management Strategy	Annual monitoring reports	Annual monitoring reports Carry out mid-term review	Annual monitoring reports Revise as required (LFRMS 3)
Action 1: Work with community groups	Continue to work with existing contacts e.g. Eastbury Road Flood Action Group, Tring Rural Parish Council Flood Working Party, and Aldbury Parish Council to determine most practical and effective support that can be offered.	Identify areas where community based initiatives are likely to be the most viable means of managing local flood risk in the long term. Develop and offer a package of support for community groups in these areas.	Review and refine support offered.
Action 2: Set up a countywide strategic flood risk partnership	Convene partnership group of LLFA, Environment Agency	Annual forums for wider group stakeholders.	Review effectiveness of arrangements.

Actions / Topics	Short Term 1 – 2 years	Medium Term 2 – 5 years	Long Term 5 years plus
Action 3: Ensure the LLFA is consulted on any proposals to reduce groundwater abstraction	Engage with water supply companies, Environment Agency and CaBA catchment groups to ensure that LLFA can input at early stages of proposal development.		Review any changes to groundwater abstraction to examine for any impacts on flood risk.
Action 4: Make up-to-date information readily available for individuals and communities	Audit current provision and research good practice examples and approaches. Establish information requirements pre, during and post flooding. Identify with partners how, when and by whom this is best delivered.	HCC led campaigns and supporting those led by others e.g. EA in Autumn /Winter. Improvements to accessibility of information on website (more interactive and directive).	Continue to monitor potential for improvements such as better forecasting of surface water flood events.
Action 5: Performance indicators linked to the asset register	Research and adopt framework to inform, inspection, characterisation and action supporting the management of assets that have a significant impact on local flood risk.	Commission inspections and where necessary programme any remedial through Action 6, Action 7 or Action 8.	Review
Action 6: Small Projects Fund	Refine criteria for allocation of budget and then monitor application of funding.		Review effectiveness of approach.

Actions / Topics	Short Term 1 – 2 years	Medium Term 2 – 5 years	Long Term 5 years plus
Action 7: Ordinary watercourse powers	Links to Action 11 if best approach determined to be longer term delegation of powers rather than on a case by case.		
Action 8: Implementing new flood risk management schemes (Initial assessment of where schemes may be required)	Complete Surface Water Management Plans for Hertsmere, Stevenage, Three Rivers and Welwyn Hatfield.		Review and where required refine identified “hotspots.”
(Feasibility, design, outline business case and construction)	Collate, prioritise and programme action for Hotspots from all 10 SWMPs and other areas identified through activity such as s19 investigations.	Implement programme through such activities as: developing projects led by the LLFA or other RMAs, informing planning decisions.	Review programme.
(Participation in RFCC programmes)	Continue to develop “pipeline” of projects for next cycle of RFCC funding from 2021 onwards.	Support delivery of projects and “refresh” with new schemes as capacity and opportunity become available.	Prepare for programme running from 2026.

Actions / Topics	Short Term 1 – 2 years	Medium Term 2 – 5 years	Long Term 5 years plus
(Natural Flood Management (NFM) pilot project)	Continue with development of pilot studies and report findings towards the end of 2020.	Apply findings from project to areas across Hertfordshire where NFM techniques would benefit surface water management and flood risk.	Review NFM as part of a catchment management approach.
Action 9: Appraising schemes – additional benefits	Include identification of wider benefits of schemes as a requirement in all new flood risk management scheme assessments.	Work with relevant partners to promote the wider benefits of schemes and identify where this may bring additional resources.	Review impact and effectiveness
Action 10: Working with LPAs on minor applications	Develop criteria and identify areas where the LLFA would want to be consulted on all planning applications and pilot with one district. Review pilot.	Roll out approach based on pilot findings across all local planning authority areas.	Review effectiveness of approach as a contribution towards longer term improvement of catchment based management of flood risk.
Action 11: Ordinary watercourse regulation	Engage with district councils and other relevant RMAs to agree a framework for consistent application of ordinary watercourse regulation across Hertfordshire through common standards or delegation.	Develop material to support role; information for riparian owners, resources to support local planning authority policies and decisions.	Review impact and effectiveness

