Counters Creek

Preferred Programme and Cost Benefit Assessment

January 2013

Thames Water

Contents

Introduction

We have now developed a programme to reduce the risk of sewer flooding and are examining with our regulator, Ofwat, how this can be taken forward to the next phase.

Counters Creek is one of the lost rivers of London and is situated on the boundary of the London Borough of Hammersmith & Fulham and the Royal Borough of Kensington & Chelsea. This former river and its catchment now form part of the sewerage network, draining all surface water from buildings and roads, as well as foul water from toilets, bathrooms and kitchens.

Putting our customers at the heart of what we do is a Thames Water priority and we recognise that sewer flooding is unacceptable and distressing. After the storms of 2007, which severely tested our sewerage network, we began a detailed review of the flooding that had affected many local properties. At the time, we envisaged building a network of storm relief tunnels to alleviate the risk of flooding, at an estimated cost of over £400 million. However, when we investigated further, using the latest technology to simulate complex rainfall patterns, we found this solution would not have protected all properties.

Over the past three years, we have protected over 600 properties in the Counters Creek catchment from flooding and have continued our detailed investigations into the causes of flooding in this area. The purpose of this document is to communicate the findings of these investigations and to propose the next steps in our programme to deliver a solution to flooding in the Counters Creek catchment. We are currently examing with our regulator, Ofwat, how our programme can be taken forward to the next phase.

There is no single solution to ease the pressure on our sewerage network, and different circumstances require different approaches. Historically, we have addressed similar challenges by providing extra capacity in our sewers.

We now recognise that we need to manage the amount of surface water entering our sewers, as well as building more capacity where it is needed. We have therefore been working to develop alternative approaches to flood alleviation, using green infrastructure such as rain gardens permeable paving and water butts, to either return rainwater to the ground, or to slow it down before it enters our sewers.

Since 2008, we have carried out a thorough local investigation to:

- accurately identify the number of properties affected by sewer flooding
- understand the causes of sewer flooding in customers' basements
- identify alternative solutions, that reduce the risk of flooding more sustainably for the future
- design a programme of work that offers the most protection to customers, but which is still affordable

To support this investigation, we assembled an Independent Advisory Group – a panel of independent experts from industry and academia – and asked them to objectively challenge and scrutinise our work. We have also been working closely with both London boroughs, exploring ways in which green infrastructure can be introduced.

Our central aim has been to protect customers from a one-in-30-year storm, at the very minimum. Our work has shown that an affordable programme with a greater level of protection than this may be possible – something that we will explore further as we complete our detailed design.

We aim to begin major construction work in 2015 and to implement some of the elements of our programme before this time. We estimate that our completed programme will:

- Protect over 2,000 properties from a one-in-30-year storm, as a minimum
- Require us to invest in the range of £230m - £310m to alleviate the risk of flooding in the area.

