Compton 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:

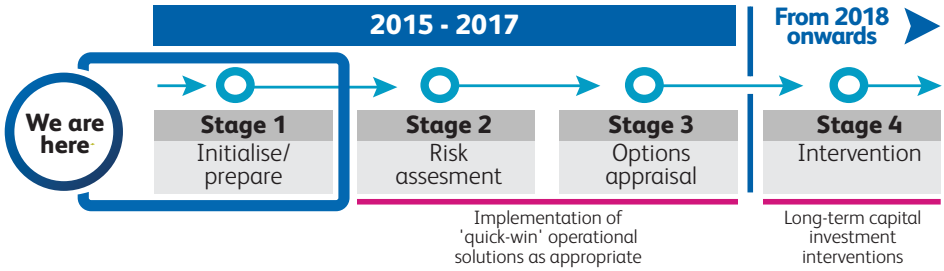
- an Introduction to the work we are undertaking to alleviate sewer flooding in our region
- a Feedback: Q&A section addressing key questions from customers and stakeholders
- the Compton Drainage Strategy technical document.

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. 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?

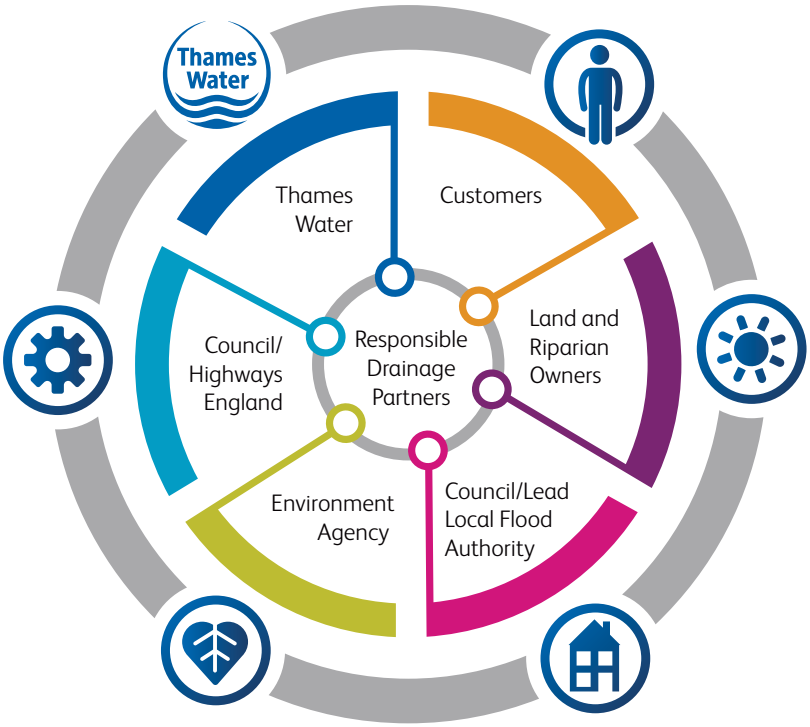
There are a number of stakeholders who, like us, have important drainage responsibilities and therefore, play an essential role in resolving sewer flooding in our region. These stakeholders include customers, private land owners and the Environment Agency; to name but a few. We are seeking to work in 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 activities and plans. We have addressed key feedback and questions raised by customers and stakeholders in the Compton 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.

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

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 Compton catchment.

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 Compton catchment:

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

1 CCTV survey of our sewer network
2 Sewer lining and manhole sealing
3 Depth monitor installation
4 Site reconnaissance
5 Sewer level monitoring
6 Flooding clean-up.

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

1. Stakeholder engagement activities
2. Ongoing surveys and repair works to our catchment sewer network and manholes
3. Sewer and manhole surveys
4. Connectivity survey
5. Customer survey
6. Innovative solution 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. Our CCTV survey work carried out as part of the temperature sensing trial, identified a number of localised issues that need addressing within the sewer network. As per Question 2 above, as the Drainage 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.

Q4 What are the improvement plans for Compton sewage treatment works to manage capacity?

Answer

The Compton 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 significant 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 ensuring that our local pumping station is operating effectively

Answer

The pumping station is supported by 24 hour diagnostic monitoring so that we can tightly control its 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 at this pumping station particularly during wet weather, carefully avoiding increasing the risk of sewer flooding in doing so.

Q6 Are you working with the Highway Authority to resolve blocked gullys, and ditches, and with andowners 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.

Q7 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. 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.

Q8 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.

Q9 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.

Q10 Are growth and urban creep minor factors in these rural catchments?

Answer

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. Working closely with the local Planning Authority, we are tracking a number of ongoing and proposed developments in the Compton catchment, and assessing their potential impact on our assets and service. 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.

When compared against the rest of the Thames Water region, the urban creep rate for Compton is above average for the Thames Water Operational Area, but not as high as suburban areas around central London and major towns. More growth and urban creep information can be found in Section 5.1 of the following 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 employing 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.

Compton 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

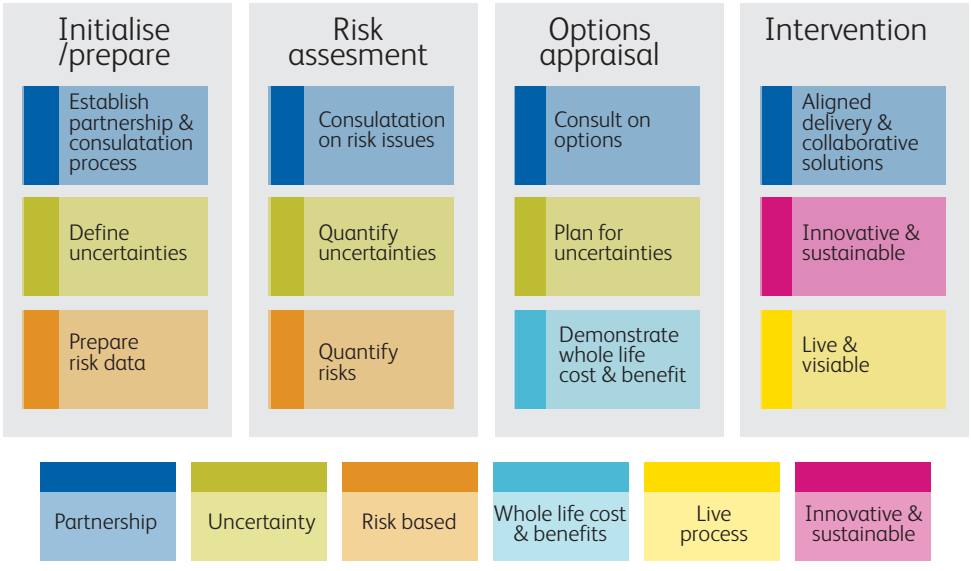
Undertaking extensive customer research has been a fundamental step in our business plan preparation for 2015-20. Our research findings have informed our business planning activities, and contributed to the development of a set of long-term customer 'outcomes'.

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 Compton 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. The Compton 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 Compton catchment has become overwhelmed in some locations, following prolonged and heavy rainfall and raised groundwater levels. This has resulted in certain properties suffering from sewer flooding and restricted toilet use.

