Ampney St Peter Drainage Strategy

Stage 1 - Initialise/Prepare

Thames Water

At the heart of daily life

Introduction

Why sewer flooding

Britain's first sewerage systems were constructed 150 years ago in the Victorian era, and have served us well for generations. The sewer network Thames Water operates today has been much improved and vastly extended over the years; yet it remains under increasing pressure.

Everyday our network manages the demands of one of the world's busiest and most densely populated capital cities, and its urbanised surrounding areas; together with the equally complex challenges arising in our predominantly rural catchments in the Thames Valley, Surrey and Kent.

A number of factors including population growth, less frequent but heavier rainfall, the urbanisation of green spaces and changes in agricultural land practices, and utilised machinery, occasionally overwhelm our sewer network. The result can be unwanted sewer flooding for customers and our neighbouring natural environments.

This document contains:

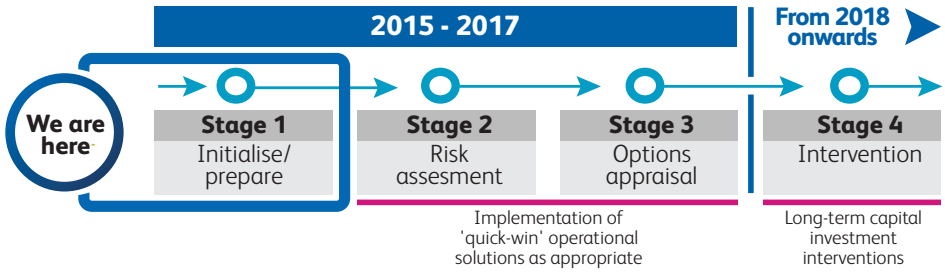
- an Introduction to the work we are undertaking to alleviate sewer flooding in our region
- a Feedback: Q&A section addressing key questions from customers and stakeholders
- the Ampney St Peter Drainage Strategy technical document.

What can be done and when?

Sewer flooding is unacceptable. We have undertaken extensive customer research and initiated a programme of work to improve drainage and alleviate sewer flooding issues across our region.

We are adopting the good practice Drainage Strategy framework* developed by the Environment Agency and Ofwat, the water industry economic regulator, to produce a drainage strategy for our affected catchments with a primary focus on our sewerage network. As outlined in Figure 1, the strategies will develop throughout the 4-stage framework to define how we intend to alleviate sewer flooding or to address growth related issues in each area sustainably, and economically, over the next few years.

Figure 1 High-level Drainage Strategy framework* and estimated delivery and intervention timeline**



* The detailed 4-stage Drainage Strategy framework can be found in the following Drainage Strategy document. ** The estimated delivery timeline is dependent on factors including weather conditions and is, therefore, open to change. The intervention timeline includes the implementation of 'quick-win' operational solutions throughout Stage 2 & 3, and long-term capital investment interventions in Stage 4.

Who will resolve the sewer flooding?

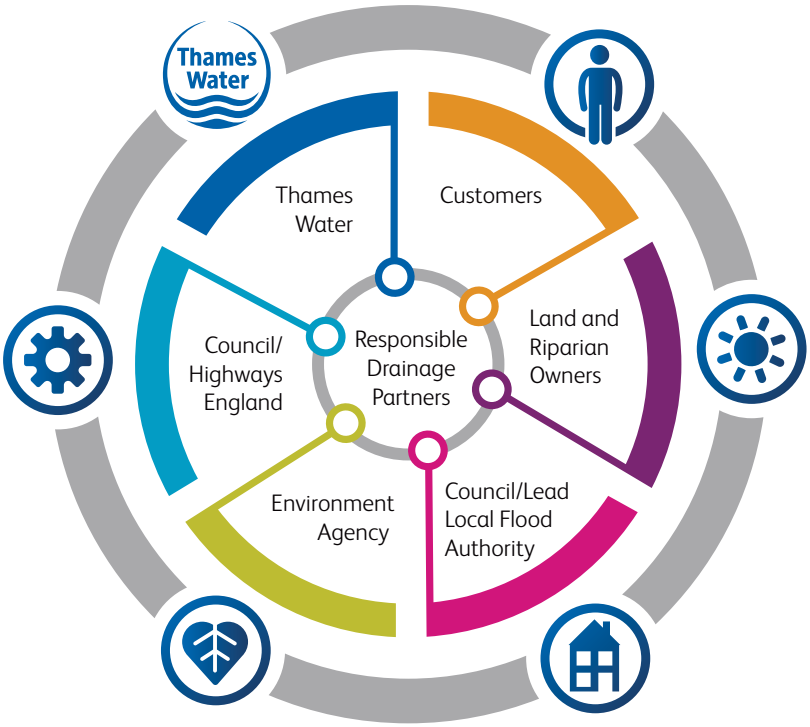
There are a number of stakeholders who, like us, have important drainage responsibilities and therefore, play an essential role in resolving sewer flooding in our region. These stakeholders include customers, private land owners and the Environment Agency; to name but a few. We are seeking to work in partnership with all stakeholders to ensure that together, we implement and maintain the most effective and sustainable drainage strategies.

Just as our responsibilities to improve drainage and alleviate sewer flooding focus on removing and treating wastewater; other stakeholders' responsibilities include managing local flood risk on riverbanks, ground water, land and highways, utilising appropriate agricultural practices and maintaining private drains.

We take full responsibility for resolving all drainage and sewer flooding issues that fall within our remit. If the causes of sewer flooding sit outside of this, we will support the responsible stakeholder to resolve the issue and to reduce the impact on customers.

Figure 2 provides a high-level view of the stakeholders responsible for drainage in each catchment area, more detail regarding responsibilities can be found in Section 1 of the following Drainage Strategy document.

Figure 2 Partners with Drainage Responsibilities



Next steps

Over the coming months we will undertake the following activities as this drainage strategy develops:

2015 - 2017

Customer Focus Actions

- Continue to consult with customers during this stage and every stage, through meetings, communications and surveys. We have gained important customer feedback during this first stage, which we are using to shape our activities
- Publish strategy documents for comment and contribution, throughout this framework process.

Partnership Actions

- Continue to establish partnership working with the regional drainage stakeholders, and agree ongoing consultation processes.

Other Key Actions

- Define catchment flooding uncertainties
- Prepare flooding risk data
- Undertake ongoing repair work to our sewer network, as the strategy develops and our investigations identify reparation work linked to drainage and flooding issues.

We will **regularly consult with customers and stakeholders, update and republish** this document throughout this 4-stage framework process.

Feedback: Q&A

Your questions answered

We are committed to listening to, consulting and collaborating with customers and stakeholders on our sewerage network activities and plans. We have addressed key feedback and questions raised by customers and stakeholders in the Ampney St Peter catchment, and customers affected by flooding throughout the region, in this Feedback Q&A section. As far as possible, and as is relevant to Stage 1 in the framework process, we have incorporated feedback from customers and stakeholders into our network strategy development. More detail can be found throughout the following Drainage Strategy document.

Q1 Will undertaking this Drainage Strategy framework process defer essential work in our area?

Answer

It is essential for us to complete this drainage strategy process, which has been developed and recommended by the water industry economic regulator Ofwat, and the Environment Agency. This will enable us to better understand the root cause of the sewer flooding issues affecting the catchment, before any major investment can be considered. However, we may carry out some repair works as this strategy develops, in the event that our investigations identify faults or problems with the sewerage network that are highly likely to have caused flooding, as outlined in Section 7 of the Drainage Strategy document. Our previous investigations have identified some sources of inflow, such as the misconnection of surface water to foul sewers. However, as stated in the following strategy, we are not yet able to say how much this impacts on flooding and will update this as our plan develops through Stage 2 to Stage 3 –Option Appraisal. Therefore, this more detailed approach is required to ensure that the most effective and sustainable drainage strategies are implemented in the Ampney St Peter catchment.

We are committed to **listening to, consulting and collaborating** with customers and stakeholders on our sewerage network activities and plans.

Q2 What drainage actions are you undertaking in our area, and when will they be happening?

Answer

As stated above, we are developing our plan for this area and will provide further details as our plan develops through Stage 2 to Stage 3 – Option Appraisal. The following drainage actions have already been undertaken, or are underway, in the Ampney St Peter catchment:

Actions completed include: (For more information please see Table 2)

1 Flooding investigation
2 Sewer cleaning
3 Flow monitoring at Ampney St Peter (Poulton) sewage pumping station
4 Flow monitoring at Ampney St Peter sewage treatment works
5 Maintenance of flow
6 Sewer flooding clean-up
7 CCTV surveys.

Actions underway or planned include:
(For more information please see Table 4)

1. Permanent flow monitoring of pumping stations in the catchment
2. Permanent flow monitoring of sewage treatment works storm discharge
3. Sewer and manhole surveys
4. Customer surveys
5. Misconnection surveys
6. Down Ampney sewage pumping station refurbishment
7. Innovative solutions analysis.

Q3 Are you renovating the sewers in our area?

Answer

We will renovate sewers which have been damaged, either as they have aged or through other streetworks activities. As our strategy work continues, we will target and repair localised sewer defects identified through our investigations as contributing to, or causing, drainage and flooding issues in the catchment over the coming months.

Q4 What are the improvement plans for Ampney St Peter's sewage treatment works to manage capacity?

Answer

The Ampney St Peter sewage treatment works operates a fully-compliant permanent storm overflow which permits us to discharge into local watercourses during storm events. To meet changing performance requirements and regulatory measures the works has undergone upgrades over the years.

The capacities of the sewage treatment works has been assessed to be more than adequate under normal design flow conditions. Therefore, we do not plan to enhance the treatment capability of the sewage treatment works at this time.

Q5 How are you planning for future development in the catchment?

Answer

As per Section 5.3 in the following Drainage Strategy document, we will continue to closely monitor development applications in the catchment and assess the impact that they may have on the capacity of our operations in the future. Our existing sewage treatment works currently has the capacity to manage all of the development applications submitted and projected for the catchment, as outlined in the latest Cotswold District Council Development Plan and through planning applications. We will continue to work with all involved stakeholders through our stakeholder engagement activities, to monitor local plans and planning applications and to incorporate current and projected developments into our business planning cycle, to ensure that our service is maintained for customers throughout the catchment's development.

Q6 Is an Infiltration Reduction Plan (IRP), required for this catchment?

Answer

Ensuring that our drainage strategies fully meet the requirements of an Infiltration Reduction Plan, as set out in the Environment Agency's Regulatory Position Statement, is a fundamental consideration in their development. Therefore, to maintain our service to customers during future wet weather events, if we need to discharge to watercourses through temporary overflows, a dedicated section will be included in each affected strategy, providing details of their location and intended use. This section will be included and /or revised when each strategy is updated.

In the event that temporary overflows are required, as stated above, we will describe their location and the circumstances under which we would use them. Together with plans to reduce infiltration, this drainage strategy would then fully meet the requirements of an Infiltration Reduction Plan.

Q7 Why are costs a consideration within your Wastewater outcomes?

Answer

The service we provide is the most fundamental of all – at the heart of daily life for the 15 million customers we serve. Getting it right is our focus every day, and we never forget it is paid for by customers.

As a regulated company we have to carefully balance service and cost in order to keep customer bills affordable, whilst delivering our outcomes and customer service commitments.

Q8 How are you ensuring that our local pumping stations are operating effectively?

Answer

The sewage pumping stations in the Ampney St. Peter catchment are supported by 24 hour diagnostic monitoring so that we can tightly control their operation through a flow of real-time information. Based on this performance data we can respond quickly through site visits by our engineers, and both project and rectify potential issues before they occur.

As we move through this 4-stage framework process and further develop our drainage strategy for this catchment, we will review the operational control options of this station, particularly during wet weather, carefully avoiding increasing the risk of sewer flooding in doing so.

Q9 Are growth and urban creep minor factors in these rural catchments?

Answer

Whilst the growth and urban creep rate for Ampney St Peter is fairly average across the Thames area, relatively small population increases in these smaller rural catchments can be influential on sewer flows, hence the need for us to closely monitor planning applications. Similarly urban creep, and in particular misconnection of surface water and change of land use, can have a significant impact on sewer flooding; particularly when permeable areas such as grass are replaced with hard-standings and driveways.