7.1.1 Ongoing and responsive activities

Activity	Task
S19 Investigations	Ongoing in response to flooding incidents and historical reports. Where appropriate commission technical support. Publish reports and facilitate engagement of effective residents.
Register of Structures and Features	Continue to add to register as structures and features come to light through investigations, surveys and scheme assessments. Carry out inspections. Follow up to facilitate assets being brought into appropriate condition.
Make sure flood risk is appropriately considered in new major developments	Continue to deliver and develop service responding to statutory consultations from LPAs and offering pre application advice to developers and those working on their behalf.

7.2 Resources associated with the work programme and strategy implementation

Measures	Benefits	Costs 1-5 years Within existing resources (2018/19 £560K pa staff and operational budget)	Costs 1-5 years Requires external contribution
Local Flood Risk Management Strategy	LLFA fulfils its statutory duties, better understanding and management of local flood risk.	Staff time to monitor, report and review.	
Action 1: Work with community groups	In order for local flood risk to be effectively managed action needs to be taken at a property and community level as it cannot be done by relying on infrastructure provision and response.	Initially resources would come from staff time and existing operational budgets.	After an initial “pilot” stage a business case may be made to access external resource e.g. through RFCC.

Measures	Benefits	Costs 1-5 years Within existing resources (2018/19 £560K pa staff and operational budget)	Costs 1-5 years Requires external contribution
Action 2: Set up a countywide strategic flood risk partnership	Promoting alignment of resources committed through medium and long term plans term plans. Development of multi benefit schemes and initiatives which benefit from joint funding to deliver a range of outcomes and benefits required by a number of stakeholders.	Staff time to facilitate	
Action 3: Ensure the LLFA is consulted on any proposals to reduce groundwater abstraction	Potential impacts are understood when there is greater the ability to plan mitigation and management of any increased risks.	Staff time to facilitate	
Action 4: Make up-to-date information readily available for individuals and communities	Gives people access to the most up to date information to inform decisions they may make about taking individual action to manage their flood risk. Decision making more transparent.	Staff time to manage process costs. Internal support to develop any web based resources.	
Action 5: Performance indicators linked to the asset register	Optimal management of Flood Risk Management assets	Resources to develop indicators from staff time and existing budgets.	

Measures	Benefits	Costs 1-5 years Within existing resources (2018/19 £560K pa staff and operational budget)	Costs 1-5 years Requires external contribution
Action 6: Small Projects Fund	Cost effective resolution of small scale significant issues where ownership and responsibilities are unclear.	Up to £50K per annum	
Action 7: Ordinary watercourse powers	Makes response to issues on ordinary watercourses more consistent and efficient.	Staff time to facilitate. Funding for projects anticipated through proposed small projects fund.	
Action 8: Implementing new flood risk management schemes (Initial assessment of where schemes may be required)	Identifies areas where there may be potential to manage to manage local flood risk. Helps prioritise where resources to develop schemes and initiatives would be best deployed and identify where further research would help decision making.	Staff time to manage process. May require funding (local budget or via RFCC programmes) for additional capacity or technical support from consultants and contractors.	May require funding (local budget or via RFCC programmes) for additional capacity or technical support from consultants and contractors.