Our findings

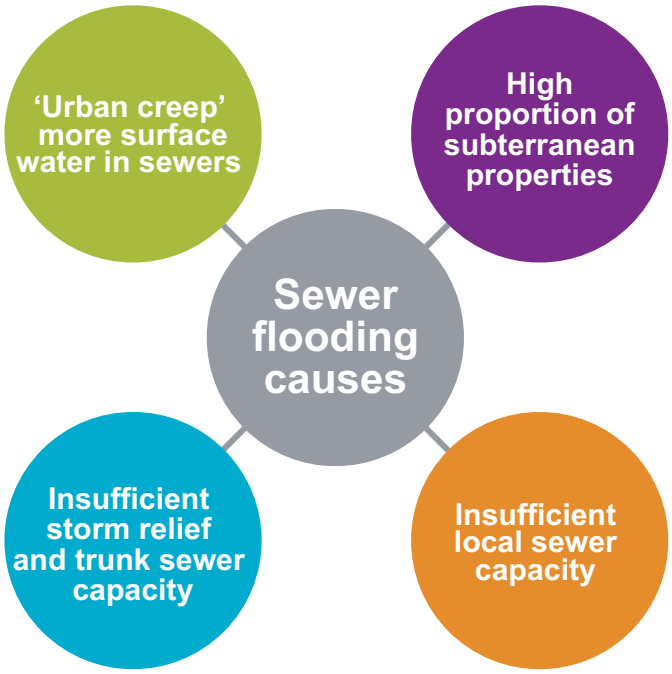
What we discovered

For the last four years we have meticulously examined the causes of sewer flooding in the Counters Creek catchment and have carefully designed the most sustainable and affordable programme to reduce the risk of recurrence.

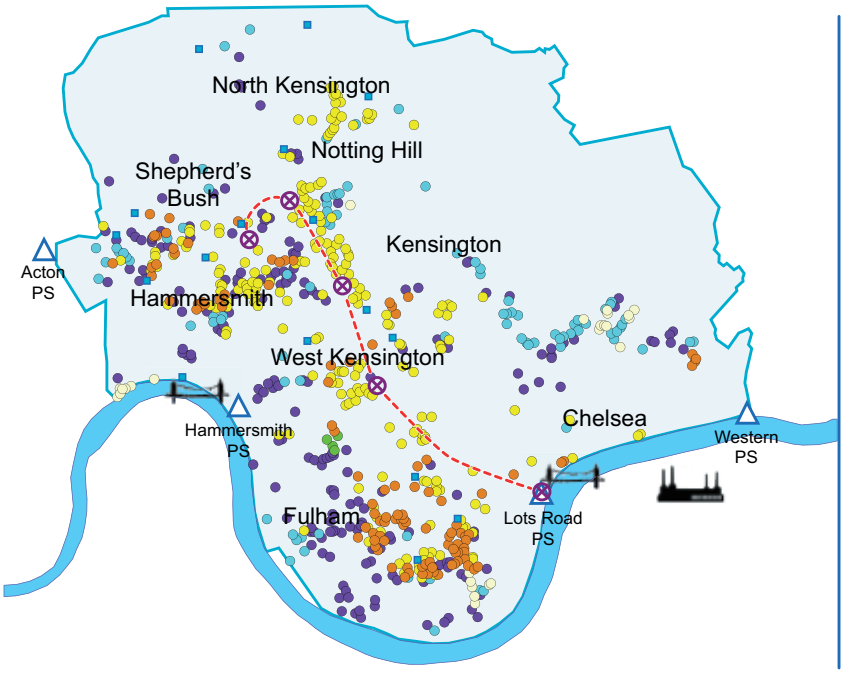
We have shared our findings with our Independent Advisory Group and can confirm the key factors contributing to sewer flooding:

1. There has been a loss of green space, known as 'urban creep', resulting in more rainwater entering our sewer network.
2. A high proportion of properties are vulnerable to sewer flooding because they have basements, some of which are already below the sewer level.
3. Local sewers have insufficient capacity after heavy rainfall.
4. Larger trunk sewers serve a wide area and back up into local sewers.

Based on our findings, we began a detailed analysis to explore the options, and to develop an affordable programme to reduce the risk of flooding.



Our proposed programme



Property flooding resolved by each programme component

- Local Solution
- New storm relief sewer and pumping station
- Anti-flood devices (FLIPs)
- Sustainable drainage
- Key overflows to new storm relief sewer
- Existing combined sewer overflows
- Pumping Stations
- Indicative route of new storm relief sewer

Just as there is no single cause of flooding in this catchment, but a number of contributing and complex factors, there is no single solution.

We propose four main elements in our overall programme. The risk of flooding at every affected property will be addressed by at least one of these elements, in order to provide the most effective and affordable solution.