More growth and urban creep information can be found in Section 5.1 of the following Drainage Strategy document.

Q10 Are you working with the Highway Authority to resolve blocked gullies, sewers and ditches, and with landowners to reduce field run-off, as both affect drainage and our sewers?

Answer

In Section 1of the following Drainage Strategy document, we outline the other stakeholders who, like us, have important drainage responsibilities and therefore, play an essential role in resolving sewer flooding issues in this catchment area. As Highways maintenance activities and agricultural land maintenance practices sit outside of our remit we will work with the responsible stakeholders, to highlight these issues where this is found to have a major influence and impact on our sewerage network.

We will continue to work closely with the Council and Highways England to understand the extent to which flood waters may be escaping from highway or land drainage systems; and impacting the foul sewer network. An update on this issue will be shared with customers and featured in the later stages of this Drainage Strategy document.

Q11 Are best practice techniques already used by other water companies being considered?

Answer

We are constantly reviewing and improving our business to meet and exceed industry standards, to implement best practice and to drive innovation. We lead and participate in a large number of industry forums both in the UK and worldwide, to share and expand our learning; with the ultimate aim of improving services for customers.

We are deploying industry best practice techniques throughout our Drainage Strategy work, and also trialling new technology that is innovative within our industry, to achieve the best possible drainage outcomes for customers and their local environment.

Q12 Why are you collecting climate change data rather than 'climate proofing' assets?

Answer

We are committed to responding to climate change and to reducing our contribution to it by reducing emissions in accordance with government policy. Our voluntary target is to achieve a challenging 20 per cent reduction in emissions (compared to 1990 levels), for our Scope 1 and 2 emissions*. We continue to assess and collect climate change data and its impact on assets across our region, to ensure that we are fully informed and can prioritise our plans, targeted actions and investments. For more information please see the Climate Change section on the Homepage of our website.

*Scope 1 emissions refer to greenhouse gas emissions associated with the operation of our assets. Scope 2 emissions are emissions associated with the use of grid electricity.

Q13 What is the impact on local rivers of overflow points?

Answer

During extreme weather conditions foul sewers may become overwhelmed through a combination of surface water or ground water, resulting in a much diluted sewage. The impact on local rivers is dependent on the nature and size of the river, and on the overflow.

To reduce the environmental impact on local watercourses we will only use overflow points when groundwater and river levels are high, and therefore sewage dilution rates are also high. Additionally, we are also investigating deploying mobile biological filters to prevent litter and other matter from entering local rivers. If during the development of our drainage strategy we consider that temporary overflow points are necessary in the local network, we will update the drainage strategy document to reflect this position.

Ampney St Peter Drainage Strategy

Technical Document

Thames Water

At the heart of daily life

Stage 1: Initialise / Prepare

Table of Contents

List of Tables

List of Figures

About this document

Based on customer research

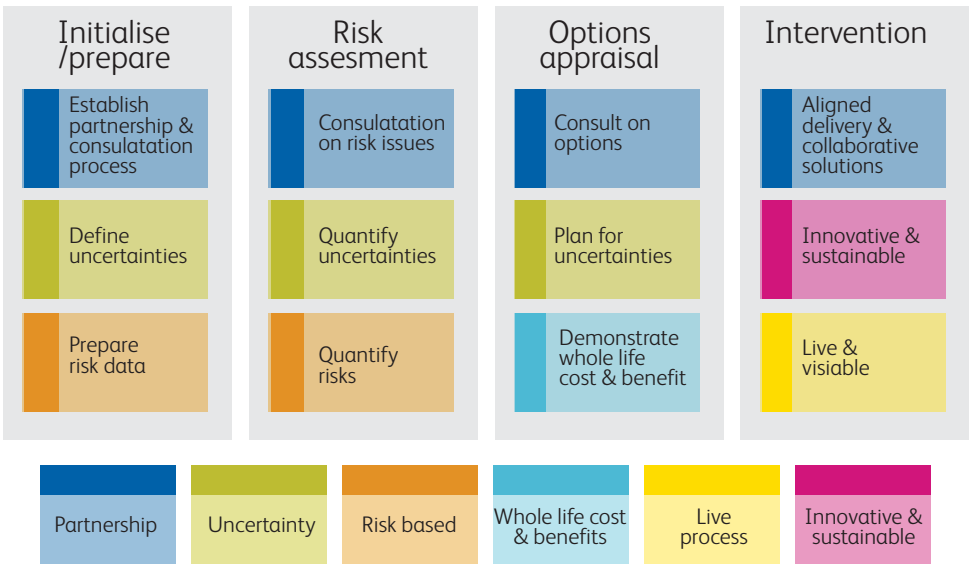
Undertaking extensive customer research has been a fundamental step in our business plan preparation for 2015-20. Our research findings have informed our business planning activities, and contributed to the development of a set of long-term customer 'outcomes'.

The water industry economic regulator, Ofwat, defines 'outcomes' as "High-level objectives that company actions, activities and achievements are intended to help deliver..[they] represent what customers and society value". As a company, we are committed to achieving our customer outcomes, a number of which are focussed on alleviating sewer flooding issues within our region, through effective, economic and sustainable drainage. This document describes the strategy that we will follow in delivering our long-term customer outcomes for drainage, specifically in the Ampney St Peter catchment, in a sustainable and economic manner.

Approved approach

We have adopted the Drainage Strategy Framework[1] outlined in Figure 1 below, developed by the Environment Agency and Ofwat. It identifies 4 key stages to producing a good-practice drainage strategy. Drainage strategies typically focus on the sewerage network, and not the performance of sewage treatment works. The Ampney St Peter drainage strategy is currently at the first stage of this framework - the Initialise/Prepare stage. In this document, we describe the activities that we plan to undertake to address current issues and future challenges facing the catchment, and the data that we need to gather to complete the risk assessment and options appraisal stages.

Figure 1 The Drainage Strategy Framework



[1] http://www.ofwat.gov.uk/future/sustainable/drainage/rpt_com201305drainagestrategy.pdf

Consultation and publication

We will update and republish this document to provide the results of our risk assessment, options appraisal and our selected strategy for intervention, once data from instrumentation and other fieldwork has been collected and analysed.

Throughout this process we will attend local flood forums for ongoing communication and consultation with customers and stakeholders. We will also make the Drainage Strategy documents available on the Drainage Strategies webpage of our website.

Meeting the Infiltration Reduction Plan (IRP)

To ensure that this drainage strategy meets the requirements of an Infiltration Reduction Plan, as set out in the Environment Agency's Regulatory Position Statement on discharges made from groundwater surcharged sewers, we have included a section in this document which defines if, how and when we propose to operate temporary overflows. This is in addition to our plans to reduce infiltration over time, where it has been identified as a root cause of sewer flooding. Please see Section 8 in the Drainage Strategy document below.

Executive summary

In recent years the foul sewerage system in the Ampney St Peter catchment has become overwhelmed in some locations, following prolonged heavy rainfall and high ground water levels. This has resulted in certain properties suffering from sewer flooding and restricted toilet use.

We believe that significant volumes of surface water run-off from the surrounding saturated fields entered the foul sewerage network during recent wet winters, causing the network to surcharge. The surveys we have carried out also suggest that there is some evidence of groundwater infiltration into the foul sewerage network when groundwater levels are high, and inundation from highways, public spaces and properties, and fluvial flooding from the Ampney Brook. Surface water misconnections (i.e. downpipes from roofs), into the foul sewerage network may also be a contributing factor, however further analysis is required to determine the extent to which this has contributed to sewer flooding.

The root causes of sewer surcharges are therefore numerous and the resolution of the issues complex, requiring all stakeholders responsible for drainage in the catchment to work together to resolve them. The Floods and Water Management Act 2010 places a responsibility on lead local flood authorities (LLFAs), to manage flood risk from surface and groundwater, plus a duty on all risk management authorities (RMAs), to cooperate regarding flood risk. In our role as a risk management authority, Thames Water will work with Gloucester County Council as Lead Local Flood Authority, Cotswold District Council as Planning Authority and the Environment Agency to ensure that a collaborative approach can be developed to address the problems.

In response, this drainage strategy follows the Environment Agency and Ofwat's 4-stage framework. The Ampney St Peter strategy is currently at Stage 1 (Initialise/ Prepare). We describe in this document the actions that we plan to carry out to complete the risk assessment and options appraisal stages. We will update and republish this document once this work is complete.

In preparing our company business plan for the 5 year period 2015 to 2020 we have listened very carefully to the views of customers. Beyond being able to maintain the current service that we provide, customers have told us that they would like to see a reduction in instances of sewer flooding and odour nuisance and an improvement in river water quality. Our research indicates that customers are willing to pay for these improvements to service ; a summary of our related customer research can be found on our website via the hyperlink below.

We have therefore developed a set of company outcomes that we are committed to working towards over the next 5 years and beyond. The outcomes relevant to the Ampney St Peter drainage strategy are:

- asset health - a composite range of measures against which we will manage the health of our sewerage network
- properties and public areas protected from sewer flooding
- river water quality meets customer's expectations and regulatory requirements.

This Drainage Strategy must also address future challenges to the Ampney St Peter catchment. We assess these to be:

- climate change – analysis of the latest data suggests that rainfall could become 15% more intensive by 2080 increasing the likelihood of flooding. Longer wetter winters may also mean groundwater levels are high more often; this could also exacerbate fluvial flooding from local watercourses
- urban creep – paving over of front gardens and loss of green space results in more strain on the sewerage network when it rains heavily. Modelling we have undertaken suggests urban creep rates in Ampney St Peter are about average for the Thames Operational Area

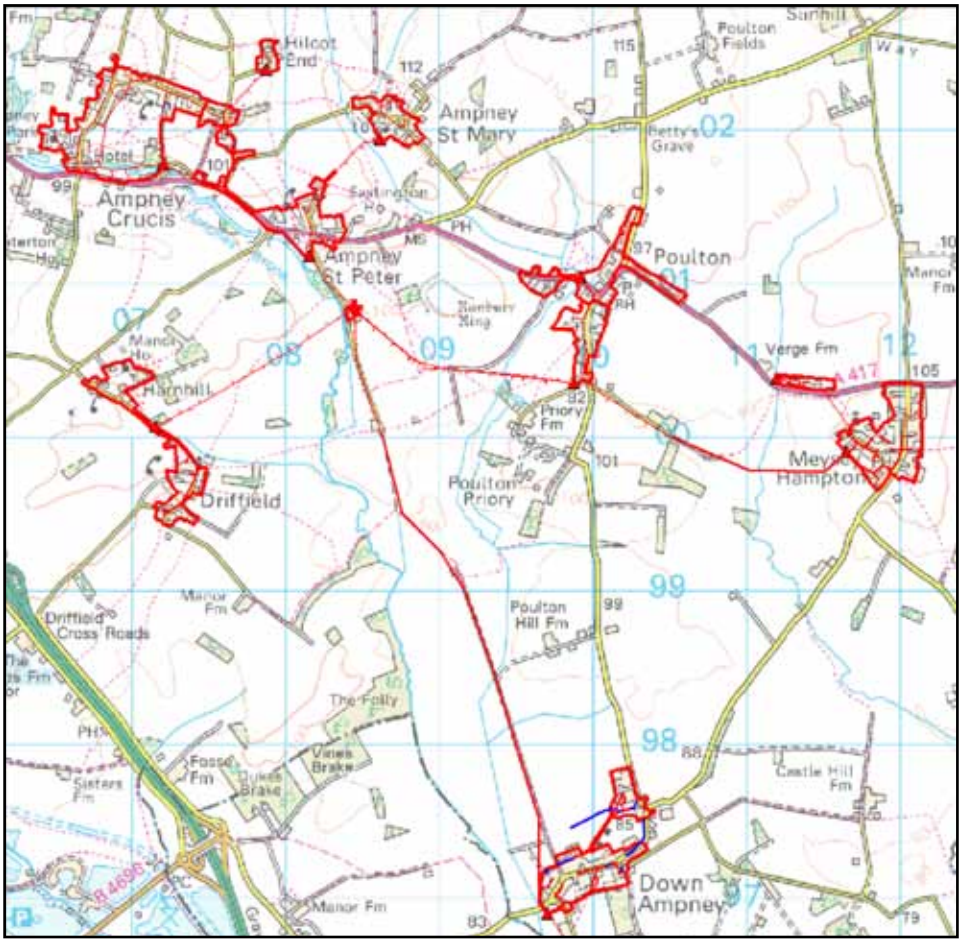
[2] http://www.thameswater.co.uk/cr/Howwedobusiness/Engagingwithourstakeholders/Publicconsultationresearch/index.html

- population growth – the population in the South East is set to grow rapidly. A number of possible developments are identified around Ampney St Peter, and we will continue to track these and any other emerging applications for this catchment arising in the future.