We believe that the foul sewerage system has surcharged because of a combination of groundwater infiltration, surface water run-off from saturated fields to the west of the village towards East Ilsley, surface water inundation from highways, public spaces and properties, surface water misconnections (ie downpipes from roofs) and river water overflowing from the River Pang and from other local watercourses.

Therefore, the root causes of sewer surcharges are 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 RMA, Thames Water will work with West Berkshire Council 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 Compton strategy is currently at Stage 1 (Initialise/Prepare). We describe in this document the actions that we plan to carry out to complete the following risk assessment and options appraisal stages. We will update and republish this document once this work has been completed.

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[2]; 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 Compton 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 customers' expectations and regulatory requirements.

This Drainage Strategy must also address future challenges to the Compton 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

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

- 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 Compton are about average for the Thames Operational Area
- Population growth – the population in the South East is set to grow rapidly. There are a number of developments ongoing and proposed for the Compton catchment. Thames Water has carried out a number of Hydraulic Modelling studies to investigate potential impacts.

Our strategy is to understand the relative impact on this catchment of overland flow from saturated fields, groundwater infiltration and surface water misconnections, and then to identify cost beneficial solutions to reduce the risk of sewer flooding; using willingness to pay research. We will carry out sewer rehabilitation 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 contributed to flooding.

In 2014 a number of manholes were sealed and the sewer in Horn Street was lined. In December that year we also installed depth monitor loggers into the foul sewers to enable us to analyse the recorded depths and compare with other catchment variables, such as rainfall events and changes in groundwater levels. Our key next steps are to continue to gather and analyse flow information from the loggers, and to gather information from customers affected by sewer flooding during the wet winters of 2012/13 and 2013/14.

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).

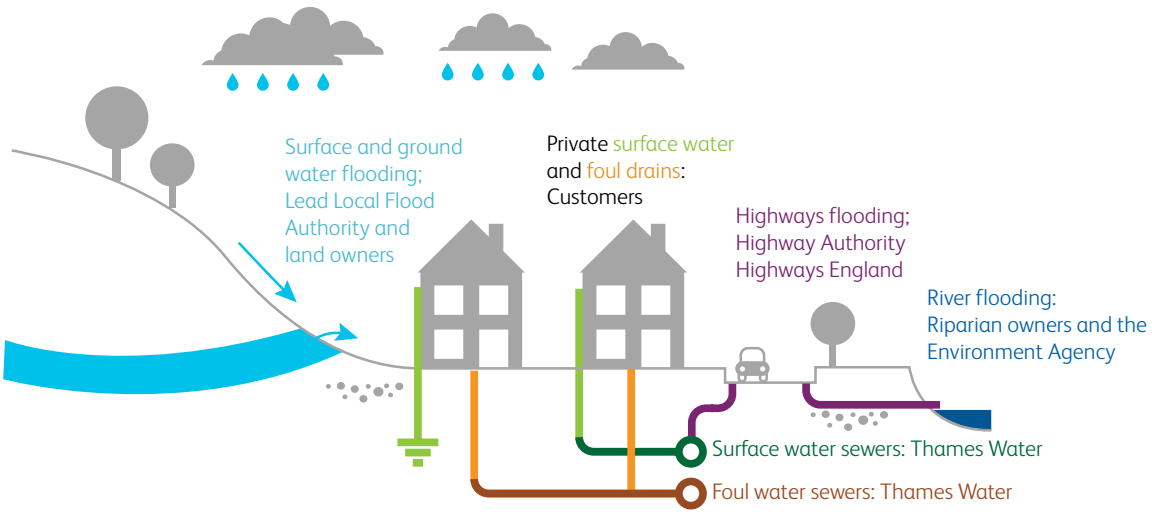
A comprehensive and detailed list of all legislation relevant to Thames Water can be found in the 'statement of obligations' published by Defra[4].

[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 2 below.

Figure 2 Stakeholder responsibilities for drainage



Thames Water

We are responsible for removing and treating wastewater, which includes the foul sewers and surface water sewers in some areas and the combined sewers that are in some of the older large urbanised areas, such as London[5]. 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

Lead local flood authorities have 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. The District Council tends to be the local Planning Authority, responsible for approving new development, but equally may have responsibility for ensuring maintenance of watercourses; particularly on council-owned land.

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].

Highway Authority

The Highway Authority is generally the County Council (or Unitary 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.

Riparian Owners

Riparian Owners are landowners who own land with watercourses or land adjacent to watercourse (ie 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

Compton is located approximately 13km north of Newbury, and is situated between East Ilsley and Hampstead Norreys. The catchment is mainly rural and domestic in nature although there is a large agricultural research station to the north of the village. The village lies in tye Pang Valley and the River Pang flows from the north west of the village, above Mayfield Farm, alongside the High Street, School Road and Aldworth Road.

An ordinary watercourse, locally referred to as the 'River Roden', flows into the village from the north. Both watercourses are 'winterbournes', i.e. only flow during the winter months and are typically dry during the summer months.The catchment bedrock is generally made up of chalk and very permeable soils. It is situated in an area that is prone to significant seasonal changes in groundwater levels.

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

The Environment Agency identifies the current ecological status of the River Pang as 'Poor'[8], although the Environment Agency does not comprehensively assess water quality in the Compton catchment.

2.2 Sewage treatment works

Compton sewage treatment works receives foul flows arising from the village of Compton, a catchment of some 73 hectares with a population of approximately 1,550. The system drains to Aldworth Road terminal sewage pumping station, which lifts flows to the sewage treatment works via 5.3km of pumped main.

The treatment works has full treatment flow consent of 3,456 m^3/day. Average flows to the works during dry weather are around 650 m^3/day and it typically treats a maximum daily flow during dry weather of up to 1,152m^3/day.

All inflow arrives at an inlet pumping station, which lifts the flow through a screen to a high level inlet works. Flows then pass to a balancing tank and on through primary and secondary biological treatment processes, with the treated effluent discharging into the River Pang. The sewage treatment works was enhanced in the 1990s with the provision of storm pumps and a storage tank which holds storm flows, this discharges back to the inlet pumping station for treatment. Any excess flow discharges via a screened overflow to the River Pang. Construction of a storm land treatment area was undertaken approximately 10 years ago to provide partial treatment for the storm sewage prior to discharge.

The works is believed to date from the 1950's and is likely to have been implemented by the District Council, together with the sewerage system, as a first-time sewerage scheme. During the intervening period, the sewage treatment works has undergone a number of upgrades to meet changing performance criteria. It was last upgraded between 2005 and 2010 to meet the requirements of the discharge consent. The capacities of the works have been assessed to be adequate under normal design flow conditions, and there are no plans to enhance the treatment capability of the works during AMP6.

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

2.3 Foul sewers

Compton has a separate foul sewer system that drains under gravity from the west of the village to Aldworth Road sewage pumping station in the south east of the village. The sewers are 150mm in size at the head of the network increasing to 225 mm in the High Street, 300mm in School Road and ultimately 375mm in diameter towards the pumping station in Aldworth Road.

