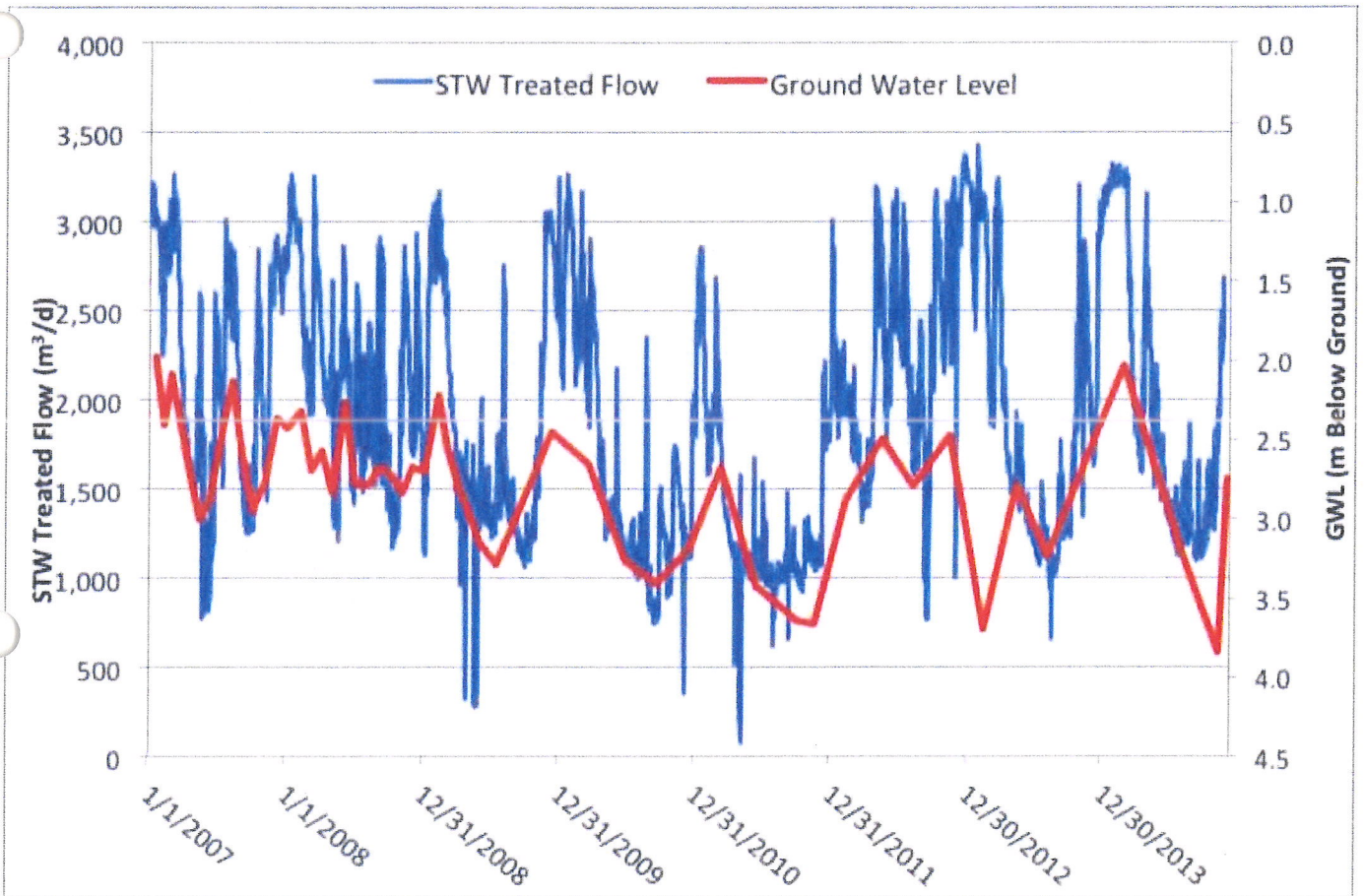


Figure 5 Fairford sewage treatment works (STW) treated flows and groundwater levels



4.2 Our operational response

To maintain service, tankers were used in the winter of 2012/13 at Fairford Moor Farm sewage pumping station for flow management purposes. Tankers have limited capacity and can only draw off water at a relatively low rate. They can also cause considerable noise and disruption to local communities.