Our strategy is to understand the relative impact on this catchment of overland flow from saturated fields, groundwater infiltration, fluvial flooding and surface water misconnections. We will then try to identify cost beneficial solutions to reduce the risk of sewer flooding using customer willingness to pay research. We may carry out sewer rehabilitation works as the strategy develops, in the event that our investigations identify faults or problems with the sewerage network that are highly likely to have contributed to flooding.

Although some works have been carried out in Ampney St Peter in recent years, flooding has still occurred, demonstrating that we need to understand the root causes of problems in the catchment in order to deliver effective solutions. Our next step is to collect sewer flooding information from customers. The priority sub-catchments we are focusing on are outlined in Figure 2 below.

Figure 2 Ampney St Peter sub-catchments



The extent of the sewerage catchment is outlined in red.

1 Thames Water and drainage

1.1 Our statutory responsibilities

Thames Water is a regulated Water and Sewerage Company. We supply water to 9 million customers in London and the Thames Valley and provide wastewater services to 15 million customers across an area that stretches from Gloucestershire to Essex. We operate 108,000km of sewer through which an average of more than 4.4bn litres of wastewater is collected and treated every day at our 350 sewage treatment works.

The primary legislation that sets out our role and responsibilities is the Water Industry Act (1991), which describes the duties and services that we are responsible for and the powers that we have to connect, operate, maintain and extend the sewerage network. We are regulated by the Water Services Regulation Authority (Ofwat). The original 1991 Act has been amended by further legislation in recent years, transferring some drains and sewers that were hitherto in private ownership to Thames Water's responsibility[3].

Other recent pieces of legislation relevant to this Drainage Strategy are the Flood & Water Management Act (2010) and the Water Act (2014). These set out new responsibilities for Thames Water to manage flood risk in partnership with local councils and the Environment Agency, with more emphasis on Sustainable Drainage Systems (SuDS), such as swales and permeable paving to mimic natural drainage.

Thames Water also has a statutory obligation to comply with environmental legislation, including European Directives. The Water Framework Directive establishes a strategic approach to managing the water environment, which the Environment Agency achieves through River Basin Management Plans and setting environmental objectives for groundwater and surface water. The environment is also protected from adverse effects of discharges of urban wastewater through the Urban Wastewater Treatment Directive, which requires us to improve and extend the sewerage system according to section 94 of the Water Industry Act (1991).

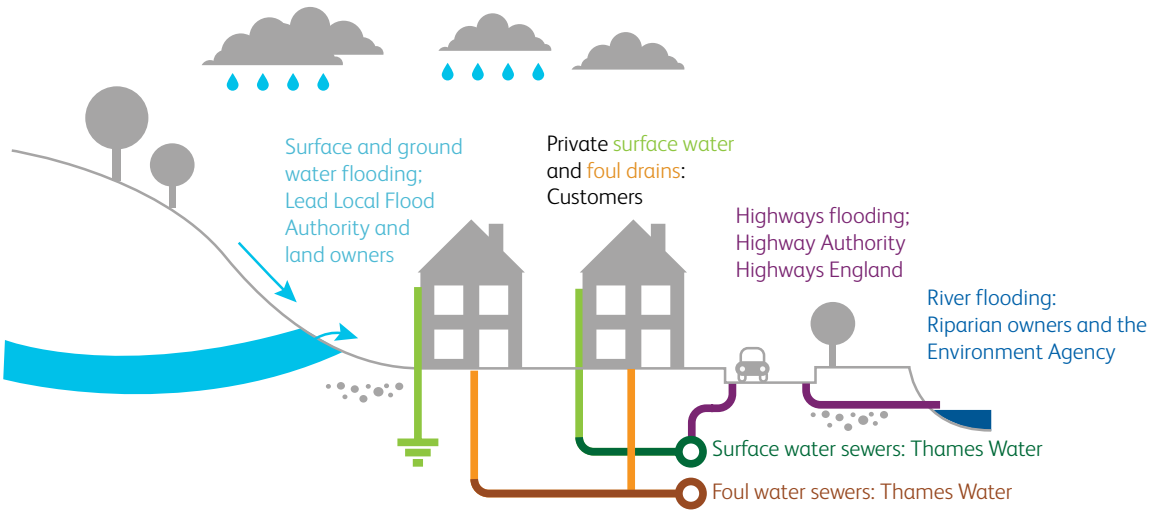
A comprehensive and detailed list of all legislation relevant to Thames Water can be found in the 'statement of obligations' published by Defra[4].

[3] See http://www.thameswater.co.uk/help-and-advice/8654.htm for more information.
[4] See https://www.gov.uk/government/publications/statement-of-obligations.

1.2 Working in partnership with other stakeholders

Other stakeholders responsible for managing various forms of drainage need to work together with us to reduce the risk of flooding. Each has specific responsibilities as summarised in Figure 3 below.

Figure 3 Stakeholder responsibilities for drainage



Thames Water

We are responsible for removing and treating wastewater, which includes the foul sewers, and in some areas the combined sewers that are in some of the older large urbanised areas, such as London[5]. We also manage and maintain surface water sewers where they exist, these will typically discharge to a watercourse or river. In some cases, the cause of sewer flooding may not fall under our responsibility. In these circumstances, we will explain what we can do to help and continue supporting the relevant authorities or third parties to reduce the impact for customers

Environment Agency

The Environment Agency is responsible for main rivers and part of its remit includes monitoring and informing the levels of ground and river water. The Environment Agency also investigates pollution incidents and monitors the quality of the water in rivers.

Lead Local Flood Authority and District Council

Gloucester County Council are the Lead Local Flood Authority and has the responsibility under the Flood & Water Management Act for managing the local flood risk from groundwater and surface water runoff e.g. local watercourses and culverts[6]. They work with landowners to maintain privately owned ditches, drainage and watercourses, keeping them clear of blockages. They are also responsible for managing the risk of groundwater flooding, both inside and outside of properties. Water from these local authority gullies and drains and privately owned ditches can also impact Thames Water's sewers, therefore, we work with all responsible stakeholders to resolve the excess flow. Cotswold District Council is the Planning Authority responsible for approving new development, but equally may have responsibility for ensuring maintenance of watercourses; particularly on council-owned land.

Highway Authority

Gloucester County Council is the highway authority and is responsible for highway maintenance and highway drainage and for clearing roadside gullies. Highways England is responsible for the drainage of motorways and certain trunk roads.

Customers

Customers own, and are responsible for, the maintenance of private drains within the curtilage of their property, which did not transfer to Thames Water ownership in October 2011[7].

Riparian Owners

Riparian Owners are landowners who own land with watercourses or land adjacent to watercourse (i.e. road side ditches). The responsibility for the operation and maintenance of ditches, local watercourses and general land drainage lies mostly with riparian owners.

Land Owners

Land owners include farmers and both residential and commercial customers, but includes trusts etc. They are responsible for ensuring the adequate drainage of their land, such that it is not a nuisance to others.

[5] Thames Water is responsible for the collection and treatment of commercial and domestic sewage. Typically this will be the foul sewerage. Domestic or commercial roof and paved drainage will often go to a soakaway or directly to a water course/river, which if so is not the responsibility of Thames Water.

[6] Some local watercourses and/or culverts are termed as 'Riparian' meaning that a land owner, possibly adjoining or owning the land containing the watercourse/culvert is responsible for the maintenance and free-flowing of the watercourse/culvert.

[7] See http://www.thameswater.co.uk/help-and-advice/8654.htm for more information.

2 Catchment description

2.1 Geology and topography

The Ampney St Peter sewerage catchment is located approximately 5km east of Cirencester and includes the villages of Ampney St Peter, Ampney Crucis, Ampney St Mary, Down Ampney, Driffield, Harnhill, Meysey Hampton and Poulton, as outlined in Figure 2 above.

The geology of the catchment is generally made up of a sandstone, limestone and argillaceous rock. The surface deposits of this area primarily consist of highly permeable soils within the villages and along the course of Ampney Brook, with clayey soils with an impermeable layer at shallow depth present in small patches of within the catchment. The impermeable layer is likely to create localised high groundwater levels within the catchment.

Appendix B includes maps showing the geology and fluvial, pluvial and groundwater flood risk areas in the catchment.

The Ampney Brook runs through the catchment and according to the Environment Agency, the current ecological status of the Ampney Brook is 'Poor'[8].

2.2 Sewage treatment works

The Ampney St Peter sewage treatment works serves a population of approximately 2,200 via 18km of public gravity sewers. The works has a daily dry weather flow consent of 458m^3 per day with the treated flows discharging to the Ampney Brook. The works includes storm tanks to handle excess flows above the flow to full treatment during storms which return flows for treatment but can discharge to the Ampney Brook when they are full. During extended wet periods, treated flows at Ampney St Peter sewage treatment works can be in excess of 1300 m^3/day, which is over three times greater than the consented dry weather flow of 458m^3/day.

The public sewerage system in the catchment is believed to date from the 1960s, when Cirencester Rural District Council drained the catchment to the site of the current sewage treatment works. The sewage treatment works has undergone a number of upgrades to meet changing performance criteria over the years, including receiving schemes in 2004 and 2006 to meet the requirements of the discharge consent. The capacities of the works has been assessed to be adequate under normal design flow conditions for the current population, and currently no further upgrades are planned.

[8] Environment Agency website, interactive map, Basin Management Plans.

2.3 Foul sewers

Each village within the catchment has a foul gravity sewerage system that drains either to a pumping station that transfers flow to the next village's gravity system or directly to the Ampney St Peter sewage treatment works as outlined in the catchment schematic in Figure 4.

The majority of the sewers in the catchment are 150mm in diameter. A 150mm diameter sewer laid at a gradient of 1 in 150 will have sufficient capacity to cater for the foul sewage from 400 to 625 houses or 1,200 to 1,875 people. Problems in these small diameter sewers tend to be a result of blockages in the pipes. However, surface water can occasionally be misconnected into the foul sewerage network – problems then arise when it rains heavily.

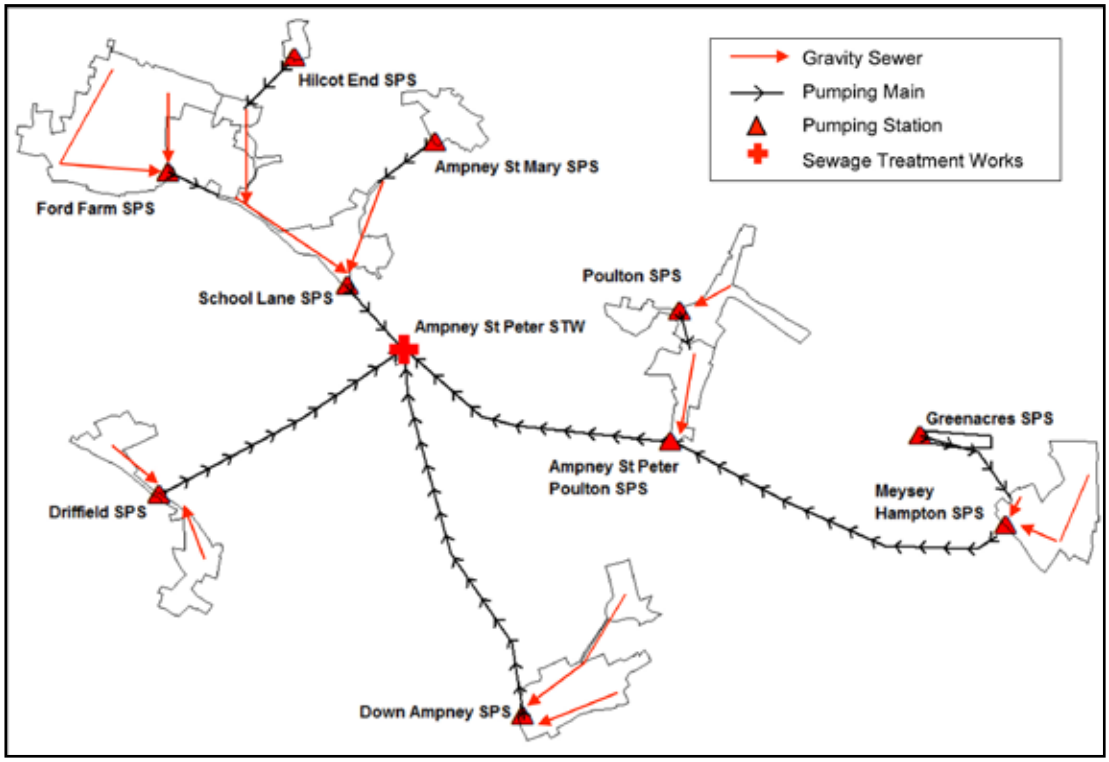
The design of the network ensures the appropriate sizing and laying of pipes at a gradient to maintain a satisfactory self-cleansing characteristic. The capacity of sewers is typically set to cater for a maximum of six times Dry Weather Flow (DWF), and a 10% allowance is included for infiltration[9].