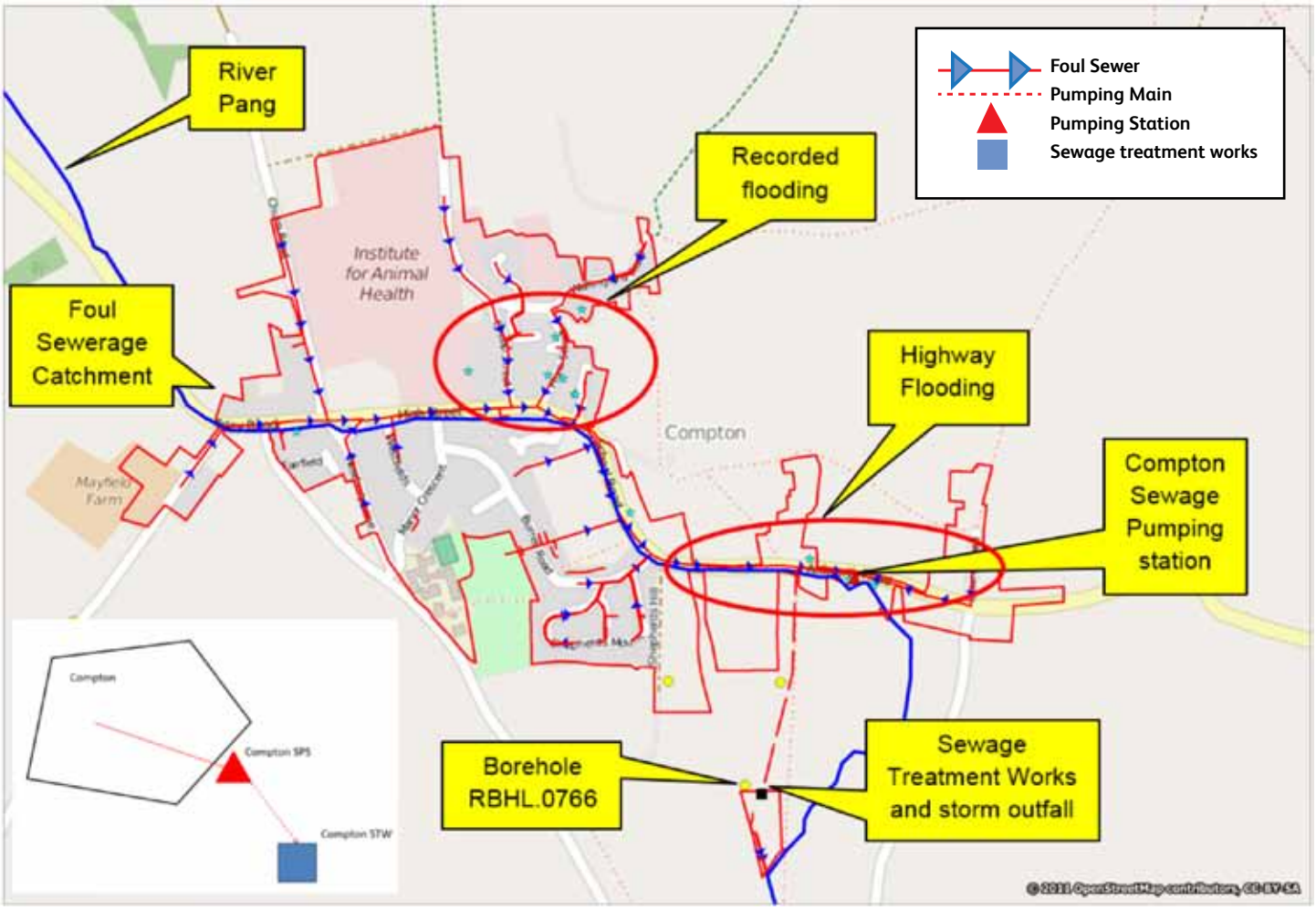
The design of the sewerage network ensures the appropriate sizing and laying of pipes at a gradient to maintain a satisfactory self-cleansing characteristic. The capacity of sewers is typically set to cater for a maximum of six times Dry Weather Flow and a 10% allowance is included for infiltration[9].

A 225mm diameter sewer laid at a gradient of 1 in 225 will have sufficient capacity to cater for the foul sewage from 1,000 to 1,500 houses or 3,000 to 4,500 people. The typical gradient through the High Street is approximately 1 in 100 so is more than adequate to deal with the normal foul flow. Problems in small diameter sewers tend to be a result of blockages in the pipes. However, occasionally surface water can be misconnected into the foul sewerage network – problems then arise when it rains heavily. The materials used in the construction of the sewerage system are typical of that time, with clay pipework, brick and concrete manholes. The clay pipework can have a very long service life, but sometimes the joint seals deteriorate over time. Prior to the 1980s, pipes were typically laid on bedding material such as pea shingle, with the trenches likely to have been backfilled with 'as dug' excavated material. More recent drains and sewers, i.e. since the 1980s, are typically surrounded with pea shingle. This protects the pipe but can also act as a good conduit for groundwater.

The layout of the village 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, the private foul water drains within the property boundaries in Compton are the responsibility of 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 3 Compton Catchment Plan



The red solid line indicates the extent of the foul water catchment, the blue solid lines show local watercourses and the red circles indicate the extent of sewer related flooding in the area.

2.4 Surface water sewers

There are few surface water sewers in Compton owned by Thames Water. There are minor systems in Shepherds Mount and Yew Tree Stables which drain to the River Pang. It is assumed that surface water from the majority of properties either drain to private soakaways or to the River Pang which flows through the village, in parts culverted.

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 Compton catchment area is mostly rural and incorporates a network of roadside ditches and minor watercourses that are intended to drain surface water from roads and public spaces. The responsibility for the operation and maintenance of these ditches, local watercourses and general land drainage lies mostly with riparian owners. West Berkshire Council as the Lead Local Flood Authority has overall responsibility for managing groundwater.

The extent of highway drainage is not certain, but it is likely that highway run-off discharges directly to roadside ditches; some of which will act as soakaways. West Berkshire Council is responsible for the highway drainage and surface water culverts in the highway.

The Environment Agency has the duty and the authority to ensure that the River Pang 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 across our region.

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 see, and pay for, an improvement to 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, properties and public areas protected from flooding and river water quality service outcomes as these are relevant to the Compton 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 Compton has become overwhelmed for weeks at a time in recent years following prolonged heavy rainfall and raised groundwater levels. This has been associated with significant surface water flooding and has resulted in certain properties suffering from sewer flooding and restricted toilet use. Site reconnaissance that we have carried out indicates that surface run-off from fields is likely to be a major source of excess water entering the foul sewerage network, during prolonged wet periods.

Photographs obtained during the extreme weather of early 2014 show that overland flow from the East Ilsley area, higher in the valley, and river water flowing from the River Pang and from other local watercourses caused surface water flooding which has led to the sewers and the pumping station in Aldworth Road becoming inundated by the excess flows. Problems are likely to have been compounded by groundwater infiltration into foul sewers and private drainage, as well as surface water misconnections from properties to the foul sewerage network. The extent of surface water misconnections has not yet been determined.

We are confident that this is a comprehensive list of factors that have caused flooding. During recent events, the following incidents have been observed with respect to the sewerage network:

- Surcharging sewers causing spills out of a number of public manholes including – Aldworth Road, High Street, Horn Street and Ilsley Road and discharging via roadside gullies to adjacent watercourse and river.
- External foul flooding and restricted toilet use at a number of properties in Aldworth Road, High Street, Horn Street and Ilsley Road
- Surface water entering the foul sewerage network due to surface water flooding through the village
- A power failure during February 2014 that affected Aldworth Road pumping station and further exacerbating flooding in the area.