Due to the significant impacts of fluvial and groundwater flooding across our region during the winter event of

2013/14, we decided to mobilise our tanker fleet of nearly 100 vehicles to protect customers most at risk of flooding inside their homes. For this reason, and recognising the limited effectiveness of tankering following more extreme weather conditions, tankering was not generally utilised in the Fairford catchment at this time. However, tankers were used at Horcott sewage pumping station to prevent properties from flooding.

To date, we have not installed temporary pipework and pumps during wet weather events in Fairford 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 survey works due to commence this year, we are investigating the circumstances under which emergency discharges would be required in future.

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 Fairford catchment. These form the extent of our current understanding of issues.

Table 2 Investigations and activities completed

Activity	Purpose	Date complete	Outcome
Sewer flooding alleviation scheme	Relieve sewer flooding in the Milton Lane, Back Lane and Moor Lane areas. Scheme included a combination of sewer rehabilitation to reduce infiltration, sewer diversion, storage and pumping station upsizing.	2006	Reduced risk of sewer flooding.
Site Reconnaissance	Photographic evidence was collected during the floods of 2014.	Feb 2014	Sources of floodwater were documented and impacts on Thames Water assets were noted.
Permanent monitoring of sewer levels	Installation of permanent depth monitors into the foul sewers at strategic locations in Fairford. Analyse the recorded depths and compare with other catchment variables, such as rainfall events and changes in groundwater levels.	Installed Nov 2014	Use the information to identify additional actions for inclusion in the drainage strategy for Fairford. Share information with other agencies.
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 Fairford. If successful, these could be used to abstract dilute sewage from surcharged sewers and discharge it safely to a watercourse.	Completed Dec 2014	Service may be restored for customers without the need for tankering.
Short-term flow monitoring of sewers	Installation of temporary flow monitors into the foul sewers at strategic locations in Fairford. Analysis of the recorded flows and comparison with other catchment variables, such as rainfall events and changes in groundwater levels.	Completed April 2015	Use the information to identify additional actions for inclusion in the drainage strategy for Fairford. Share information with other agencies.
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.	Completed October 2015	Use information to help test the cost benefit of options to improve drainage and reduce the risk of sewer flooding in Fairford.

In summary, following previous concerns that the foul sewerage network becomes overwhelmed by groundwater and surface water, considerable effort has been made to identify and remedy potential points of ingress on the public network and to address the issues. Although the sewer

flooding alleviation work carried out may have been locally successful, it has not impacted significantly on the extent of surcharging and flooding seen in the more extreme winter of 2013/14. Further survey and investigation is required to identify sources of inflow and their resolution.

Permanent depth monitors were installed in the catchment in 2014, and further monitoring is planned to better understand this impact. We will continue to monitor 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 Fairford 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 River Coln, River Leach, watercourses 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	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.
Routine maintenance of land drainage	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.
Strategy for infiltration through private drains*	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.
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 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, e.g. Fairford 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 Fairford 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)¹² 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 Fairford 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.

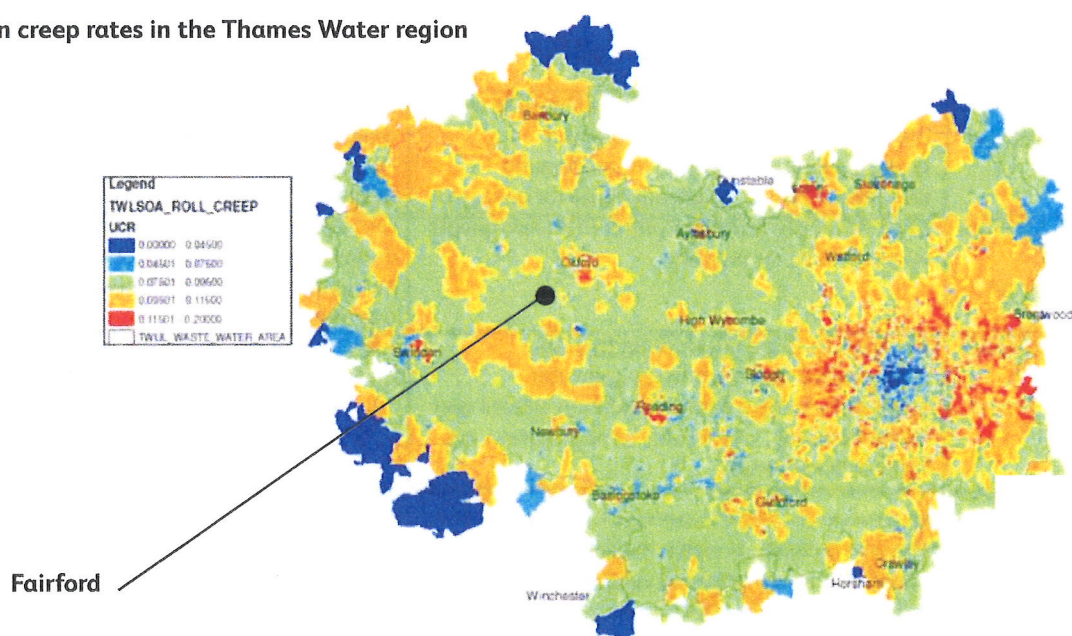
We have studied aerial photography and satellite imagery across 11 catchments across the Thames Water region using data from two periods in the late 1990s and mid-2000s to determine the rate at which urban creep is occurring. We then carried out a statistical analysis and built