- **New storm relief sewers and pumping station**
  These will provide increased storage capacity and redistribute flows more efficiently in the catchment area.
- **Sustainable drainage**
  Rainwater will be returned to the ground, or slowed down before it enters our sewers using green infrastructure.
- **Local schemes**
  Four schemes will reduce the risk of flooding by easing the flow at pinch points.
- **FLIPs**
  Targeted installation of anti-flood devices ('flooding local improvement projects', known as 'FLIPs') will prevent further sewer flooding in properties with particularly deep basements.

Cause	Programme components - how they solve the problem			
	Storm relief sewer & pumping station	Sustainable drainage	Local Schemes	FLIPs
'Urban Creep' - more surface water in sewers		✓		
High proportion of basements	✓		✓	✓
Insufficient local sewer capacity	✓	✓	✓	✓
Insufficient storm relief and trunk sewer capacity	✓			

How our programme addresses the causes of flooding

We have designed these elements to complement each other within the overall proposed programme.

Together they will support our aim to protect customers from a one- in-30-year storm, at the very minimum. We will continue to work closely with the local authorities and their surface water management plans to manage more extreme rainfall.

Our programme will resolve each of the identified causes of sewer flooding, as outlined in the table below.

Future-proofing the programme

Our research has shown that approximately 20% of local green space across the Counters Creek catchment was lost due to urbanisation over the period 1970 to 2007. For example, many front gardens have been paved over to make way for parking spaces. This significantly increases the risk of flooding when it rains heavily, as more rain water runs into our sewers, rather than soaking into the ground. However, we recognise that there is only a finite amount of permeable area remaining in some parts of London, and so the rate of urban creep can be expected to slow or stop over time.

As the Counters Creek programme progresses through the planning process, we continue to refine and incorporate within our design our assumptions around the likely ongoing rate of urban creep, as well as the impact of climate change. If urban creep is not managed and exceeds our assumptions, our proposed programme will not deliver the same level of service in future. We therefore need to start the future-proofing process now.

We are keen to continue to work closely with the London Borough of Hammersmith & Fulham and Royal Borough of Kensington & Chelsea, as they develop their surface water management plans, to ensure that together we safeguard the long-term performance of the proposed improvements to our local sewerage networks. We will continue to work with them on planning issues to manage urban creep.

How we determined our programme

The information we gathered from customers enabled us to identify parts of the network where the smaller local sewers have insufficient capacity when it rains heavily, compared with other areas where the larger trunk sewers are the main cause of flooding.

Programme definition

We have based our approach on the following three-phase process:

Each phase has been planned considerately, recognising the distress that customers have experienced in recent years. Where specific opportunities to reduce the risk of flooding are found, we have sought to provide them as early as possible in our programme.

2008

1

Data Collection

- Property surveys to improve accuracy of Sewer flooding database
- Property and basement measurement and evidence surveys
- Basement level measurement versus sewer levels and ground levels assessment
- Network deficiency and improvements assessment
- Existing site and borehole review
- Additional review of basement layer
- Interface with Thames storm relief sewer project

Review & Challenge
Ofwat; Local Authorities; IAG, Wider independentexperts and auditors

2

Understanding the problem

- Flood impact risk assessments and complex modelling
- Spatial rainfall study
- Storm simulation analysis
- Rainfall patterns and impact studies
- Rainfall simulation and risk modelling
- Hydraulic assessments and influence of basement flooding and modelling
- Analysis of 'urban creep' using state of the art techniques

Review & Challenge
Ofwat; Local Authorities; IAG, Wider independentexperts and auditors

3

Considering the options

- Tested hydraulic options
- Buildability and practicability assessment
- Defined cost benefit analysis (CBA), for each component within the proposed programme

Review & Challenge
Ofwat; Local Authorities; IAG, Wider independentexperts and auditors

Data collection

We have planned our approach over a four-year period of intense modelling and analysis. We have collaborated with industry specialists and academics from Imperial College London to gather information, including:

- over 3,000 door-to-door surveys
- taking physical measurements of basements
- sewer level and ground level assessments