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

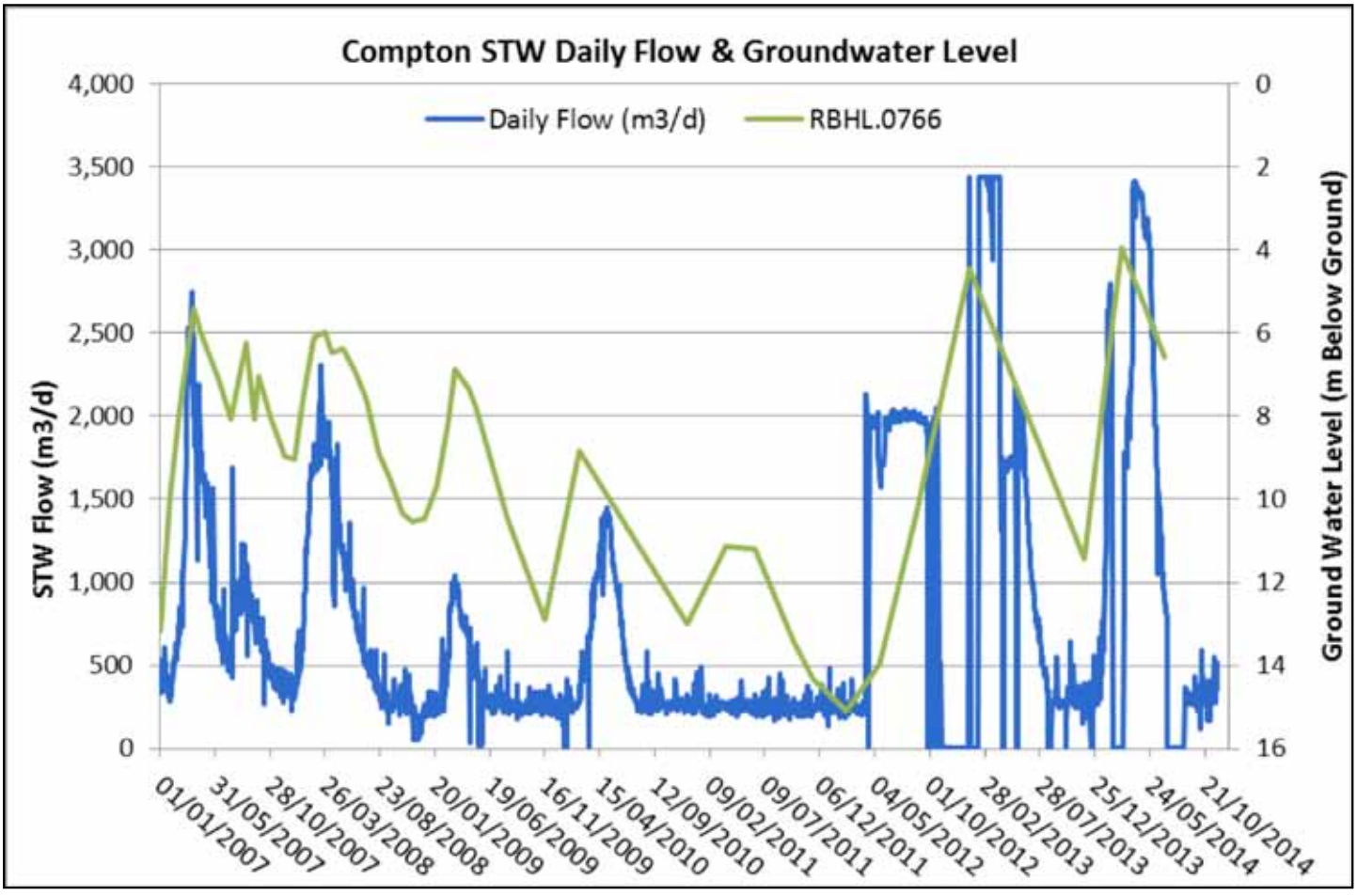
- Highway drainage overwhelmed causing highway flooding
- Land drainage issues with water running off fields around the village and onto the highway.

To reduce the risk of flooding, residents have had to pump floodwaters onto the highway or protect their properties with sandbags.

During extended wet periods, treated flows from Compton sewage treatment works exceed the maximum permitted daily flow of 3,456m3/day for periods of time. Figure 4 below, compares the treated flows from Compton sewage treatment works with groundwater levels recorded at an Environment Agency borehole in the area (RBHL.0766), the location of which is shown in Figure 3 above.

The graph suggests that there is a correlation between flows treated by Compton sewage treatment works and changes in groundwater levels in the catchment and further work is being undertaken to better understand the direct impact of rainfall on the flows received at the works

Figure 4 Compton Sewage treatment works treated flows and groundwater levels



Following the extreme weather experienced in 2013/14 West Berkshire Council, as Lead Local Flood Authority, produced a flood report and details are available on their website.

The following is extracted from their report. The River Roden began flowing in late January and the River Pang started to flow along the High Street watercourse in early February, fed by a combination of the overland flow route from East Ilsley and local groundwater and surface water runoff. Both of these winterbournes were dry prior to these dates. The water level in the village was highest in mid February and the southern end of Cheap Street was flooded to a depth of approximately 300mm as a result of a blocked surface water drain. A number of foul manholes along Cheap Street also surcharged and a number of cottages on the eastern side of Cheap Street came close to suffering internal flooding as a result of the flood water on the road. West Berkshire Council attempted to clear the drain on Cheap Street to alleviate the flooding, but water continued to flood the highway following each subsequent rainfall event. West Berkshire Council deployed tankers to reduce the water level.

Sewer manholes also surcharged on Horn Street, causing sewage approximately 150mm deep, to collect on the road. This water flowed off the highway into the Horn Street pond. A culvert beneath Wallingford Road was unable to cope with the flow from the River Roden, causing water to spill out of the channel and flow onto the carriageway from the north, flooding the road to a depth of approximately 100mm. The water flowed across the road and back into the culvert via four highway gullies.

A number of properties experienced groundwater flooding in their cellars, though reported to be a relatively common occurrence in these properties during the winter months, the flood water in the cellars was deeper than normal and was observed to remain high for a longer period than typically experienced. School Road and Aldworth Road were both flooded to a depth of 150mm and 300mm respectively. An apparent lack of capacity in the Burrell Road culvert caused water to back up and spill out onto the highway on School Road. The water flooded Aldworth Road due to access crossings further downstream on Aldworth Road restricting the flow of water in the channel. The majority of the kerb drains in the affected area on School Road and Aldworth Road had reverse flow. The foul sewer and utility manholes on Aldworth Road surcharged, due to groundwater ingress in the sewer system and utilities pipes. Property owners along Aldworth Road reported problems flushing toilets.

The southern-most extension of Coombe Road was flooded to a depth of 200mm as a result of water spilling out of the channel. South of the junction with Coombe Road, Newbury Road was closed due to 300mm deep flood water. A lack of capacity in the culvert is thought to be the cause of these incidences of highway flooding. The footpath between Church Farm Cottage and Compton Sewage Treatment Works was closed due to flooding to a depth of 400mm on the section that runs alongside the eastern boundary of the Sewage Treatment Works, making it impassable.