Measures	**Benefits**	**Costs 1-5 years Within existing resources (2018/19 £560K pa staff and operational budget)**	**Costs 1-5 years Requires external contribution**
(Feasibility, design, outline business case and construction)	Required to provide justification for projects and initiatives. Helps to give a better understanding of the potential benefits and costs of schemes to refine decision making and prioritisation.	Staff time to manage process. May require funding (local budget or via RFCC programmes) for additional capacity or technical support from consultants and contractors.	Construction costs will require additional local contributions which may include bids to HCC's capital programme.
(Participation in RFCC programmes)	Gives access to national and regional funding schemes. Promotes integrated management of catchments and the potential for strategic partnership working.	Staff time to manage process.	Additional local (partnership funding) contributions which may include bids to HCC's capital programme.
(Natural Flood Management pilot project)	Opportunity to improve flood risk in two pilot locations and assess the potential to use NFM as a means of reducing flood risk in areas where localised projects are not viable.	Staffing and operational budget £250K - £350K for the period July 2017 to August 2020 (depending on the potential to implement projects).	Contribution from local level through RFCC already allocated.

Measures	Benefits	Costs 1-5 years Within existing resources (2018/19 £560K pa staff and operational budget)	Costs 1-5 years Requires external contribution
Action 9: Appraising schemes – additional benefits	Will improve the potential to attract resources to fund and facilitate flood risk management schemes. Will demonstrate how the flood risk management strategy contributes to wider objectives of sustainability.	Staff resource as required. Specialist support commissioned using operational budget. Not anticipated to be a significant demand.	
Action 10: Working with LPAs on minor applications	Realise any opportunities to manage existing flood risk through changes linked to new development. Ensure that any increase in flood risk linked to new development is minimised.	Staff time to manage process, training, research, data provision from operational budget. Staff resource to assess applications.	May need to be offered as a chargeable service.
Action 11: Ordinary watercourse regulation	Local drainage networks are maintained in a functional condition helping reduce the potential for flooding.	0.5 full time equivalent (FTE)	

Measures	Benefits	Costs 1-5 years Within existing resources (2018/19 £560K pa staff and operational budget)	Costs 1-5 years Requires external contribution
S19 Investigations	LLFA fulfils its statutory duties, enables better understanding of flood risk by those affected and promotes better management of local flood risk.	Staff resource as required. Specialist support commissioned using operational budget.	
Register of Structures and Features	LLFA fulfils its statutory duties, better understanding and management of local flood risk.	Staff resource as required. Specialist support commissioned using operational budget.	
Make sure flood risk is appropriately considered in new major developments	Realise any opportunities to manage existing flood risk through changes linked to new development. Ensure that any increase in flood risk linked to new development is minimised.	3.5 full time equivalent FTE)	

8. Monitoring and updating the strategy

Progress will be reported annually to the relevant HCC member panel and published on the web.

It is intended that this strategy will be reviewed after 5 years.

Appendices

A1. Appendix 1: Responsibilities of Risk Management Authorities

A1.1 Hertfordshire County Council

Hertfordshire County Council as the Lead Local Flood Authority (LLFA) has an important role to play as the strategic leader for local flood risk management in Hertfordshire. This involves developing this Local Flood Risk Management Strategy document, ensuring that all organisations involved in flood risk management are aware of their responsibilities, monitoring progress and activity by all parties involved in flood risk management and co-ordinating communication with the public and between organisations.

As LLFA the county council has a range of duties which includes:

- Preparing reports and plans to meet the requirements of the Flood Risk Regulations 2009 (FRR).
- Carrying out investigations of flooding where appropriate and publishing reports (s19 F&WMA 2010).
- Keeping a public register and associated record of structures and features which have a significant effect on local flood risk (s21 F&WMA2010).
- Regulation of ordinary watercourses outside of areas covered by Internal Drainage Boards (s23, 24 and 25 of the LDA 1991).
- Statutory consultee to advise local planning authorities on surface water drainage and local flood risk for major development

In addition the authority has incidental powers under s14A of the LDA 1991 which allow it to carry out practical works to manage flood risk from surface water and groundwater.

Designation of structures and features where appropriate.