Materials used in the construction of the sewerage system are typical of the time, with clay pipework and brick and concrete manholes. The clay pipework can have a very long service life, but sometimes the joint seals deteriorate over time. The 1960s pipes were laid on bedding material such as pea shingle, with the trenches likely to have been backfilled with 'as dug' material. More recent drains and sewers, i.e. since the 1980s, are typically surrounded with pea shingle. This protects the pipe but also acts as a good conduit for groundwater.

The layout of the villages suggests that most properties are likely to have their own foul drains (as opposed to shared drains) that connect directly into the public sewer. As per Section 1.2 above, the private foul water drains within the property boundaries in the catchment are the responsibility of the property owners where they are not shared.

[9] Dry Weather Flow is the term given to the average flow rate observed over a 24 hour period and based on Sewers for Adoption, the industry standard, includes an allowance for infiltration of 10% of the calculated flow rate.

Figure 4 Ampney St Peter catchment schematic



2.4 Surface water sewers

There are very few surface water sewers in the Ampney St Peter catchment. Down Ampney has a localised surface water sewer that is likely to drain directly to the Ampney Brook near Suffock Place. The majority of the surface water within the catchment is likely to drain to local drainage ditches or nearby soakaways. Soakaways can only function satisfactorily when ground conditions allow soakage and may be completely ineffective when groundwater levels are high. In some areas, we have seen examples of customers draining surface water through their foul drains when their soakaways do not work. This exacerbates capacity problems for other customers connected further downstream in the sewerage network.

The catchment is mostly rural and incorporates a network of roadside ditches and minor watercourses that are intended to drain surface water in the area. As per Section 1.2, the responsibility for the operation and maintenance of these ditches, local watercourses and general land drainage lies principally with riparian owners. Gloucester County Council has overall responsibility for managing groundwater.

The extent of highway drainage is not certain, but it is likely that highways surface water run-off discharges direct to the roadside ditches, some of which will act as soakaways. Owing to the high local beauty of the area the ditches tend to be well maintained with clearance of vegetation and debris occurring. However, the area does have an active groundwater table and as a result groundwater springs do occur from time to time, which can lead to localised land drainage issues. Gloucester County Council is responsible for highway drainage and culverts crossing the highway.

The Environment Agency has the duty and the authority to ensure that the Ampney Brook is maintained appropriately. The responsibility for maintenance lies with the riparian owners.

3 Long-term outcomes

We have listened very carefully to the views of customers before developing our plan for the Asset Management Period 6 (AMP6) regulatory period. Between 2009 and 2013 we carried out over 50 separate customer research and engagement activities.

Beyond being able to maintain the current service that we provide, customers have told us that they would like to see a reduction in instances of sewer flooding and odour nuisance and an improvement in river water quality. These are areas where customers are prepared to pay for an improvement in the current level of service.

In response to this, we have developed 4 company outcomes and 11 service outcomes for our wastewater service that we are committed to working towards over the next 5 years and beyond, further details can be found in Table 1 below and on our website[10].

Table 1 Wastewater outcomes

Company outcome	Wastewater service outcome	Why is this service outcome chosen
We will provide a safe and reliable wastewater service that complies with all necessary standards and is available when our customers require it.	Asset health: maintaining our assets to ensure we can provide a safe and reliable service in the long-term.	We must ensure an appropriate balance between reducing costs today and not compromising our future service.
	Properties and public areas protected from flooding.	Flooding is one of the worst service failures for customers.
	Resilient sewage treatment service that minimises the impact of extreme events on river water quality.	We need to be able to provide service against a variety of pressures such as climate change and population growth.
Our customers and stakeholders can trust us, we are easy to do business with and we care.	Do the basics excellently by getting things right first time.	This service outcome ensures our wholesale activity is completely aligned to our objective to improve our Service Incentive Mechanism (SIM) scoring.
We will provide the level of customer service our customers require, in the most economic and efficient manner, to ensure that bills are no more than necessary.	Reduced dependence on energy from the grid.	Reducing dependence on energy from the grid is one of a range of measures across our entire plan to keep costs down to an affordable level for customers.
We will limit our impact on the environment and achieve a socially responsible, sustainable business for future generations, including reducing levels of leakage.	Minimising our carbon footprint.	There is an expectation from society that we will play our part in reducing carbon emissions.

[10] See http://www.thameswater.co.uk/tw/common/downloads/about%20us%20-%20corporate%20responsibility/AMP6_-_Outcomes_Reporting_Policy.pdf for more information.

Company outcome	Wastewater service outcome	Why is this service outcome chosen
	River water quality meets customers' expectations and regulatory requirements.	We must meet environmental regulations, and river quality is a visible indicator to citizens of our environmental stewardship.
	Satisfactory sludge disposal.	Sludge is a resource that we should manage effectively to keep bills down.
	Corporate responsibility.	We will act as a responsible company, meeting expectations from wider society.
	Reduced odour from wastewater operations.	Odour is a problem for some of our customers.
	Compliance with new environmental regulations.	We must meet environmental regulations, and river quality is a visible indicator to citizens of our environmental stewardship.

Below we provide more information about our asset health and properties and public areas protected from flooding service outcomes, as these are relevant to the Ampney St Peter drainage strategy.

3.1 Asset health

Our asset health performance commitment encompasses a composite range of measures against which we will manage the health of our sewerage network. This commitment underpins our outcome of a safe and reliable wastewater service. It includes sewer collapses, blockages, unconsented category 1 to 3 pollution incidents and properties internally flooded due to operational problems (such as blockages, collapses or equipment failures).

3.2 Properties and public areas protected from flooding

There are two performance commitments that underpin the delivery of this service outcome:

1. We commit to protecting properties from flooding due to rainfall. We estimate that our plan for 2015-20 will result in over 2,100 properties being alleviated from internal flooding, external flooding and also from restricted toilet use (for example when groundwater levels are high following prolonged periods of wet weather). Our customer research indicates that our sewer flooding programme will deliver £20m of benefit to customers every year by 2020.

2. We commit to reducing the risk of sewer flooding and pollution from combined sewers (i.e. those that convey both foul and surface water) by slowing down surface water run-off and re-routing the flow through sustainable drainage measures such as water butts, permeable paving, rain gardens and green roofs. We aim to retrofit over 20 hectares of sustainable drainage measures by 2020. We may also apply this commitment to areas where the network was designed to take foul flow only, but investigation shows that a substantial amount of surface water is in the foul sewer.

3.3 River water quality meets customers' expectations and regulatory requirements

We have a performance commitment to reduce the number of pollution incidents as a result of discharges from our sewerage network and treatment works. Pollution can occur as a result of blockages, collapses or failure of our equipment and also following heavy rainfall when our sewers have insufficient capacity to cope with the flow. All pollution incidents are reported to the Environment Agency's National Incident Recording System (NIRS).

4 Current issues

4.1 Recent wet weather events

The foul sewerage system in Ampney St Peter has become overwhelmed for weeks at a time in recent years following prolonged heavy rainfall. This has been associated with significant sewer flooding and restricted toilet use for certain properties. Based on site reconnaissance that we have carried out we believe that the system has surcharged due to a combination of groundwater infiltration, surface water run-off from saturated fields, surface water inundation from highways and public spaces, surface water misconnections and fluvial flooding from Ampney Brook.

We are confident that this is a comprehensive list of factors that have caused flooding.

The following incidents have been observed with respect to the sewerage network:

- surcharging sewers causing flooding, restricted toilet use and pollution from a number of public and private manholes in Ampney Crucis, Ampney St Peter, Poulton, Meysey Hampton and Down Ampney – as identified in Figure 5 below
- 6 'Category 3' pollution incidents caused by sewage spilling out of manholes.

During these events, other sources of flooding have also been observed:

- highway drainage overwhelmed causing highway flooding
- land drainage issues with water running off fields and onto the highways.

The pumps at Ampney St Peter, Meysey Hampton and Poulton pumping stations were in constant operation during the winter 2013/14 due to high flows.

During extended wet periods, treated flows at Ampney St Peter sewage treatment works can be in excess of 1300 m3/day, which is over three times greater than the consented daily flow of 458m3/day. Figure 6 compares the treated flows at Ampney St Peter sewage treatment works with groundwater levels recorded at Environment Agency boreholes RBHL.0098 and RBHL.0103 located in the catchment. It can be seen from the graph that periods of high flow to the works correlate well with periods of high groundwater. However, high groundwater levels do not necessarily mean that infiltration levels will be high because pluvial and fluvial flooding also correlate with high groundwater levels.