In early March 2014 West Berkshire Council removed the ground above the twin-pipe culvert under the field entrance immediately before the River Pang changes course by Floodcross. This alleviated the situation. Two pumps were installed in the village. The first on the 21st February in School Road, to the west of the junction with Burrell Road. Water was pumped to the River Pang south of Aldworth Road until the 27th February. A second pump was installed on the High Street on the 24 th February. This pump was located at the entrance to the culvert, west of the junction with Cheap Street. Water was pumped approximately 1km east to the watercourse just upstream of the point where the School Road pump discharged, until the 6th March.

4.2 Our operational response

To maintain service for customers, tankers were used in the wet winters of 2012/13 and 2013/14 in areas such as Horn Street and Aldworth Road, where customers' homes were at high risk of flooding. We also used tankers to clear up pollution around Aldworth Road sewage pumping station.

Tankers have limited capacity and can only draw off water at a relatively low rate. We acknowledge that 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 Compton to maintain service instead of using tankers, but we would consider doing so to prevent the backup of sewage into customers' properties and uncontrolled spilling from the sewer system into the environment. As part of the survey works that commenced in winter 2014/15, we are investigating the circumstances under which emergency discharges would 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 via storm tanks to the River Pang. 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 Compton catchment. These form the extent of our current understanding of issues within the catchment.

Table 2 Investigations and activities completed

Activity	Purpose	Date complete	Outcome
Sewer and manhole surveys	Ascertain sewer and manhole condition and evidence of infiltration.	2014	Significant clear flows observed in the foul sewers. Identified infiltration through some manholes.
Sewer lining and manholes sealed	Manholes and sewers in the Horn Street.	2014	Reduced infiltration and likelihood of flooding.
Flooding clean-up	Tankering was used to alleviate surcharged sewers.	As required in 2014	Public health and safety.
Site reconnaissance	Photographic evidence was collected during the winter of 2014.	Winter 2014	Sources of floodwater were documented and impacts on Thames Water assets identified.
Depth monitor installation	Permanent installation of 2 depth monitors into the foul sewers in School Road and High Street. Enable analysis of the recorded depths and comparison with other catch-ment variables, such as rainfall events and changes in groundwater levels.	December 2014	Used information to identify additional actions for inclusion in the drainage strategy for Compton. Share information with other agencies, customers and stakeholders

In summary, following the impact of the extreme rainfall and high groundwater experienced in the winter of 2013/14 surveys were undertaken in 2014 to identify the potential sources within our network. As a result of these surveys a number of manholes were sealed and a sewer lined in Horn Street to reduce groundwater ingress.

It is clear that a range of factors contribute to flooding and surcharge issues in the Compton catchment and only through determining the relative contributions from these sources can an integrated solution be developed. Further survey and investigations are ongoing in order to determine the most effective and economical long-term strategy for alleviating these issues.

4.4 Activities carried out by drainage partners

Table 3 below, details the activities carried out by other stakeholders with drainage responsibilities within the Compton catchment, alongside our work, 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 River Pang, water-courses and local ditches	Ensure free flow of river and ditches.	Less risk of surface water 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 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 Routine maintenance of land drainage	Ensure adequate highway drainage.	Less risk of surface water 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*	Ensure effective land drainage.	Less risk of surface water inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Monitoring and control of construction	Consider a strategy for reducing infiltration into the sewer network via private drains if investigations and permanent monitoring identifies this as a significant cause for concern.	Less risk of groundwater infiltration into private drains and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
standards for private drains	Local Authority Building Control to ensure private drainage is fit for purpose.	Less risk of groundwater 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 flood forums as appropriate, e.g. River Pang flood forum.	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 Compton 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 Compton catchment in this section.

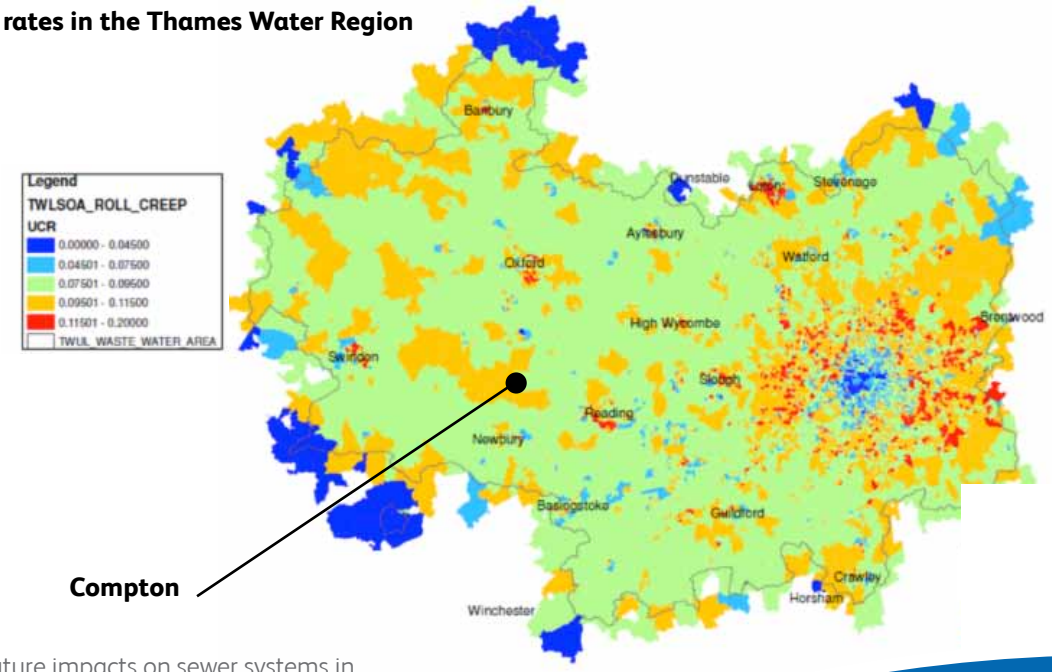
5.1 Urban creep

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 5 below. The urban creep rate for Compton is 0.115%. 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, Compton is above average for the Thames Water Operational Area, but not as high as suburban areas around central London and major towns. Whilst the immediate issues in Compton 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 West Berkshire Council, who is responsible for managing surface water. We may then also look to work with other partners 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 5 Urban creep rates in the Thames Water Region