As well as being a Risk Management Authority by virtue of being the LLFA Hertfordshire County Council as the Highway Authority is also an RMA in addition there are a number of other roles that relate to flood risk management; these include:

- Highways Authority – management of the majority of roads in the county and their associated drainage.
- Planning Authority - the county council is the planning authority for minerals and waste development together with its own projects e.g. school sites. The authority produces Strategic Flood Risk Assessments (SFRA) to support the Minerals Local Plan and Waste Local Plan.
- Emergency Planning – the authority is a category one responder under the Civil Contingencies Act.
- Historical and Natural Environment - maintenance of databases which are shared with other authorities. The information is relevant to planning of practical works and assessing of potential for environmental impacts.

A1.2 Environment Agency

The Environment Agency has a role in flood risk management both as a national strategic body and also more locally operating as a Risk Management Authority (RMA) at a catchment and area level. Aspects of the strategic role that are relevant to the Local Flood Risk Management Strategy are:

- Using strategic plans like the River Basin Flood Risk Management Plans to set the direction for Flood Risk Management.
- Collation and review of the assessments, plans and maps that LLFAs produce to meet the Flood Risk Regulations 2009.
- Providing the data, information and tools to inform government policy and aid risk management authorities in delivering their responsibilities.
- Supporting collaboration, knowledge-building and sharing of good practice including provision of capacity-building schemes such as trainee schemes and officer training.
- Managing the Regional Flood and Coastal Committees (RFCCs) and supporting their decisions in allocating funding for flood defence and flood resilience schemes.
- Monitoring activity and reporting on flood and coastal erosion risk management.
- Providing grants to RMAs to support the implementation of their incidental flooding or environmental powers.

The Environment Agency's local role as an RMA is relevant in the following areas:

- Managing flooding from main rivers and reservoirs.
- Communication about flood risk warnings to the public, the media and to partner organisations.
- Supporting communities to be flood resilient through sharing best practice and provision of information.
- Advising on the planning process.

- Emergency planning, multi-agency flood plans, which are developed by local resilience forums.
- Bringing forward flood defence schemes through the RFCCs, working with LLFAs and local communities to shape schemes which respond to local priorities.

A1.3 District and Borough Councils

Have a flood risk management function relating to ordinary watercourses and in addition have a range of functions which are relevant to the Local Flood Risk Management Strategy:

- As planning authorities, the district and borough councils prepare a local plan to guide development. Flood risk is taken into account based on a SFRA which must consider flood risk from all forms of flooding.
- Under the Flood and Water Management Act 2010 (FWMA), district and borough councils have the powers to carry out works on ordinary watercourses to reduce flood risk.
- Activity relating to powers under the Land Drainage Act 1991 to make bylaws relating to ordinary watercourses.
- District and borough councils own and manage public spaces which, may already, and could potentially perform a flood risk management function.
- District and borough councils have responsibilities for emergency planning as a responder under the Civil Contingencies Act and this role is outlined in the Multi Agency Flood Plan.
- Consult the LLFA on major planning applications.

A1.4 Internal Drainage Boards

In addition to the universal responsibilities under the FWMA, Internal Drainage Boards (IDBs) have the following new responsibilities and responsibilities:

- Power to designate structures and features that affect flooding.
- Duty to act consistently with local and national strategies.
- Regulation of ordinary watercourses within the IDB district.

A1.5 Water Companies

There are two types of water companies serving Hertfordshire. Affinity Water Central is a water supply only company, while Anglian Water and Thames Water Utilities Limited provide both water supply and wastewater services.

Water Supply Companies
Water supply companies are not RMAs and do not have the same obligations to co-operate and be subject to scrutiny by LLFA committees. However, like all persons, they will be required to provide information related to flood risk to Hertfordshire County Council and the Environment Agency.