Figure 5 Ampney St Peter key performance issues

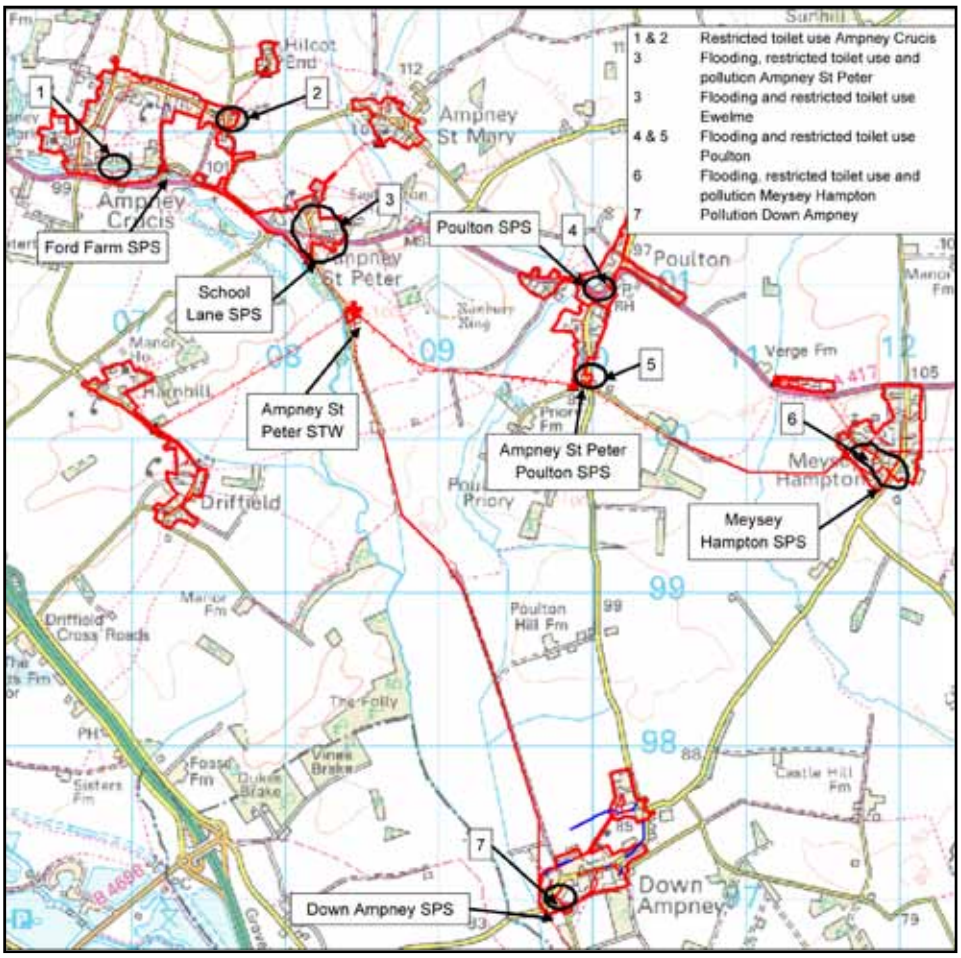
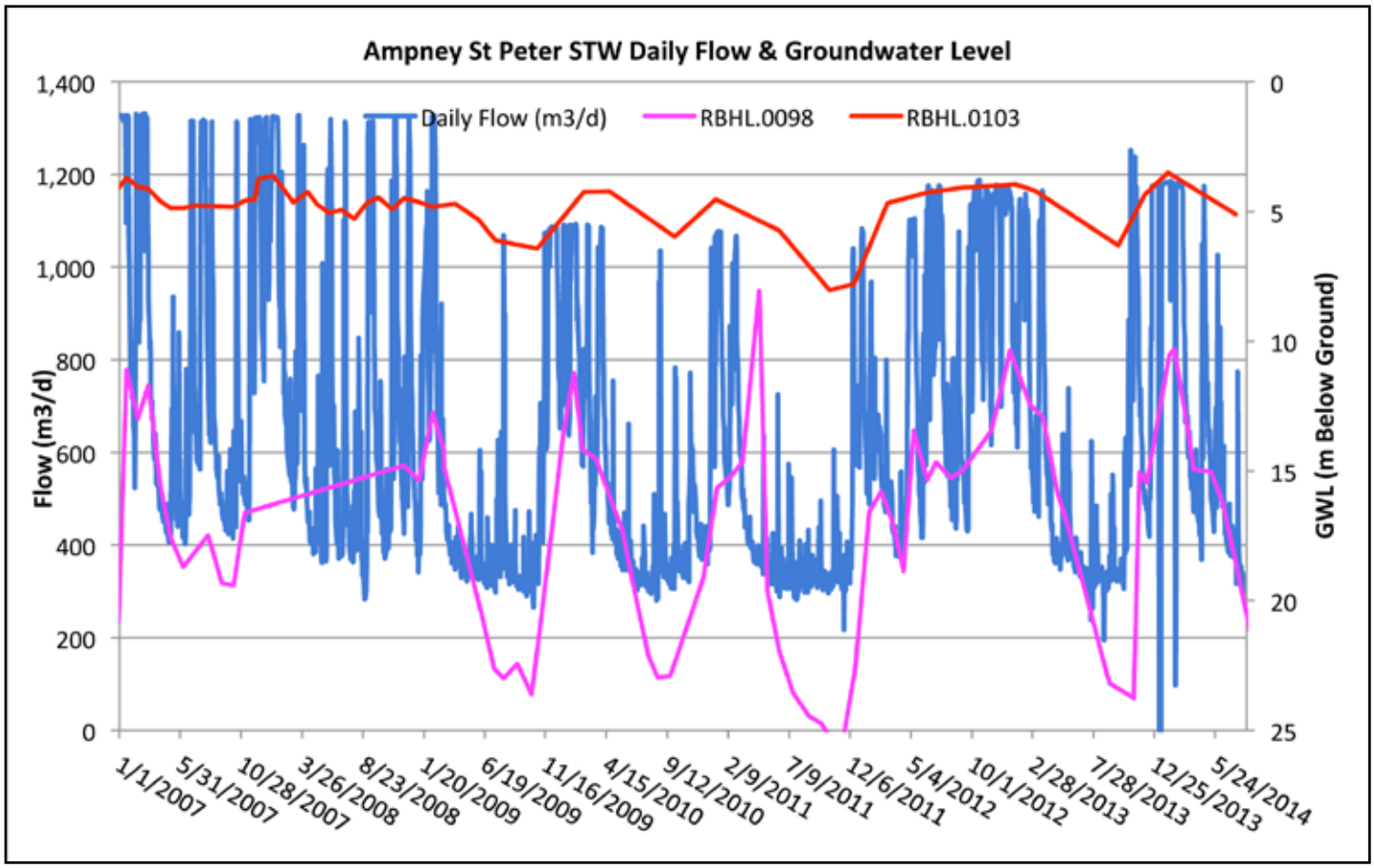


Figure 6 Ampney St Peter Sewage treatment works (STW) treated flows and groundwater levels



4.2 Our operational response

To maintain service, tankers have been regularly used for the last three winters at a number of sewage pumping stations in Ampney St Peter, and occasionally at Down Ampney and Meysey Hampton sewage pumping stations, to reduce internal and external foul water flooding of properties and pollution incidents. Tankers have limited capacity and can only draw off water at a relatively low rate, so are only effective in certain circumstances. They can also cause considerable noise and disruption to local communities.

To date, we have not installed temporary pipework and pumps during wet weather events in the catchment to maintain service through temporary overflows, but we would consider doing so to prevent the backup of sewerage into customers' properties and uncontrolled spilling from the sewer system into the environment.

As part of this Drainage strategy we will be investigating the circumstances under which temporary overflows may be required in future. Even if flows can be contained within the sewer network, excessive flows arriving at the treatment works may not always be given full treatment prior to discharge to Ampney Brook. The use of such storm sewage overflows is accepted by our regulators, subject to conditions.

4.3 Investigations and activities completed to date

Table 2, below, details the investigations and actions that we have completed in recent years within the Ampney St Peter catchment. These inform the extent of our current understanding of issues.

Table 2 Investigations and activities completed

Activity	Purpose	Date complete	Outcome
Flooding project	Project 4F7C – Ampney St. Peter	March 2000	Project to address flooding to two properties with a history of flooding occurring in the 1990's.
Flooding investigation	Study 6C2F - South Court, Ampney St Peter sewer flooding investigation, included manhole lift and look and CCTV surveys of sewers	July 2007	Report 6C2F did not identify infiltration in public sewers though did find some via private connections. It recommended installing low leak manhole covers, localised sealing of lateral connection and long term monitoring of catchment
Pump replacement	Pumps replaced at Down Ampney sewage pumping station	June 2011	Maintain 'asset health'.
Sewer cleaning	Sewer cleaned (removal of grit and debris) between M/H 6703 & M/H 7703.	March 2012	Maintain 'asset health'.
Depth monitoring at Ampney St Peter (Poulton) pumping station	Depth monitors installed in the wet well to ascertain flows arriving at the pumping station to identify seasonal trends and infiltration.	Sept 2013	Very clear prolonged wet weather response between Dec 2013 and March 2014 showing all the signs of infiltration.
Flow and depth monitoring at Ampney St Peter sewage treatment works	Flow and depth monitors installed in the balancing tank and storm tanks to ascertain flows going to treatment and storm at the works.	Nov 2013	Very clear prolonged wet weather response between Dec 2013 and March 2014 showing all the signs of infiltration.
Maintenance of flow	Tankers required to manage flows at sewage pumping station over the previous 3 winters.	Jan 2014	Short term discharges to reduce impact of surcharged sewers.
Sewer flooding clean up	Thames Water schedule clean-ups after sewer flooding events to ensure public health and safety.	Jan 2014	Numerous minor clean-up activities under-taken between December 2012 and January 2014 mainly following spells of heavy rain.
CCTV surveys	Ascertain sewer condition and gain evidence of infiltration and to check all blockages have been removed.	Feb 2014	Some minor defects identified.

In summary, a number of projects have been undertaken in the past to investigate and address localised flooding. Recent concerns over the capability of the catchment's sewage network during prolonged wet weather conditions have led to a number of activities, including sewer cleansing and use of tankers to control sewage levels. More recently, CCTV surveys have been utilised and monitoring equipment installed in order to try and quantify the amount of inflow into the catchment. Further monitoring is required to identify issues within the villages in the catchment, and to track down the specific sources of infiltration. We will continue to monitor and assess this data as our strategy develops through this 4-stage framework process.

4.4 Activities carried out by drainage partners

Table 3, below, details the activities carried out by other stakeholders with drainage responsibilities within the Ampney St Peter catchment, to reduce the risk of flooding in the area. For more detail on the other organisations responsible for managing various forms of drainage within the catchment, please see Section 1 of this Drainage Strategy document.

Table 3 Actions by other stakeholders to prevent flooding

Activity	Purpose	Impact on sewerage
Routine maintenance of Ampney Brook, watercourses and local ditches	Ensure free flow of river and ditches.	Less risk of surface water flooding and inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Routine maintenance of private surface water drainage and soakaways	Ensure adequate surface water drainage from properties.	Less risk of surface water flooding and inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Routine maintenance of highway drainage	Ensure adequate highway drainage.	Less risk of surface water flooding and inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Routine maintenance of land drainage	Ensure effective land drainage.	Less risk of surface water flooding and inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Strategy for infiltration through private drains*	Consider a strategy for reducing infiltration into the sewer network via private drains if the permanent monitoring identifies this as a significant cause for concern.	Less risk of groundwater flooding and infiltration into private drains and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Monitoring and control of construction standards for private drains	Local Authority Building Control to ensure private drainage is fit for purpose.	Less risk of groundwater flooding and infiltration into private drains and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Sharing of information	Agencies to share information to ensure collaborative approach to groundwater infiltration, surface water inundation, pluvial and fluvial flooding. Use forums as appropriate.	Identification of most cost beneficial solutions and quicker resolution of issues.

*Thames Water does not have powers to compel customers to repair defective private drains at their cost. At this stage, we do not know how significant infiltration from private drains is within the Ampney St Peter catchment, but we will develop an appropriate strategy as part our of stage 2 risk assessment, when information becomes available and this document is updated. We note that local authorities are only able to instigate action under Section 59 of the Building Act where evidence is provided of a defective private drain.

5 Future challenges

In 2011, Ofwat commissioned Mott MacDonald to look at factors likely to affect sewerage networks in the future. The report 'Future impacts on sewer systems in England and Wales' (June 2011)[11] looked at the likely relative impact of climate change, population growth and impermeable areas up to around 2040. In preparing our plan for 2015-2020, we have also carried out research into these factors across the Thames Water region. We summarise our findings for the Ampney St Peter catchment in this section.

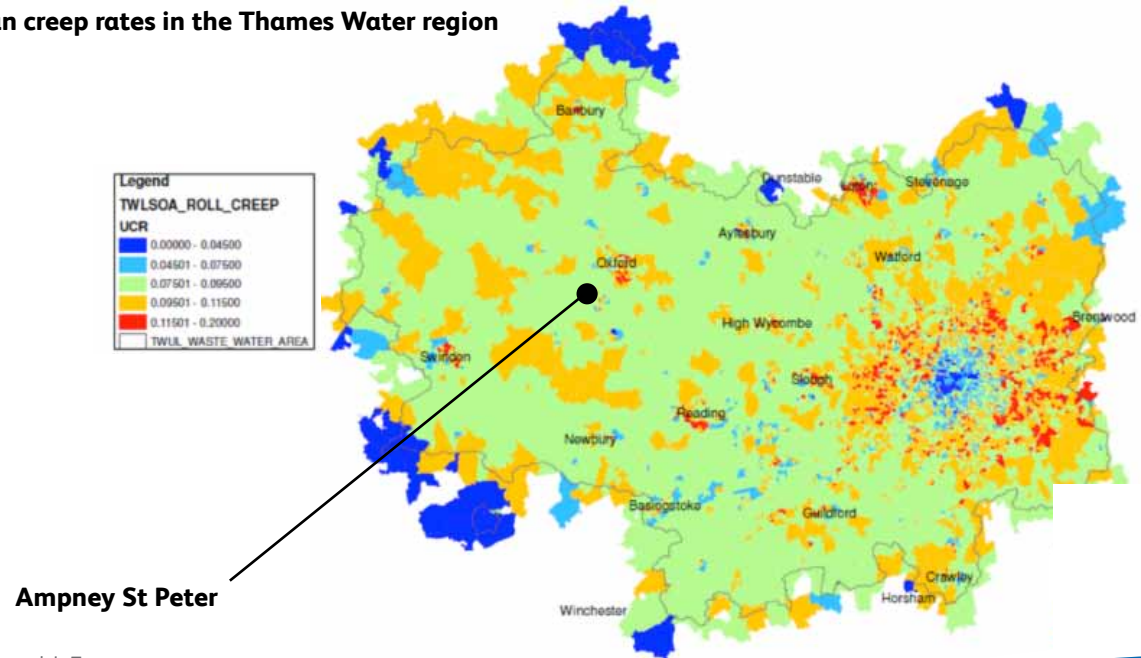
5.1 Urban creep

Urban creep is defined as the transformation of a catchment by the paving over of previously permeable areas, and includes extensions to existing properties and other land use changes. Rather than surface water soaking into the ground when it rains heavily, more water runs off into the sewerage network and can cause the sewers to surcharge and flood. It is therefore important to understand the rate at which urban creep is occurring.