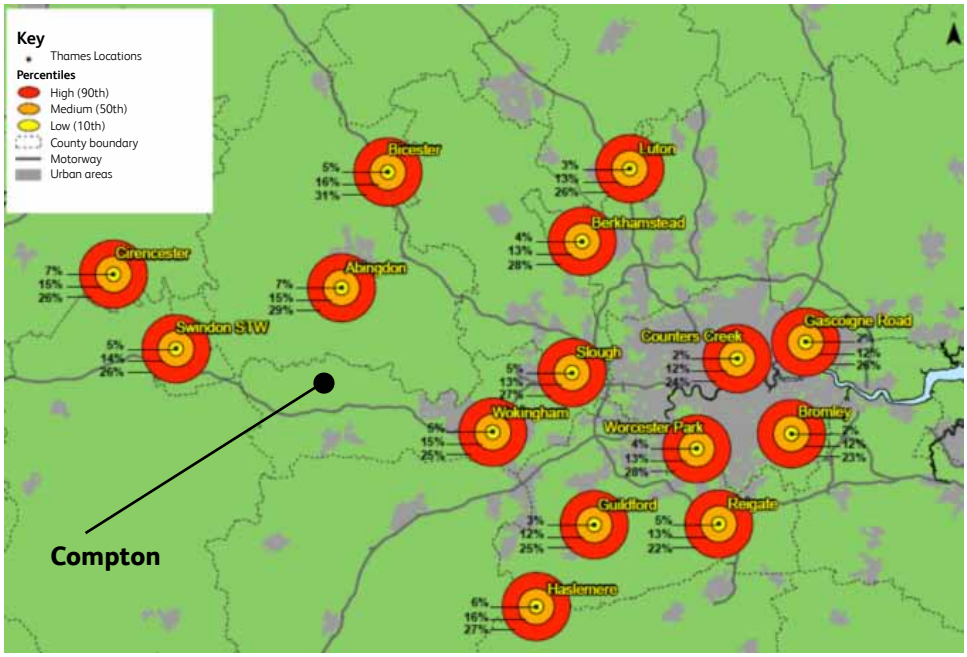


[11] Mott MacDonald, Future impacts on sewer systems in England and Wales, June 2011.

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 Compton that was analysed for climate change was Abingdon. 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 29% or as low as 7% as shown in Figure 6 below. We will ensure that our strategy takes account of these potential increased peak flows as it develops.

Figure 6 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 to 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 demonstrated 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 the 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 system, causing overloading and back-up of water to the surface. Typically, SuDS slow the rate of surface water run-off and improve infiltration, thus mimicking natural drainage in both rural and urban areas. It now seems likely that the Government will make changes to the current planning regime in order to approve, adopt and maintain SuDS for all new development. This will be a change to the original proposals envisaged in the 2010 Flood and Water Management Act.

In the case of Compton, whilst SuDS might help to reduce the risk of flooding following heavy rainfall when groundwater levels are low (i.e. typically during summer months), they will not be effective in reducing flood risk when groundwater levels are high. We will take account of this when we come to assess options as part of this drainage strategy.

The key development sites that we are currently tracking in Compton include:

- 140 properties planned for the Pirbright Institute site, on the High Street
- 25 properties planned for Compton High Street
- 12 properties planned on Newbury Lane.

Sources of data include the West Berkshire Council Development Plan, West Berkshire Strategic Housing Land Availability Assessment and third party planning enquiries, other applications exist but relate to single 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 development may be significant in the context of challenges currently experienced. This assessment will be undertaken and the findings shared in an update to this strategy document.
We have carried out a preliminary assessment of the potential impact that these development sites may have on the sewerage network and our initial view is that capacity enhancements may be necessary to accommodate the increased flow. We will continue to work closely with the local Planning Authority and with the developers to understand progress through the planning system, and if planning is approved, the build-out rate for the new properties and timing of occupancy. We will continue to monitor future plans for the catchment through our stakeholder engagement work.

6 Strategy development

The drainage strategy for the Compton 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
Stakeholder engagement	This document will be circulated to the Environment Agency, Lead Local Flood Authority, Highways Authority and West Berkshire Council before being published on our website. The Local Flood Forum will continue to be used as the primary route for stakeholder engagement. All third party data will contribute to drainage strategy development.	Ongoing	Stakeholders informed about progress and timing of works to reduce the risk of flooding. Work carried out by Thames Water is coordinated with activities of other partners involved with drainage.
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 by Thames Water.	From autumn 2015	Use information to help test the cost benefit of options to improve drainage and reduce the risk of sewer flooding in Compton.
Sewer and manhole surveys	Ascertain sewer and manhole condition and evidence of infiltration via CCTV survey and manhole "lift and look" surveys, when appropriate.	From autumn 2015	Use information to identify additional actions for inclusion in the drainage strategy for Compton. Share information with other agencies.
Connectivity 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 when appropriate.	From autumn 2015	A better understanding of the contribution that misconnections make to sewer flooding in the area.
Pilot trials of Biological Filters	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 Compton. 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.
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.
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.

7 Preferred strategy and plan

We believe that Compton's foul sewerage system has surcharged predominantly because of significant surface water run-off from saturated fields surrounding Compton, and from the River Pang which has inundated the sewerage system and sewage pumping station. Groundwater infiltration into public sewers and private drains is also likely to be a contributing factor, along with surface water misconnected into foul sewers. 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.

Our strategy is to understand the relative impact that each of these factors has on the risk of flooding, and then to develop a plan comprising cost beneficial solutions using customer willingness to pay research.

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 activities that we have identified to date.

Table 5 Activities identified in preferred plan to date

Activity	Purpose	Date planned	Outcome
Localised sewer rehabilitation	Undertake localised sewer rehabilitation to include lining, patch repairs, localised pipe replacement and manhole repairs identified through survey work and where considered cost effective in reducing ingress of ground water.	Ongoing	Reduce infiltration into the public sewers.
Manhole cover replacement	Replace manhole covers with leak tight covers where identified through survey work.	Ongoing	Stop ingress of surface water through manholes located in flood plain.
Permanent monitoring of sewer levels	Continued monitoring of depth monitors for at least 5 years and to capture the next wet weather event as a minimum. Analyse the recorded depths and compare with other catchment variables, such as rainfall events and changes in groundwater levels.	Ongoing	Identify additional actions for inclusion in the Drainage Strategy for Compton, data to be shared through future update to the Drainage Strategy.

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 Compton 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 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 Fluvial flood risk for Compton based on Environment Agency plans

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.