Water and Sewerage Companies
Water and sewerage companies have the following responsibilities around flood risk management:

- Respond to flooding incidents involving their assets.
- Maintenance of a register of properties at risk of flooding due to a hydraulic overload in the sewerage network (Flood Risk register).
- Investigating the potential to make improvements to alleviate sewer flooding problems affecting properties on their Flood Risk registers.
- Provide, maintain and operate systems of public sewers and works for the purpose of effectually draining an area.
- Have a duty to co-operate with other relevant authorities in the exercise of their flood and coastal erosion risk management functions.
- Must have a regard to national and local flood and coastal erosion risk management strategies.
- May be subject to scrutiny from LLFAs' democratic processes.
- Have a duty for the adoption of private sewers.

A1.6 Highways England

Highways England is a government company formed in 2015 responsible for operating, maintaining and improving the strategic road network in England on behalf of the Secretary of State for Transport. It acts as the Highways Authority for a

number of major highways in Hertfordshire and is responsible for the maintenance of the following motorways and trunk roads in Hertfordshire:

- M1 - Junction 4 – Junction 10.
- M25 - Junction 16 – Herts /Essex border (managed by Connect Plus).
- A1 Herts/LB Barnet border to Junction 1 of A1(M).
- A1(M) - Junction 1 – Junction 10.
- A5 - M1 Junction 9 – Herts / Beds border.
- A414 from the M1 Junction 8 to A405 at St. Albans.

The M25 is in the DBFO Area 5 the other roads are in Area 8.

As a Highways Authority, Highways England has the same obligation to co-operate on flood risk issues as the other RMAs. It also has the following responsibilities under other legislation:

- Responsibility to maintain the highways which includes highway drainage systems.
- Powers to deliver works considered necessary to protect the highway from flooding.
- Highway Authorities may divert parts of a watercourse or carry out any other works on any form of watercourse if it is necessary for the construction, improvement or alteration of the highway or provides a new means of access to any premises from a highway.

A2. Appendix 2: Responsibilities of Other LFRMS Stakeholders

A2.1 Property owners and businesses

Residents and Businesses

It is the responsibility of property owners and businesses to maintain and safeguard their property which includes protecting it from flooding. While in some circumstances other organisations or property owners may be liable due to neglect of their own responsibilities, there will be many occasions when flooding occurs despite all parties meeting their responsibilities. Consequently it is important that householders, whose homes are at risk of flooding, take steps to understand the flood risk and take appropriate steps.

Riparian Owners

Householders or businesses whose property is adjacent to a river or stream or ditch are likely to be riparian owners with responsibilities.

Riparian owners have a right to protect their property from flooding and erosion but in most cases will need to discuss the method of doing this with the Environment Agency or Lead Local Flood Authority. They also have responsibility for maintaining the bed and banks of the watercourse and ensuring there is no obstruction, diversion or pollution to the flow of the watercourse. Full details can be found at the link below.

https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities

A2.2 Utility and Infrastructure Providers

Utility and infrastructure providers such as Network Rail, TfL, The Canal and River Trust, energy companies and telecommunication companies are not risk management authorities (RMAs). However they have a crucial role to play in flood risk management as their assets can be important consideration in planning for flooding.

They already maintain plans for the future development and maintenance of the services they provide and it is important that they factor in flood risk management issues into this planning process. This will ensure that their assets and systems are resilient to flood risks and that the required level of service can be maintained in the event of an incident.

A2.3 Parish Councils and Communities

Communities have vital knowledge about the history of flooding in their areas and can make important contributions to helping manage the levels of flood risk and also by helping residents to be aware of and manage the risk to their household.

Parish Councils and community groups in areas which suffer from local flooding should record and report flooding incidents when they occur.

Most flood defence and flood resilience projects, particularly in small communities, will require some local funding to supplement that provided by national government if the project is to go ahead.

Parish Councils can raise funds through council tax precept or through other local commitments to raise the funds. They can also coordinate activity in communities facilitating practical contributions from residents.