Outputs and learning

As a result, we now have:

- an accurate sewer flooding database, enabling us to identify high-to-low risk properties, and the size and scale of affected areas
- clear information on the cause of flooding
- a more accurate view of the extent, location and depth of affected property basements

Data Collection Stage

Contacted over 6000 local properties to discuss and determine sewer flooding risk

Since 2008 invited over 3000 customers to our bi-annual consultations

Completed over 3000 customer and property questionnaires

Significantly improved the accuracy of the sewer flooding database

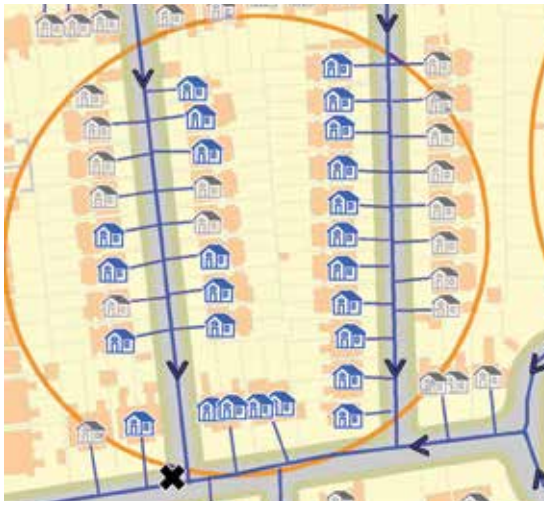
Understanding the problem

We analysed in detail the information we gathered on customers' properties and our sewerage network. This enabled us to identify parts of the network where the smaller local sewers have insufficient capacity when it rains heavily, compared with other areas where the larger trunk sewers are the main cause of flooding. Making this distinction was important to us in identifying the most sustainable and affordable elements of our proposed programme to apply.

Outputs and learning

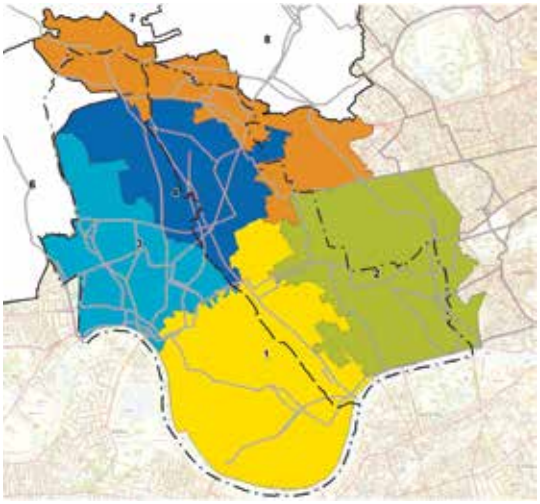
Our team of hydraulic engineers worked together with industry experts to:

- rigorously test and verify the data
- undertake simulation, forecasting and complex modelling techniques to allow historical and future weather patterns to be analysed
- develop a broad range of solutions that address effectiveness, affordability and sustainability



Identifying local constraints and 'pinch points'

- Non Flooding Property
- Potential Flooding Property
- Hydraulic Pinch Point
- Sewer & Direction of Flow
- Zone of Influence



Breaking the problem down into regions for analysis

- Kensington & Chelsea and Hammersmith & Fulham

Counters Creek Regions 1-8

- 1
- 2
- 3
- 4
- 5
- 6,7,8
- Trunk Sewers

Understanding the problem stage

Data collected used in our hydraulic modelling

Different rainfall scenarios tested to understand flooding risks

Further customer and property surveys conducted to refine our risk model

Findings and results shared with the IAG and Ofwat at numerous workshops

Deciding on the options

Within this phase, our engineers worked with stakeholders, including representatives from the affected London boroughs, to turn possible solutions into credible and affordable elements of our proposed programme.