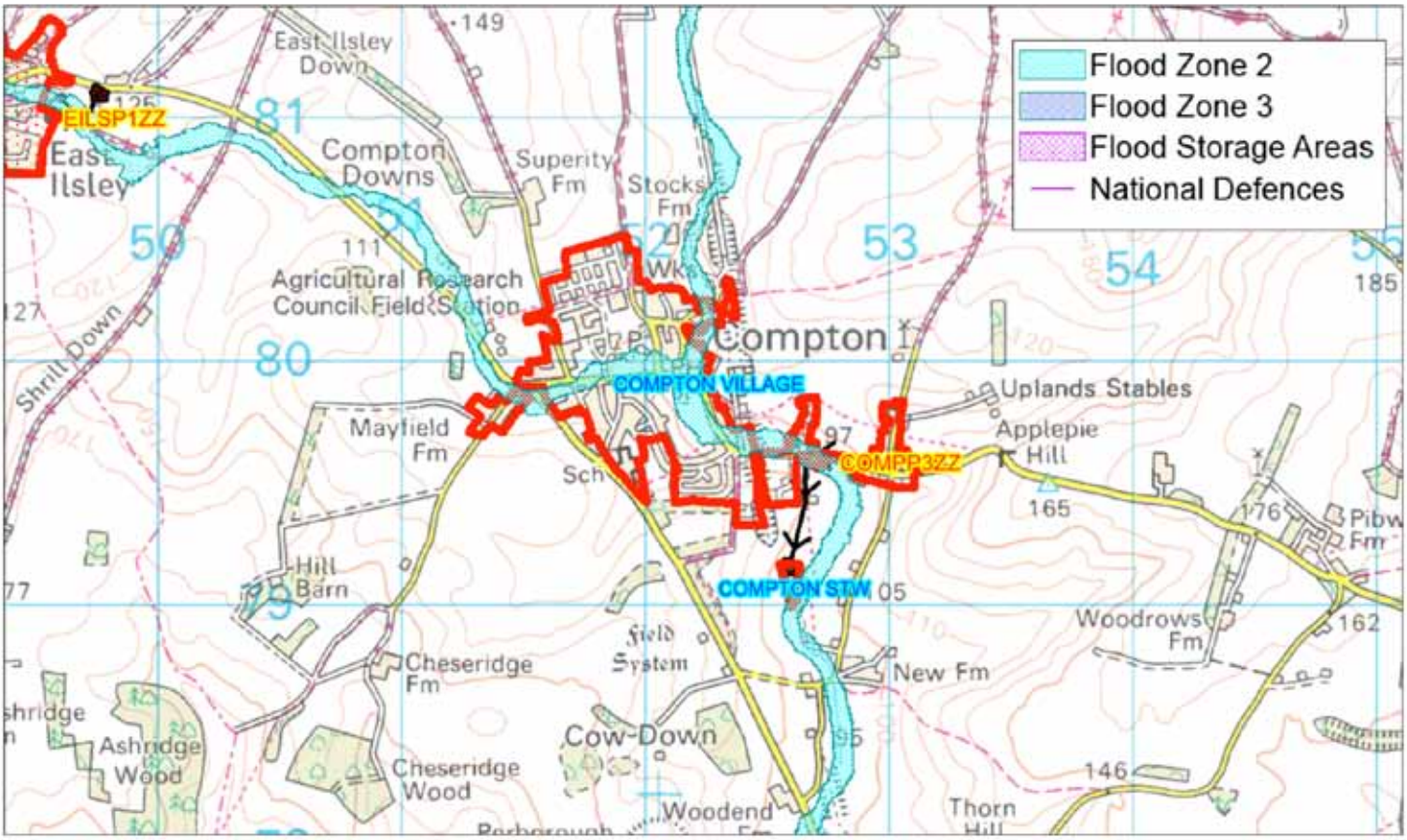


Figure B2 Surface water flood risk for Compton from Environment Agency plans

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.

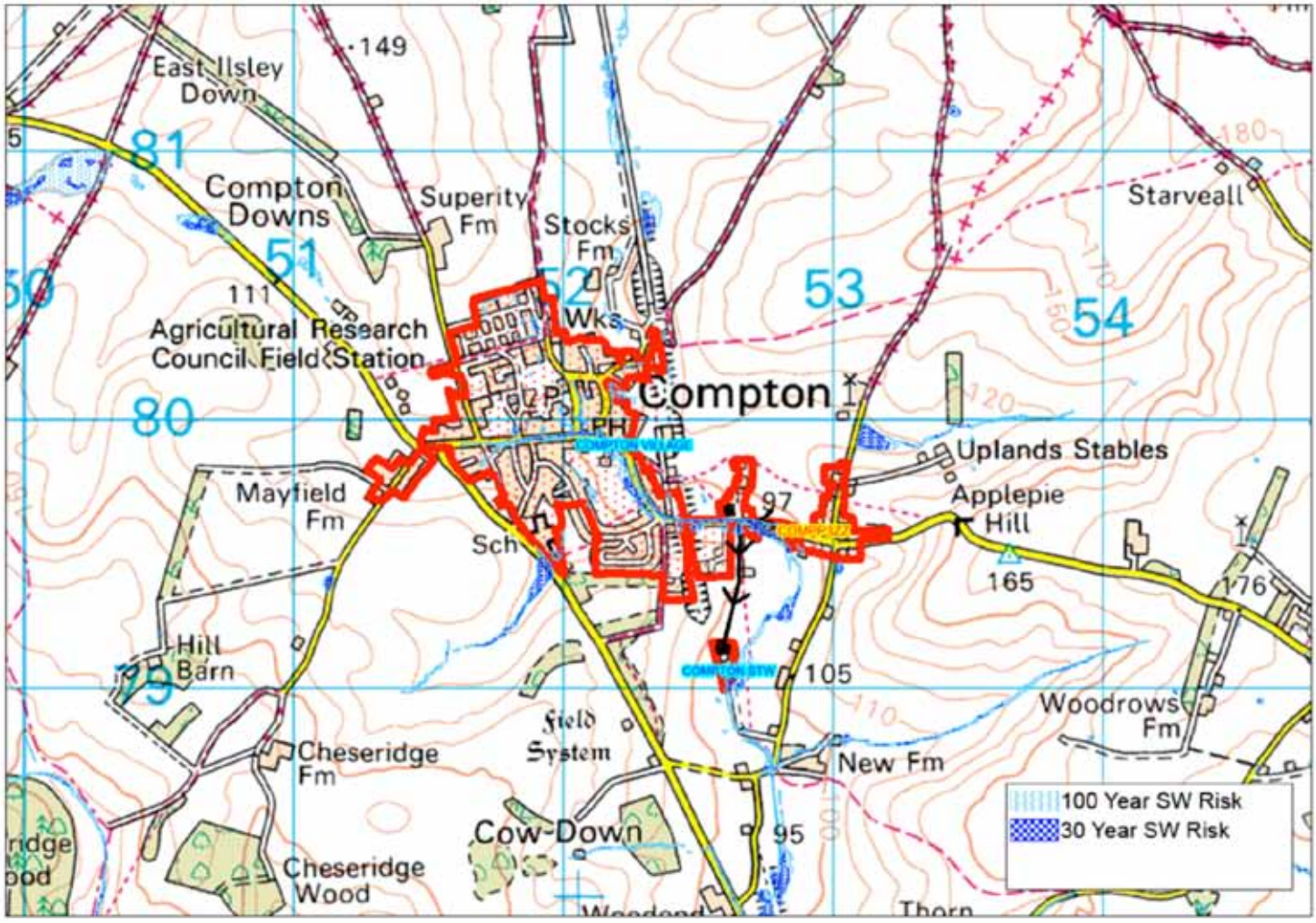
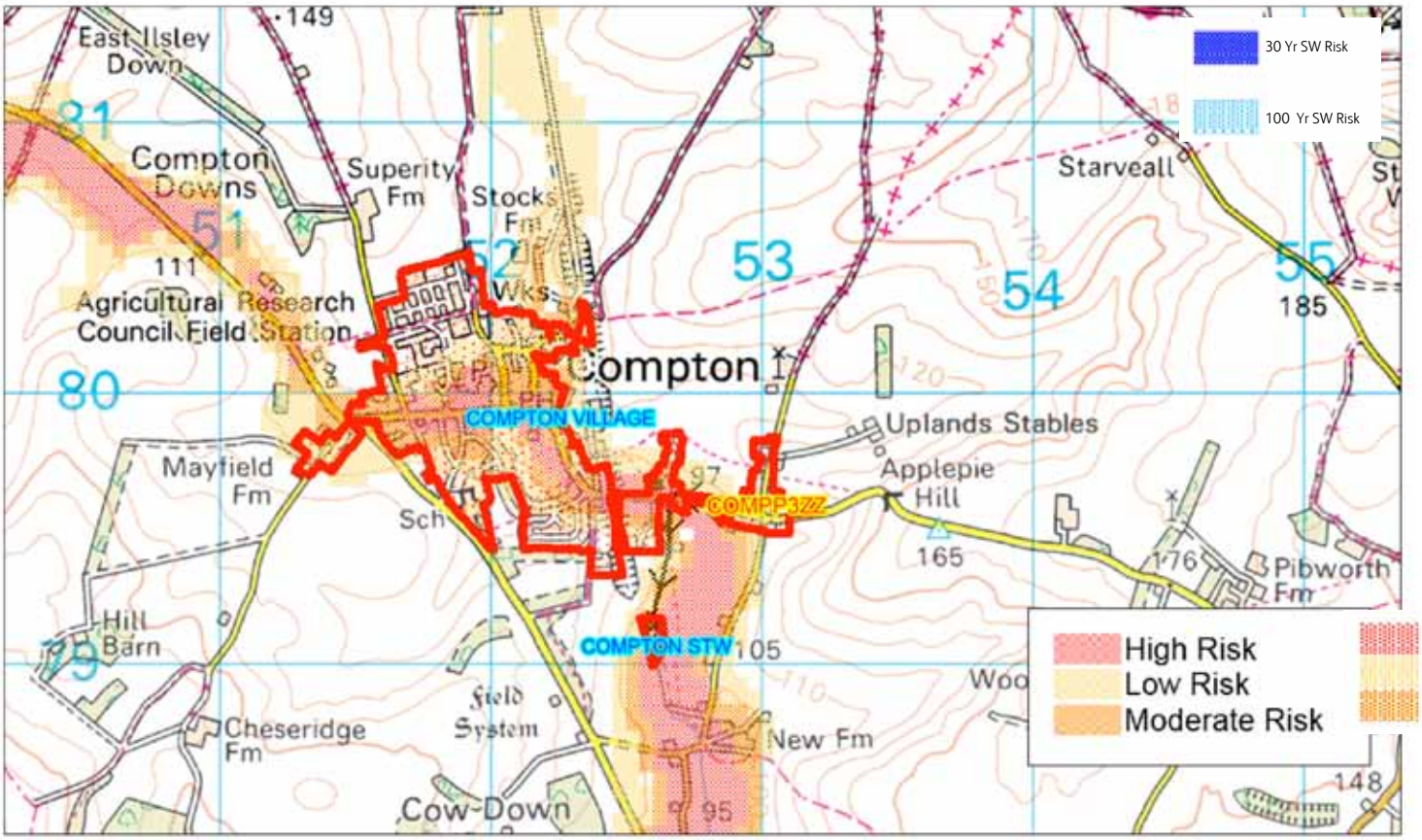