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 6 below. The urban creep rate for Fairford is 0.091%. 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, Fairford is about average on the scale. Whilst

the immediate issues in Fairford 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 Gloucester County 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 6 Urban creep rates in the Thames Water region



¹² 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 region¹³. More intensive rainfall in the future will increase the peak flow in sewerage networks and with it the likelihood of sewer flooding.

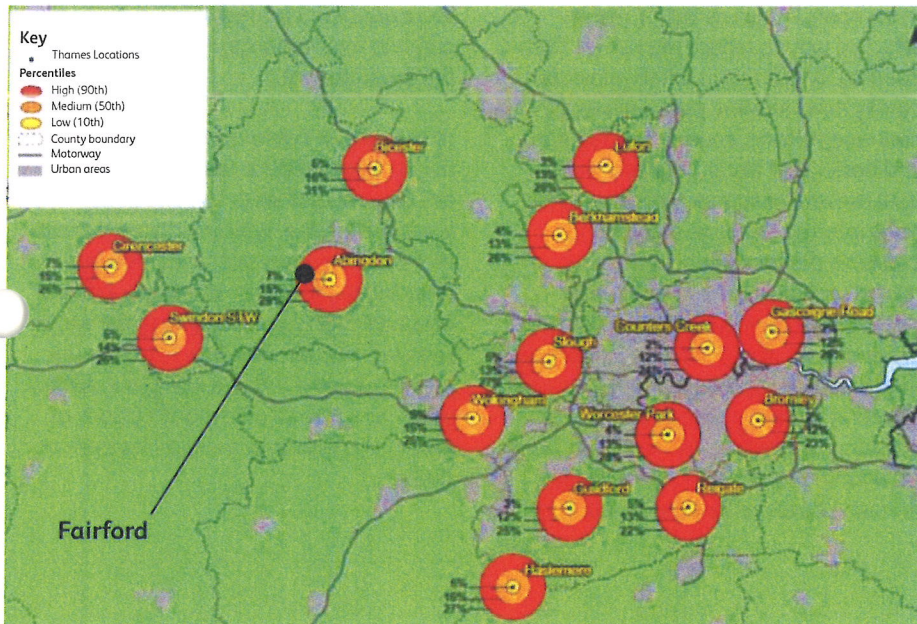
Fifteen catchments across our region were

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 Fairford 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% as shown in figure 7 below. We will ensure that our strategy takes account of these potential increased peak flows as it develops.

Figure 7 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.

¹³ 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 systems, causing overloading and back-up of water. Typically, SuDS slow the rate of surface water run-off entry into the drainage system and improves 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 Fairford, 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:

- land south of Home Farm, Cirencester Road, Fairford – 120 dwellings
- London Road, Fairford (Off Cinders Lane) – 120 dwellings
- Pengerric, East End, Fairford – 25 dwellings
- land to southwest of Saxon Way, Fairford – 22 dwellings
- land behind Milton Farm and Bettertons Close, Fairford – 49 dwellings

- Milestone House, London Road, Fairford – 63 apartments and 18 units
- land west of Pips Field, Fairford – 124 dwellings, currently under construction
- Pips Field, Fairford – 37 dwellings, currently under construction
- Milestone House and Lakes 103, 103A & 104 – 59 units and leisure facilities.

Other applications exist but relate to developments of less than 10 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.