We aimed to minimise disruption to customers during our work, which included assessing possible solutions and construction sites, measuring flows and levels in our sewerage network and surveying over 3,000 properties.

Outputs and learning

Among the key outputs and learning from this phase, we:

- tested hydraulic options to resolve flooding at a local level and across the catchment
- assessed whether it would be practical to carry out construction work in areas key to our programme
- compared the costs and benefits of each part of our programme, with the help of customer input

Considering the options stage

Problem broken down into smaller areas for thorough analysis

Broad range of possible solution options analysed for each area

Local solutions built back up to identify strategic options

Results shared with Ofwat and IAG

Review and challenge

Throughout each phase we have shared our findings with all stakeholders.

Early in the process we established an Independent Advisory Group, made up of the following independent experts from industry and academia who, together with Ofwat, have reviewed and challenged our work:

- Professor Bob Andoh, Director of Innovation at Hydro International and Visiting Professor at Liverpool John Moores University
- Professor David Balmforth, Executive Technical Director at MWH, Visiting Professor at Imperial College and Vice President of the Institution of Civil Engineers
- Professor Adrian Saul, Professor at the University of Sheffield and leading academic in the Flood Risk Management Research Consortium

We have addressed the group's challenges to the data acquired, our overall approach, and the scope and extent of identified solutions. They also encouraged us to explore options that have until recently not been applied by the UK water sector (such as green infrastructure), drawing upon experiences from other countries to make this programme more sustainable.

In response, we have produced deeper analysis, commissioned studies, completed more complex modelling and conducted further detailed reviews.

The culmination of this work has enabled us to state with confidence that we have identified the most effective and affordable programme for the Counters Creek catchment.

Stakeholder engagement

Since 2008, we have held many public meetings with customers and other stakeholders, to review our findings. Our engagement activities have included:

- nine workshops with our Independent Advisory Group
- nine half-yearly public meetings
- over 6,000 letters sent to local properties to determine sewer flooding risk
- over 3,000 customer door-step interviews and measuring of property basements
- independent audit and approval of our hydraulic model
- customer research into affordability and willingness to pay

Programme benefits

We combined customer research with our detailed hydraulic modelling. This allowed us to understand the level of protection that we would be able to offer to customers, whilst ensuring that our programme remains affordable.

Flood risk benefits

In designing our proposals, our main aim has been to maximise the protection from the risk of sewer flooding, whilst ensuring that our programme remains affordable. We do this through a 'cost benefit assessment', in which we compare the cost of our programme with the number of properties that will benefit and the level to which they will be protected. We carry out research to determine customers' willingness to pay for different levels of sewer flooding protection, giving us a financial value for the benefit that our programme delivers.

Our approach to analysing the costs and benefits has been developed with our Independent Advisory Group and challenged by Ofwat. We have also gained input from affected customers, wider stakeholders and from an independent environmental economics expert.

Assessing costs and benefits

In developing the potential costs and benefits, we followed an approach used throughout the water industry and considered to be best practice.

As outlined below, the fundamental initial steps were entirely based on gathering customer opinions specifically on service value. We engaged with customers from across our region through a variety of methods including interviews, telephone surveys, focus groups and market research.

We found that the benefit customers place on sewer flooding schemes diminishes as the solution protects against ever more extreme, and much less frequent, rainfall and storm events. Conversely, the cost of a sewer flooding scheme rises exponentially in order to accommodate flow from heavy rain.

Nevertheless, based on our comprehensive work to date, we strongly believe that a cost-beneficial programme exists within our range of identified benefits and costs, which is capable of alleviating the risk of sewer flooding from a storm of at least one-in-30-year intensity and potentially more extreme rainfall.