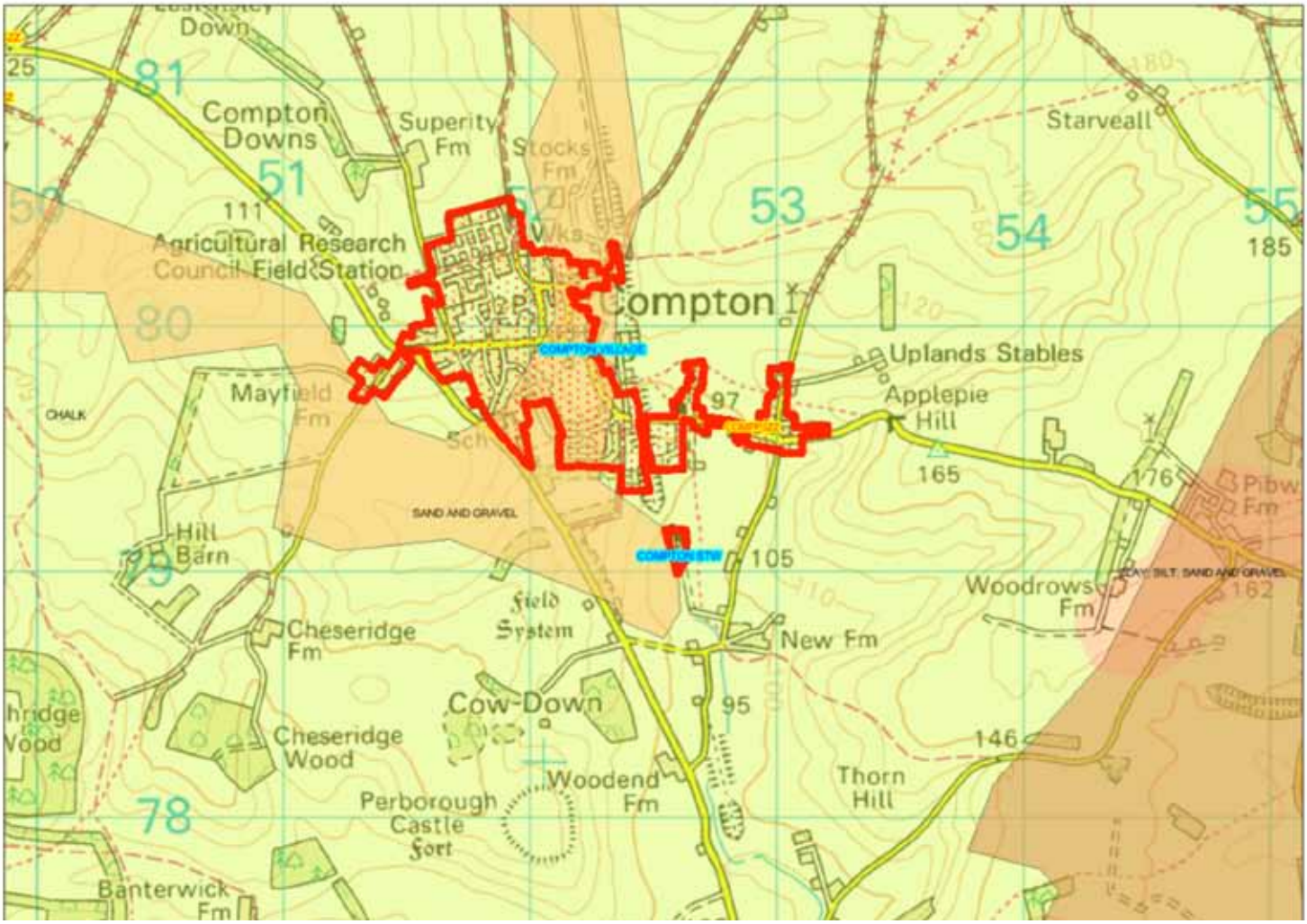
Figure B3 Groundwater flood risk for Compton



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

Figure B4 Compton 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.



Photographs taken during wet weather of 2013/14

Photo 1 – Flooded fields with surface water flow from East Ilsley

Photo 2 – Groundwater flooding in front of Compton Pumping station, Ilsley Road

Photo 3 – Groundwater spring at junction of Horn St and Roden Down Mews

Photo 4 – Evidence of overflow from highway drain, Wallingford Road

Photo 5 – Ditch north of village overflowing into fields and flowing into surface water drains on road

Photo 6 – Flooded road and overflowing sewer, Aldworth Road (east)

Photo 7 – Flooded Road and overflowing sewer – Aldworth Road

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