We have studied aerial photography and satellite imagery across 11 catchments across the Thames Water region using data from two periods in the late 1990s and mid-2000s to determine the rate at which urban creep is occurring. We then carried out a statistical analysis and built a model to predict the rate of urban creep for the entire Thames Water region, taking account of factors such as property age, land use, demographics such as family sizes and financial income, need and available space. We found that affluent suburban areas with detached and semi-detached properties, where families have young children, are most likely to have high urban creep rates.

The results for the Thames Region are presented in Figure 7 below. The urban creep rate for Ampney St Peter is 0.095 %. In other words, this is the increase in impermeable area per year as a percentage of the total area connected to the sewerage network. When compared against the rest of the Thames Water region, Ampney St Peter is about average – it is not as high as suburban areas around central London and major towns. Whilst the immediate issues in Ampney St Peter appear to be strongly related to groundwater, we will continue to monitor change in impermeable area as the strategy continues to develop. If we observe an increase in urban creep, we will raise the issue with Cotswold District Council who is responsible for managing surface water. We may then also look to retrofit sustainable drainage measures (such as permeable paving and water butts), in the area to counter the increased run-off following rainfall, to reduce the risk of flooding.

Figure 7 Urban creep rates in the Thames Water region



[11] Mott MacDonald, Future impacts on sewer systems in England and Wales, June 2011.

5.2 Climate change

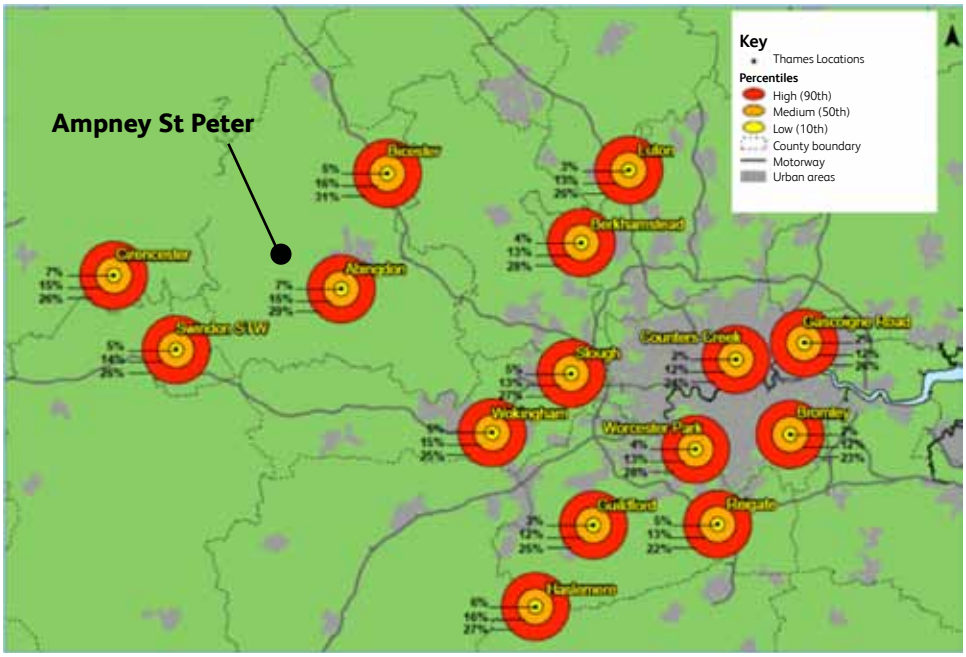
We have analysed the 2009 UK Climate Projections (UKCP09) to determine the likely increase in rainfall intensity due to climate change in 15 catchments across our region[12]. More intensive rainfall in the future will increase the peak flow in sewerage networks and with it the likelihood of sewer flooding.

Fifteen catchments across our region were selected to give a representative sample of inner London, outer London and more rural areas in the Thames Valley. A number of these catchments are also areas which experience sewerage related issues like pollution, flooding and urban creep.

We assessed different combinations of emission scenarios and climate change percentiles for each of the 15 catchments.

The nearest catchment to Ampney St Peter that was analysed for climate change was Cirencester. The results show a central estimate of an increase of 15 % in rainfall by 2080, but in some scenarios this could be as high as 26 % or as low as 7 %. We will ensure that our strategy takes account of these potential increased peak flows as it develops.

Figure 8 Locations assessed for increased rainfall intensity by 2080



Increased rainfall intensity may not be the only consequence of climate change. UKCP09 data also suggests that the UK is likely experience longer wetter winters in future. Further research is needed to understand whether high groundwater levels, such as those observed in the winters of 2012/13 and 2013/14 are likely to become more frequent in future. As the recent experience of prolonged rainfall and high groundwater levels have been shown to be the principal factors, this research will be very significant in informing any risk assessment and appraisal of costs and benefits of solutions.

[12] Atkins, Thames UKCP09 Rainfall Intensity Assessment Revised Report, October 2012.

5.3 Population growth and new development

We use a combination of top-down and bottom-up information to ensure that our forecast of population and new development is as robust as possible to keep costs down, in order to minimise the bill impact of any investment that may be necessary.

Our forecast of the number of new households is taken directly from Experian data. We have used the 'Plan-Based' projection which uses information provided by local authorities about planned numbers of new dwellings in their respective areas. During the period 2015 to 2020 we expect to see an increase in new development across that Thames Water region and are forecasting a total of 263,000 new connections to the sewerage network during this time.

Our Development Tracker System (DTS), is used to track developer enquiries through the planning process to construction. When we are contacted by a developer, we typically carry out preliminary modelling to determine whether our network or treatment works has the capacity to accommodate the increase in flow. Where it does not, we propose planning conditions for consideration by the Planning Authority, although we encourage developers to contact us as early as possible in the planning process to avoid this.

The independent review into the causes of the 2007 floods (The Pitt Review), concluded Sustainable Drainage Systems (commonly known as SuDS), are an effective way to reduce the risk of 'flash-flooding' which occurs when rainwater rapidly flows into the public sewerage and drainage systems, causing overloading and back-up of water. Typically, SuDS slow the rate of surface water run-off entry into the drainage system and improve the percolating feature, ie rainfall recharging the groundwater system, thus mimicking natural drainage processes. In April 2015, the Government made changes to the planning process effecting planning policies and decisions on planning applications of 10 dwellings or more (or equivalent non-residential or mixed development), to ensure that sustainable drainage systems are put in place, unless demonstrated to be inappropriate. This requires that when considering planning applications, local planning authorities should consult the relevant Lead Local Flood Authority (County Council or Unitary Authority), on the management of surface water, to satisfy themselves that the proposed standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

In the case of Ampney St. Peter, whilst SuDS might help to reduce the risk of flooding following rainfall when groundwater levels are low (i.e. typically during summer months), they may not be as effective in reducing the flood risk when groundwater levels are high (typically during the winter months). We will therefore take account of the potential influence of groundwater when we come to assess any options as part of this drainage strategy framework process.

Cotswold District Council is currently developing its Local Plan for the period to 2031. Using sources of data that include the Cotswold District Council Preferred Development Strategy (PDS May 2013), and third party planning enquiries, potential development sites we are currently tracking include:

- 44 dwellings at Broadway Farm, Down Ampney
- 10 dwellings at Dukes Filed, Down Ampney
- 29 dwellings at Cedar Close, Down Ampney
- 8 dwellings at Rook Tree Farm, Down Ampney
- 13 dwellings at Broadleaze, Down Ampney
- 8 dwellings at School Lane, Ampney Crucis
- 11 dwellings at Bell Lane, Poulton.

Other applications exist but relate to developments for which detailed numbers have not been confirmed or are fewer than 5 properties.

We will continue to monitor future plans for the catchment through our stakeholder engagement work. A key element of our assessments will be to establish the extent to which these developments may be significant in the context of challenges currently experienced in the catchment.

This assessment work will be undertaken and findings shared in an update to this Strategy document. A number of developer funded impact studies have already been undertaken and recommendations have been made to developers regarding the need to provide enhancements to the sewerage system, if development is to proceed. Concerns have also been raised with Cotswold District Council requesting that drainage conditions should be imposed on the more recent planning applications.

6 Strategy development

The drainage strategy for the Ampney St Peter catchment is currently at Stage 1 (Initialise/prepare), of the 4-stage framework process. The following activities in Table 4 are planned and ongoing, in order to carry out the risk assessment and development of our strategy options.

Table 4 Activities planned and ongoing to enable strategy development

Activity	Purpose	Date planned	Outcome
Permanent monitoring of pumping stations	Install permanent monitors on rising mains to establish pumped flows to the sewage treatment works.	From winter 2015	Use information to identify additional actions for inclusion in the drainage strategy for Ampney St Peter. Share information with other agencies.
Sewage treatment works storm discharge monitoring	Monitor the discharges from the storm tanks and the change in pollution levels that this causes.	From winter 2015	Use information to identify additional actions for inclusion in the drainage strategy for Ampney St Peter. Share information with other agencies.
Extensive Sewer and manhole survey	Gauge to what extent the flooding problems are caused by infiltration into the network.	From winter 2015	Use information to plan a strategy to react to possible infiltration threat to the sewage network in Ampney St Peter.
Customer surveys	Validate the historical records of flooding and restricted toilet use in the catchment to enable a detailed benefits assessment of potential further intervention options that could be implemented .	From winter 2015	Use information to help test the cost benefit of options to improve drainage and reduce the risk of sewer flooding in Ampney St Peter.
Misconnection surveys	Carry out visual inspection of properties to determine the extent of roof drainage and other surface water drainage that discharges into the foul sewer network.	From winter 2015	A better understanding of the contribution that misconnections make to sewer flooding in the area.
Pilot trials of mobile treatment plant	As part of our wider approach to managing high groundwater levels, we have trialled the use of biological filters within other catchments. Our findings will inform and may influence our strategy plans for Ampney St Peter. If successful, these could be used to abstract dilute sewage from surcharged sewers and discharge it safely to a watercourse.	Ongoing	Service may be restored for customers without the need for tankering.

Activity	Purpose	Date planned	Outcome
Down Ampney sewage pumping station refurbishment	Replace pumps, valves, pipework, control panels and kiosk.	Ongoing	Project approved December 2015
Update drainage strategy	Improve the drainage strategy based on the initial results from the permanent monitoring, customer surveys, misconnection surveys and feedback from stakeholders.	2017	Risk assessment, options appraisal and preferred strategy to be completed, subject to capturing weather events through monitoring and surveys.
Consider innovative solutions	Identify quicker / cheaper / collaborative options that improve the benefit to cost ratio in order to keep customers' bills down to prioritise investment to ensure greatest benefit to customers.	Ongoing	Enhanced toolkit available to reduce the risk of sewer flooding and then apply this once data becomes available.

7 Preferred strategy and plan

We believe that the foul sewerage system in Ampney St Peter has surcharged and flooded because of a combination of groundwater infiltration, surface water run-off from saturated fields, surface water inundation from highways, public spaces and properties, surface water misconnections and fluvial flooding from the Ampney Brook. Our network strategy is to understand the relative impact that each of these factors has on the risk of sewer flooding, and then to develop a plan comprising cost beneficial solutions using customer willingness to pay research. In parallel, we will assess the extent to which new developments may be significant in the context of challenges currently experienced and where necessary, we will develop solutions to accommodate the proposed development in the catchment.

We may carry out some repair works as this strategy develops, in the event that our investigations identify faults or problems with the sewerage network that are highly likely to have caused flooding. Table 5 below, details the repair activities that we have identified to date.