Defining customer benefit

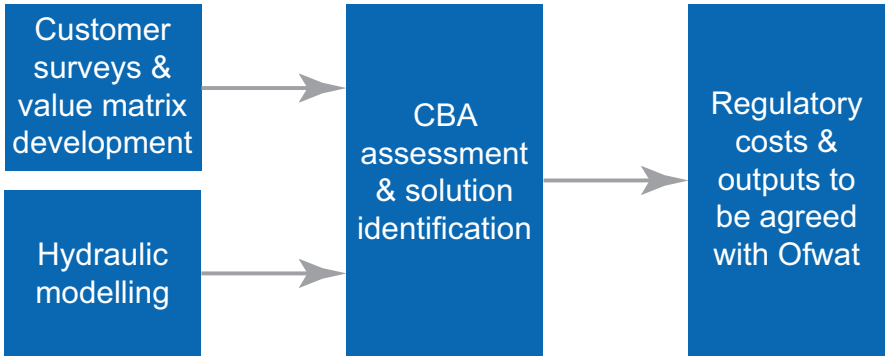
The purpose of our customer research on costs and benefits was to define:

- how important it is for us to protect customers whose properties have flooded many times, compared with those who may have flooded once
- the relative importance that customers place on where sewer flooding occurs, e.g. inside their homes, or outside in the street
- the value that customers place on us addressing the severity of sewer flooding, e.g. whether a clean-up is required, or whether they were forced to move out of their homes

Our customer research and willingness to pay survey comprised over 500 customer interviews and followed water industry best practice. Its method and results were also independently reviewed by Professor Ken Willis, of Newcastle University. The results gave us a defined range of values that customers would be willing to pay, to protect their properties, and local public areas, from flooding.

Understanding the benefits

We combined customer research with our detailed hydraulic modelling. This allowed us to understand the level of protection that we would be able to offer to customers, whilst ensuring that our programme remains affordable.



Next steps

Wherever possible, in planning our work we have aimed to provide protection as early as possible.

How it will affect customers

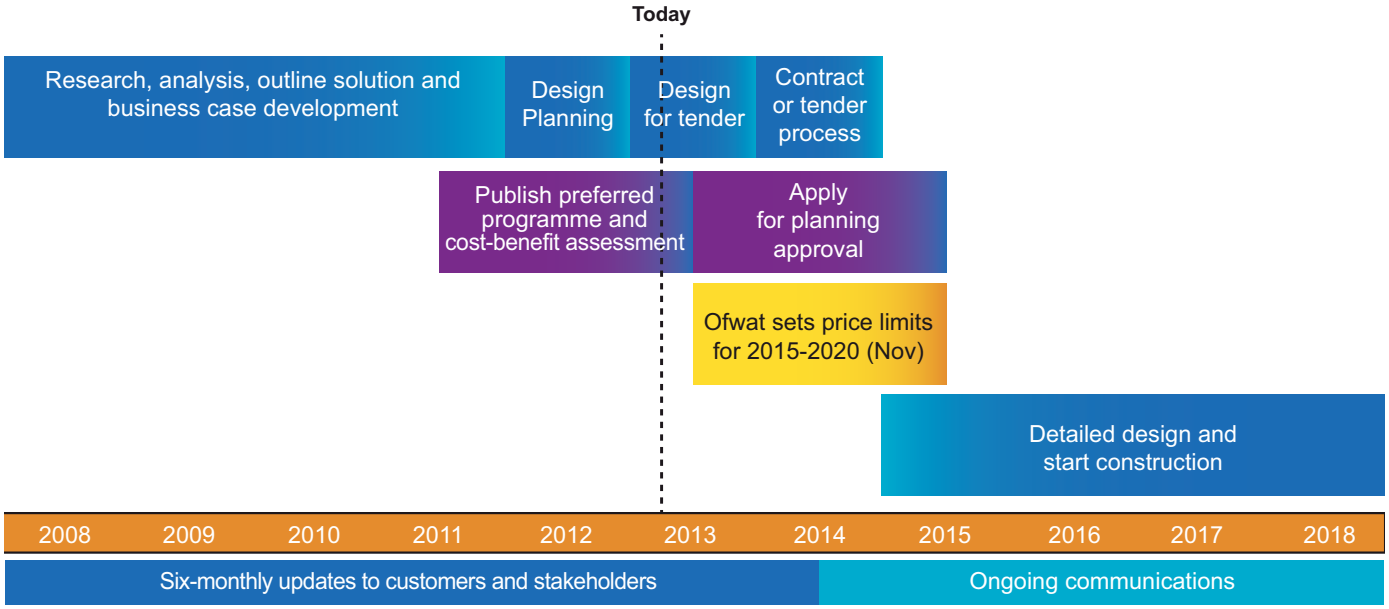
We have already implemented some short-term protection initiatives by fitting anti-flood devices (FLIPs) in the properties of more than 600 local customers, identified to be at the highest risk of flooding. This has provided them with immediate flood protection and, importantly, peace of mind.