A3. Appendix 3: Links to resilience information

Hertfordshire Local Resilience Forum

https://www.hertfordshire.gov.uk/services/business/business-advice/business-continuity-and-fire-safety.aspx

https://www.hertfordshire.gov.uk/services/fire-and-rescue/are-you-ready-for-anything.aspx

District councils

Dacorum

http://www.dacorum.gov.uk/home/business/business-continuity-management

http://www.dacorum.gov.uk/home/community-living/community-safety-asb/severe-weather-advice

Broxbourne

https://www.broxbourne.gov.uk/resident-environment-climate-change/flooding

https://www.broxbourne.gov.uk/business-support-businesses/business-continuity

East Herts

https://www.eastherts.gov.uk/article/34874/Emergencies

https://www.eastherts.gov.uk/article/35112/Flooding

Hertsmere

https://www.hertsmere.gov.uk/Environment-Refuse--Recycling/Drainage/Flooding.aspx

https://www.hertsmere.gov.uk/Community/Preparing-for-Emergencies/Emergency-planning/Flooding.aspx

https://www.hertsmere.gov.uk/Community/Preparing-for-Emergencies/Emergency-planning/Emergency-plans.aspx

https://www.hertsmere.gov.uk/Community/Preparing-for-Emergencies/Business-continuity.aspx

North Herts

https://north-herts.gov.uk/home/emergency-planning/warning-and-informing-pages/severe-storms-flooding

https://www.north-herts.gov.uk/home/emergency-planning/business-continuity-planning

St Albans

http://www.stalbans.gov.uk/contact-us/emergencies/floods.aspx

http://www.stalbans.gov.uk/contact-us/emergencies/emergency-planning.aspx

http://www.stalbans.gov.uk/business/continuity/

Stevenage

http://www.stevenage.gov.uk/about-the-council/156034/41316/

Three Rivers

http://www.threerivers.gov.uk/egcl-page/floods

http://www.threerivers.gov.uk/service/flooding

http://www.threerivers.gov.uk/egcl-page/business-continuity

http://www.threerivers.gov.uk/service/business-continuity

Watford

https://www.watford.gov.uk/info/20016/the_council/133/out_of_hours_emergencies

Welwyn Hatfield

http://www.welhat.gov.uk/flooding

http://www.welhat.gov.uk/article/627/Emergency-Plans

http://www.welhat.gov.uk/businesscontinuity

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https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england

Thames River Basin Flood Risk Management Plan (Flood Risk Regulations)

https://www.gov.uk/government/publications/thames-river-basin-district-flood-risk-management-plan

Anglian River Basin Flood Risk Management Plan (Flood Risk Regulations)

https://www.gov.uk/government/publications/anglian-river-basin-district-flood-risk-management-plan

Thames River Basin Management Plan (Water Framework Directive)

https://www.gov.uk/government/publications/thames-river-basin-district-river-basin-management-plan

Anglian River Basin Management Plan (Water Framework Directive)

https://www.gov.uk/government/collections/river-basin-management-plans-2015#anglian-river-basin-district-rbmp:-2015

Internal Drainage Boards (IDBs)

http://www.idbs.org.uk/

Water and Sewerage Companies (WaSCs)

http://www.anglianwater.co.uk/about-us/our-plan-2015-to-2020.aspx

https://corporate.thameswater.co.uk/About-us/Our-strategies-and-plans/Our-5-year-plan--2015-to-2020

Road investment strategy for the 2015 to 2020 road period

https://www.gov.uk/government/publications/road-investment-strategy-for-the-2015-to-2020-road-period

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waste-and-planning-policies/flooding-and-drainage-policies/drainage-and-planning-policy-statement

Milton Keynes Council. Surface Water Drainage and SUDS: Update to Planning Policy and Statutory Consultee Arrangements. https://www.milton-keynes.gov.uk/planning-and-building/urban-design-and-landscape-architecture-udla/flood-and-water-management-drainage?chapter=2