Table 5 Activities identified in preferred plan to date

Activity	Purpose	Date planned	Outcome
Manhole cover replacement	Replace manhole covers with leak tight covers where identified through survey work.	When identified	Stop ingress of surface water through manholes located in flood plain

Our plan will be updated once the Risk Assessment and Options Appraisal sections have been completed in accordance with the Drainage Strategy Framework.

8 Temporary overflows

We have not installed temporary pipework and pumps in the sewerage network during wet weather events in Ampney St Peter to maintain service, but we would consider doing so to prevent the backup of sewerage into customers' properties and uncontrolled spilling from the sewer system into the environment.

As part of the stage 2 risk assessment and stage 3 options appraisal, we will be investigating the circumstances under which emergency discharges would be required in future, such as the use of temporary overflows, to pump out from the sewerage network through biological filters to maintain service to customers and prevent homes from flooding. As this drainage strategy develops, in this section we will describe the location of any proposed temporary overflows and the circumstances under which we would use them, in order that this drainage strategy, together with our plans to reduce infiltration, fully meets the requirements of an Infiltration Reduction Plan as set out in the Environment Agency's Regulatory Position Statement. We will continue to identify sewer rehabilitation and other permanent works to reduce groundwater infiltration alongside refining the use of temporary overflows.

Appendix A
Glossary of terms

Term	Definition
Blockages	Obstacles or the build-up of fat and grease, block or obstruct our sewerage pipes. This is normally caused by things which should not be flushed, or poured, into drains and sewers.
Combined sewer	A pipe conveying the combined rainwater and contaminated wastewater from two or more properties. A combined sewer is designed to carry wastewater to a sewage works for treatment but during periods of heavy rainfall or snowmelt, the volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water courses.
Dry weather flow	The average flow rate observed over a 24 hour period in dry weather and based on Sewers for Adoption, the industry standard, includes an allowance for infiltration of 10% of the calculated flow rate.
Foul drain	A pipe conveying the contaminated wastewater from a single property. If the pipe extends beyond the property boundary, the portion of the pipe outside of the boundary is termed a lateral drain. The portion of the pipe inside the boundary is a private drain. On 1 October 2011 water and sewerage companies in England and Wales became responsible for lateral drains, which were previously the responsibility of property owners. Private drains remain the responsibility of property owners.
Foul sewer	A pipe conveying the sewage from two or more properties. On 1 October 2011, water and sewerage companies in England and Wales also became responsible for private sewers, which were previously the responsibility of property owners. A foul sewer is designed to carry contaminated wastewater to a sewage works for treatment. It disposes of wastewater from sources including toilets, baths, showers, kitchen sinks, washing machines and dishwashers.
Infiltration	Groundwater finds its way into the sewerage system (including private drains), via defective pipes or pipe joints and through the brickwork or defects in manhole structures.
Inundation	Accumulated surface water from rain and/or river floodwater that has resulted in localised flooding, finds its way into the sewerage system through manhole covers and drains. These may be public or private.
Lateral drain	See definition for Foul drain.
Misconnections (surface water to foul water)	Property owners have connected rainwater and/or land drainage to our sewers (e.g. roof drainage, paved driveways drains, soakaway overflows), and can cause major issues for the performance of the sewerage system.
Misconnections (foul water to surface water)	A plumbing mistake resulting in wastewater appliances being misconnected to the surface water system.
Private sewers	See definition for Foul sewer.
Rainfall induced infiltration	Sewer infiltration that occurs as a result of rainfall percolating into the ground impacting the sewer on route to recharging the groundwater table.
Riparian owner	If you own land adjoining, above or with a watercourse running through it, you have certain rights and responsibilities. In legal terms you are a 'riparian owner'. If you rent the land, you should agree with the owner who will manage these rights and responsibilities.
Soakaway	Surface water from a roof and driveway of a property is piped to an underground pit, usually filled with gravel or similar material. Some soakaways are situated within the boundary of the property.
Surface water drain	A pipe conveying uncontaminated rainwater from a single property.
Surface water sewer	A pipe containing uncontaminated rainwater from two or more properties. A surface water sewer is designed to dispose of rainwater from roofs, driveways, patios, roads, etc to a local watercourse.
Sustainable Drainage Systems (SuDS)	Measures designed to attenuate and slow down surface water before it enters sewers to reduce the risk of flooding following heavy rainfall. Includes green infrastructure such as raingardens, green roofs as well as other measures, such as permeable paving and water butts.

Appendix B
Supporting figures and photographs

Figure B1 Ampney St Peter Watercourses

This watercourse map information has been sourced from the Environment Agency website. For more detailed flood map information for this catchment, please access the Environment Agency website.

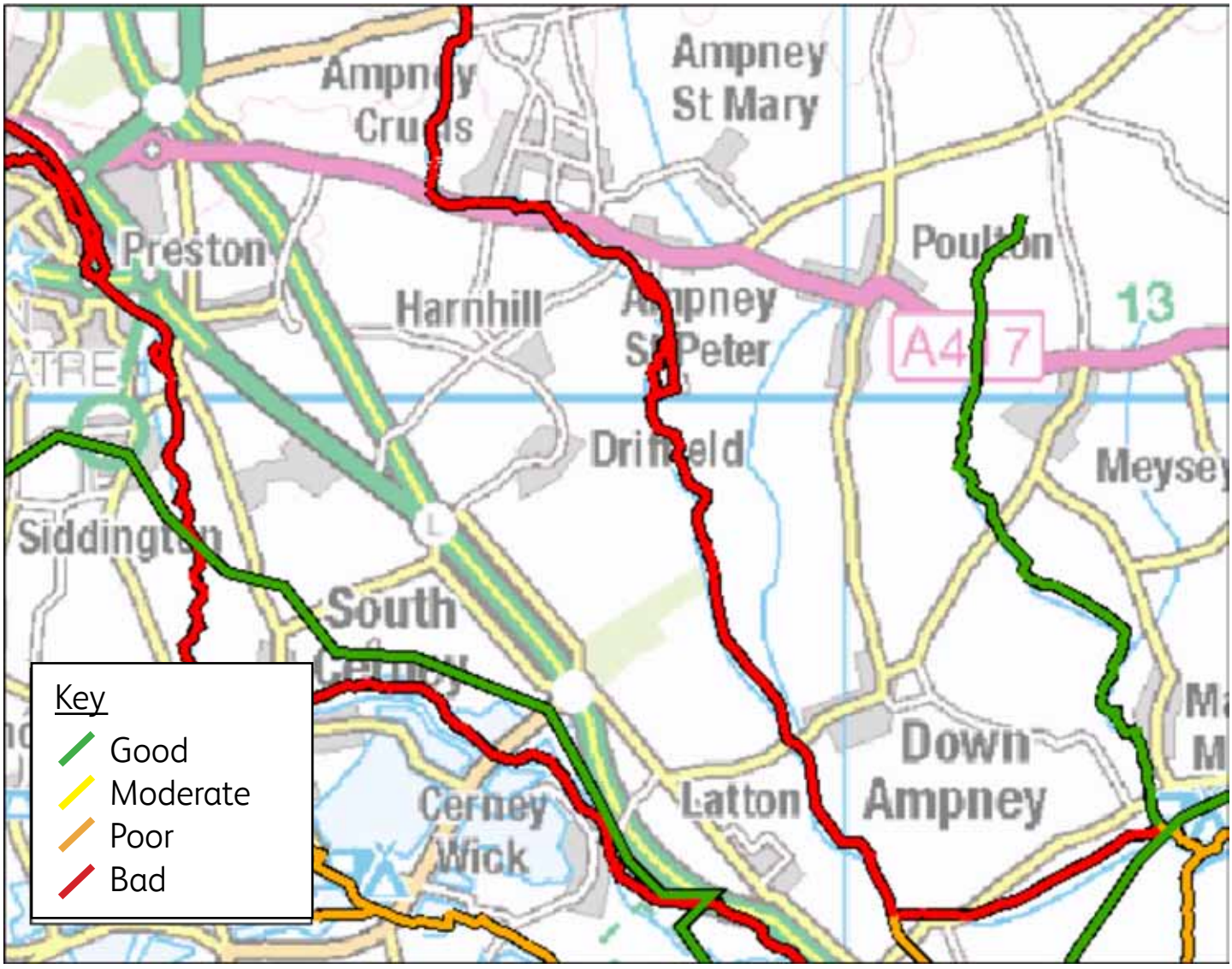


Figure B2 Ampney St Peter Bedrock and Drift Geology

This geological map information has been sourced from the British Geological Survey website. For more detailed geological information for this catchment, please access the British Geological Survey website.

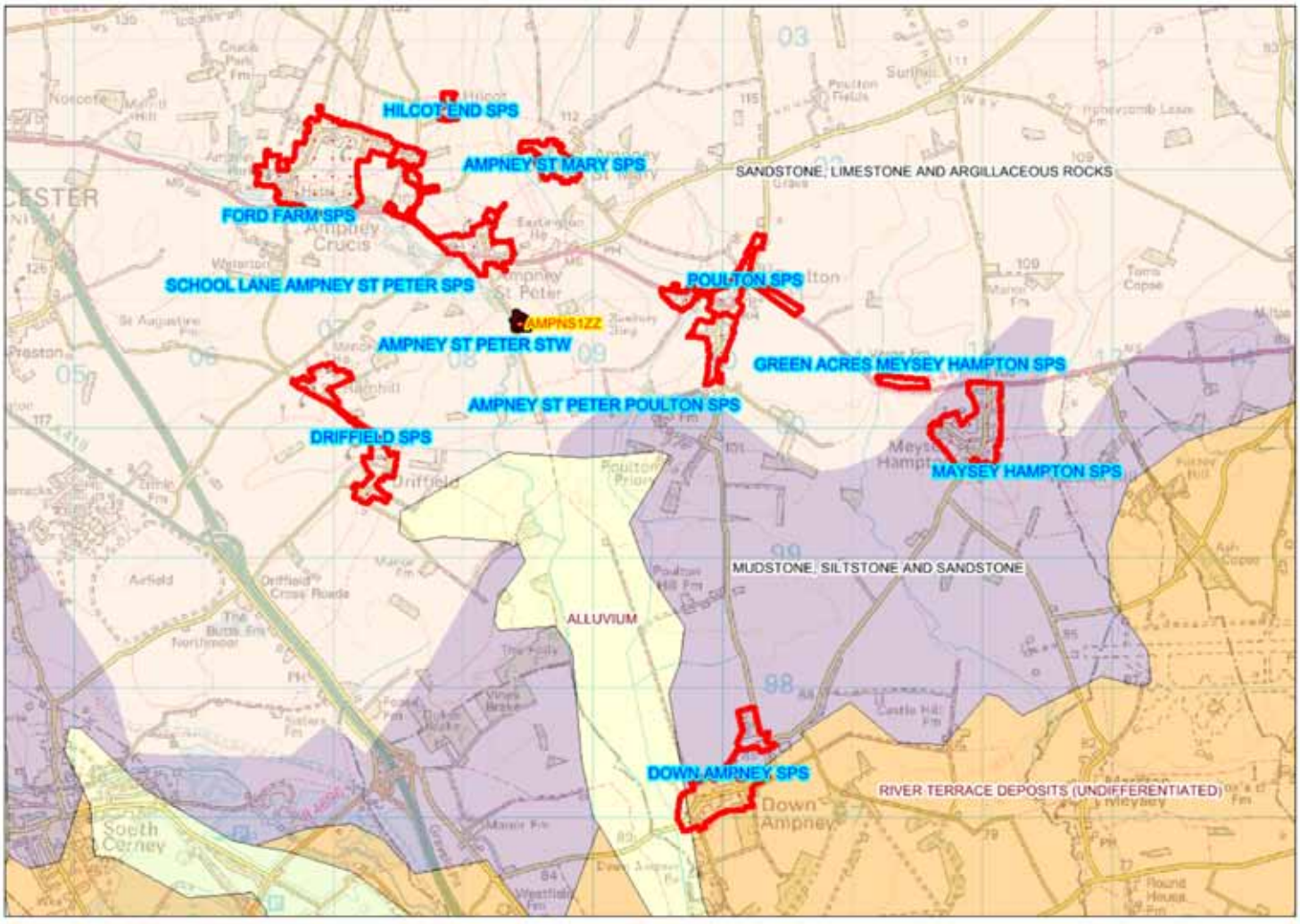


Figure B3 Ampney St Peter Fluvial Flood Risk

This watercourse map information has been sourced from the Environment Agency website. For more detailed flood map information for this catchment, please access the Environment Agency website