Some elements of our proposed programme could be provided over the next three years, and we are working with Ofwat to examine how these can be taken forward.

The proposed new storm relief sewer needs detailed design work to improve certainty of costs, and environmental and planning considerations, in order for construction to start in 2015 at the earliest. We will then be able to determine the impact of this programme on our customers' water bills.

During this work we plan to carry out further sensitivity analyses with customers and stakeholders. This will ensure that the level of protection that we can offer, the associated cost and our service level commitments are acceptable to all stakeholders, before any programme implementation work is progressed.

Counters Creek Programme: Key Next Steps



Summary

Conclusions and recommendations

Sewer flooding is arguably the worst service failure that our customers can experience. We have learnt a significant amount about the sewerage network in the Counters Creek catchment since widespread flooding occurred in July 2007. Following this period of prolonged and heavy rainfall, we have researched in detail both the number of customers affected and the underlying causes.

Over the last two years, we have provided a short-term solution and protected over 600 properties by installing anti-flood devices. However, a long-term solution to the problem is now required.

More than 2,000 customers have reported flooding to us, with some homes flooding up to six times in recent years. Clearly, this is completely unacceptable. We have endeavoured to contact a further 4,000 customers in the area to learn more, as our modelling identifies a significant number to be at risk. However, we recognise that sewer flooding is a very emotive issue and customers have concerns about its impact on the value of their properties, as well as their ability to obtain home insurance.

Our modelling and work to identify options has used the latest technology and we have invited prominent academics in the field of urban drainage to form an Independent Advisory Group. These experts have reviewed and challenged our work as we developed the most effective, sustainable and affordable programme to alleviate the sewer flooding problem.

We have worked closely with other stakeholders, including the London Borough of Hammersmith & Fulham and Royal Borough of Kensington & Chelsea, as well as customer action groups and civic societies. We would like to thank them for their time and input.

We have compared the cost of our preferred programme with the benefits identified in customer research, comprising over 500 interviews from our wider customer base. This process has followed water industry best practice and the results have been peer reviewed by Professor Ken Willis of Newcastle University. Taking account of reasonable ranges of costs and benefits available to us at this stage, we believe that a programme capable of protecting customers from at least a one-in-30-year storm is cost-beneficial.

What happens next?

Some elements of our proposed programme could be provided over the next three years, and we are working with Ofwat to examine how these can be taken forward.

The remainder of our proposed programme now needs to progress through detailed planning and design, in order for construction to begin by 2015 at the earliest.

Appendix

5 December 2012

To whom it may concern

Counters Creek Sewer Flooding Alleviation
Independent Advisory Group – Statement of Support

Background

There are approximately 44,000 properties with basements in the Counters Creek area, of which some 30,000 lie within the London Borough of Hammersmith & Fulham and Royal Borough of Kensington & Chelsea. The construction of the Thames Barrier and associated flood defence works in the early 1980s largely removed the risk of flooding from the river and since then many of these basements have been converted to habitable dwellings. However, because the expansion of paved areas upstream has increased the amount of flow that has to be drained through the sewerage system, many of these properties are now at risk of sewer flooding.

The Independent Advisory Group

Thames Water has developed an approach to better understand the fundamental causes of sewer flooding and to systematically identify the most appropriate and best value solution within the Counters Creek area. To test the robustness of this solution, Thames Water has exposed its approach to critical review by an Independent Advisory Group (IAG) of industry and academic experts. Over the course of the development of the approach, nine workshops have been held and throughout these workshops the IAG have been asked to question and challenge all areas of the project development in an open forum that has included the economic regulator, Ofwat.

Specifically the IAG posed the following questions to ensure they could be satisfied that the outcomes of the approach would meet the requirements of Ofwat, Thames Water and its customers:

Certainty over Causes of Flooding - Have the different causes of flooding been properly identified by Thames Water?

The IAG needed to be comfortable that the sewer flooding that occurs in the catchment had been thoroughly investigated and assessed against a historical context, i.e. how the catchment had changed over time and how the cause and effect of flooding had evolved over the same period. They spent a considerable amount of time understanding the inherent complexities of the system and the associated underlying causes of flooding. Additionally, they had to ensure that they were comfortable that the sewer network model, a computer program that simulates flow in the system, had been validated and was an appropriate tool to undertake an objective evaluation.

Thames Water Utilities Ltd
PO Box 436
Swindon
SN38 1TU

0845 6410 011
www.thameswater.co.uk

Appropriate Measures to Manage Flood Risk - Have Thames Water gone beyond conventional solutions to consider all possibilities?

Rain that falls within a catchment can be managed in three locations; at source (tackling rain where it falls), by dealing with system capacity (pathway) and at the reception point (at sewage treatment works, watercourses and properties that flood). In doing so the IAG challenged Thames Water to ensure that the most appropriate and best value solution had been selected in each situation, from the installation of property level protection called FLIPs (a localised packaged pumping station), through to Sustainable Drainage Systems (SuDS) and the provision of new sewerage infrastructure.

Structure Approach to Developing Options - How do Thames Water get the right option in the right location?

Thames Water openly developed a methodology that adopted a structured approach to solution development. The process distinguished between those properties that flooded due to local incapacities in the sewerage network (local schemes) and those that could be considered strategic (caused by incapacity in the trunk sewer systems – termed strategic schemes). The IAG were satisfied that by combining the options in a systematic fashion, Thames Water were able to ensure that they fully understood the contribution that individual options made and that each was appropriate.

Robustness of Solutions – Has Thames Water undertaken sufficient work to deliver the necessary level of flood risk management to meet future demand?

The IAG needed to be comfortable that sufficient work had been undertaken to ensure that any solution provided a long term cost beneficial reduction in flood risk to Thames Water's customers. The IAG challenged Thames Water to demonstrate performance for variations in urban creep, climate change, population change, design standard and applied rainfall, using sensitivity analysis.

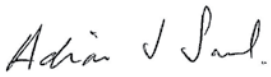
Summary and Statement of Support

The members of the Independent Advisory Group for Counters Creek confirm that within the time available we have had every opportunity to challenge Thames Water on the design of the local and strategic schemes for flood risk alleviation in the Counters Creek catchment. We have been given unrestricted access to the data, design calculations, modelling assumptions and outputs, and whilst we recognise that there is a significant amount of refinement to be undertaken by Thames Water in the next stages of the design development, we are fully supportive of the approach and solution that is being proposed to Ofwat to obtain funding.

Yours sincerely,

Professor Bob Andoh
Director of Innovation at Hydro International and visiting Professor at Liverpool John Moores University.

Professor David Balmforth
Executive Technical Director at MWH, visiting Professor at Imperial College and Vice President of the Institution of Civil Engineers.



Professor Adrian Saul
Professor at the University of Sheffield and leading academic in the Flood Risk Management Research Consortium.