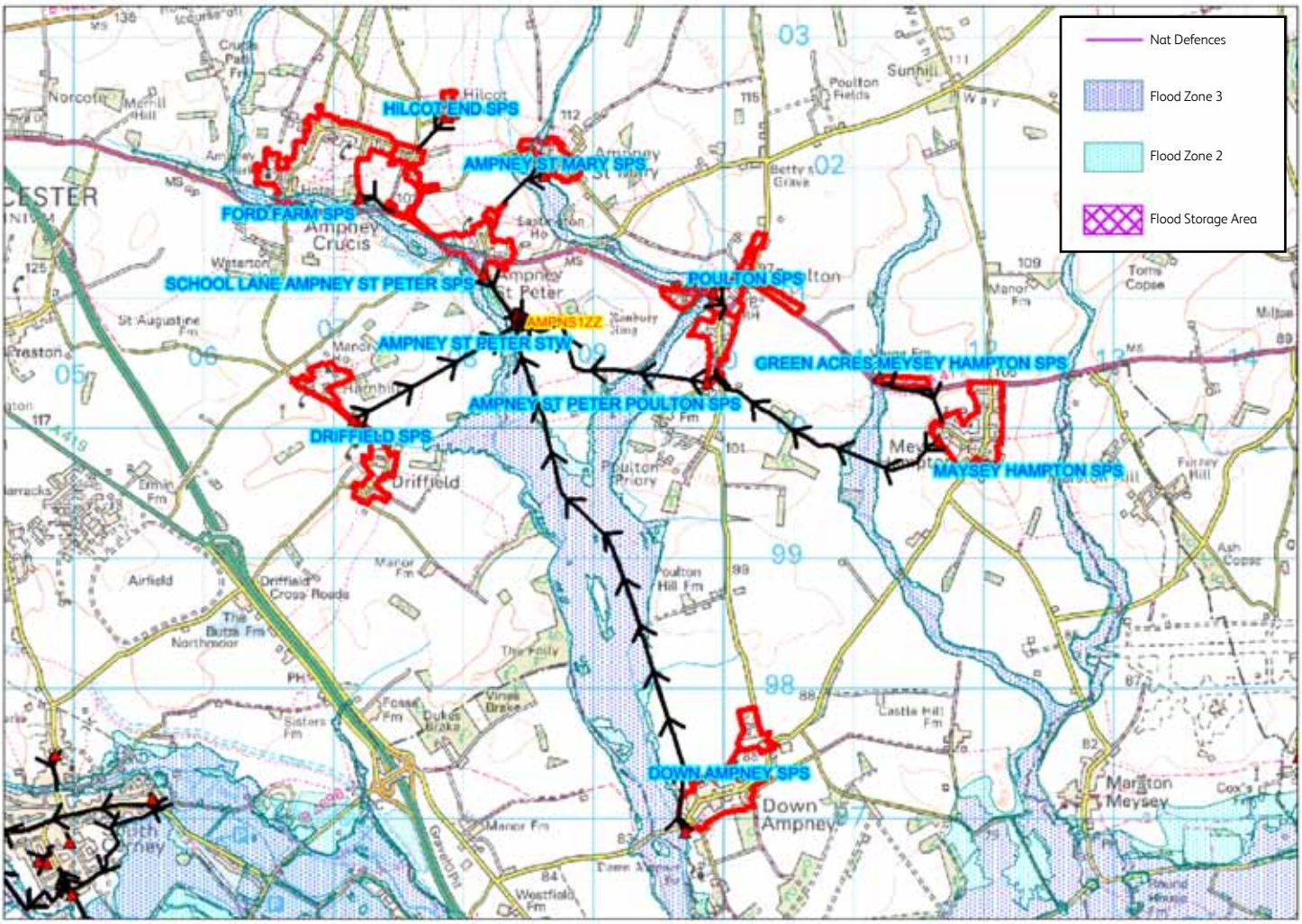


Figure B4 Ampney St Peter Surface Water Flood Risk

This flood risk map information has been sourced from the Environment Agency website. For more detailed flood map information for this catchment, please access the Environment Agency website.

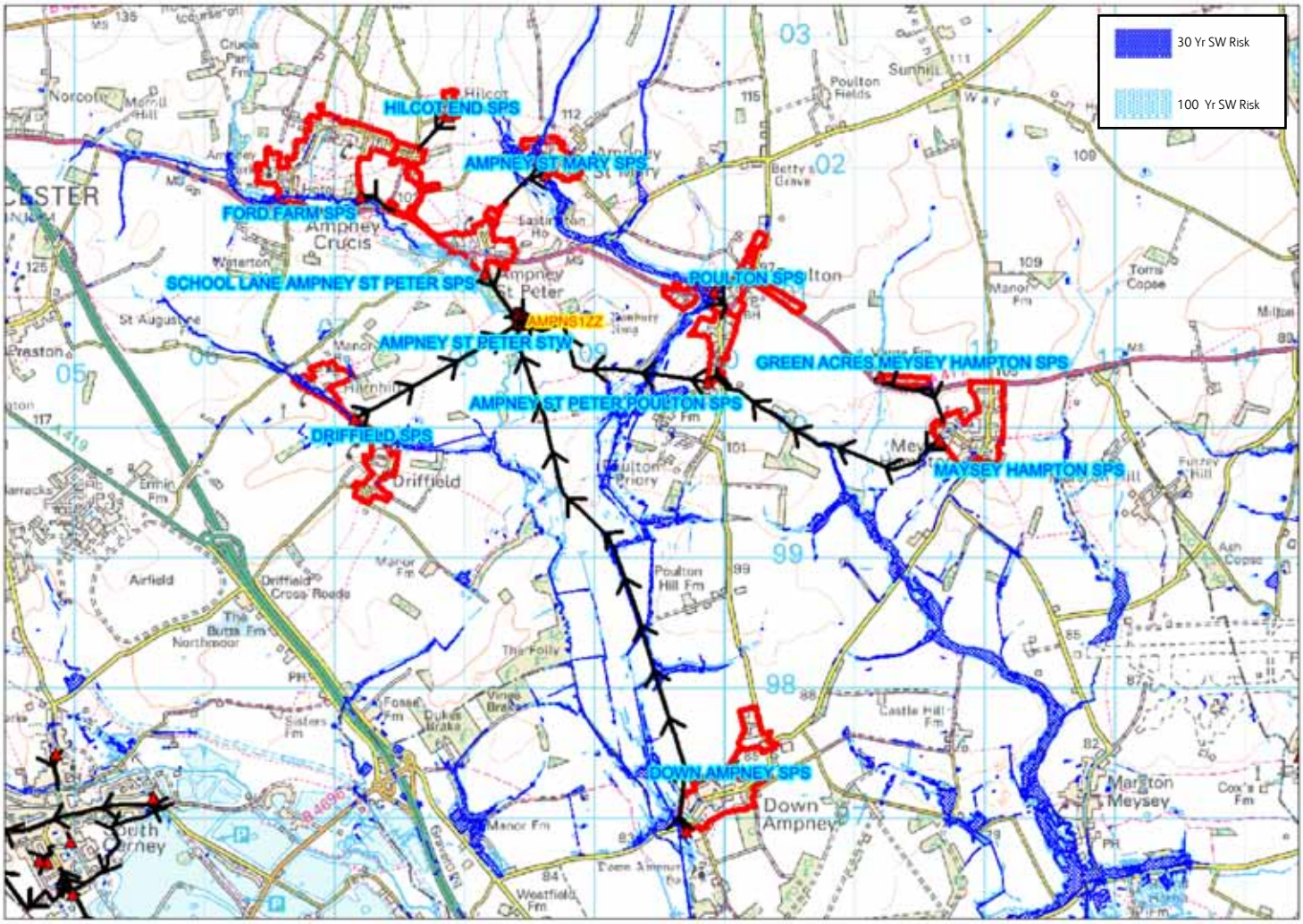
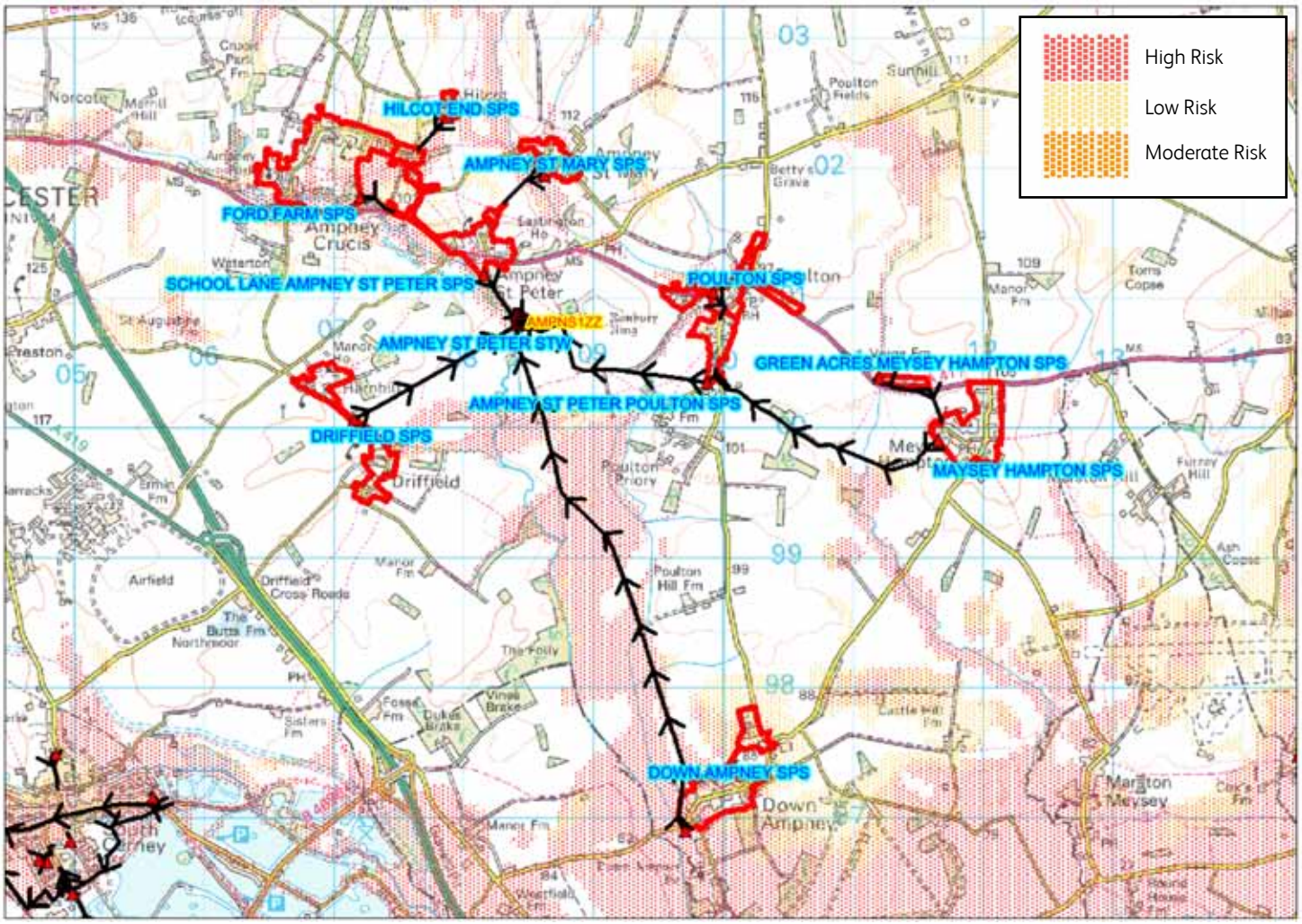


Figure B5 Ampney St Peter Groundwater Flood Risk

This groundwater flood risk map information has been sourced from ESI Ltd.



ESI Groundwater Flood Risk Map of England and Wales © www.esinternational.com

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