Groundwater Infiltration Management Plan

Cirencester System (including South Cerney)

(River Churn)

January 2021

Version control

Version	Date	Amendment	Author	Checked	Reviewed
1-d1	Nov 2020	Draft for EA	NW and AJ	DJ	APH
1-d2	Jan 2021	Final Draft for EA	DJ	APH	JO
1-V1	Jan 2021	Version 1	DJ	APH	JO

Table of contents

Introduction

This document sets out Thames Water's approach to the management of groundwater infiltration in sewerage systems where the influence of groundwater infiltration is viewed as excessive and likely to be the source of uncontrolled escape of untreated or partially treated sewage.

All sewerage systems combined and separate will experience some groundwater infiltration[1] and a nominal allowance in design will be made for this. However, in some catchments the impact of groundwater infiltration can be considerable leading to impacts on service during periods of high groundwater, typically during the winter.

Groundwater can enter the sewerage system through the pipes and manholes, this may occur at a defect (crack, hole, displaced joint) or on a normal joint on the sewer or in the manhole. A key point to note is that where infiltration occurs it is not necessarily an indicator that the sewer is in poor structural state simply that jointing techniques used are not completely watertight.

Ingress of groundwater is not limited to the public system that Thames Water owns and maintains but potentially the private drains, manholes and sewers that connect to our system.

Preventing and reducing the impact of groundwater infiltration is predominately achieved through the lining of sewers and sealing of manholes. This entails the application of a synthetic liner within the pipe that creates a contiguous membrane for the length of the pipe or possibly section if the source of ingress can be narrowed down. For manholes it will typically entail sealing in a similar manner.

To line all sewers and manholes within most catchments would be prohibitively expensive to do so. Our approach to date has been centered on a 'find and fix' basis which has involved monitoring and investigating the networks in periods of high groundwater to identify sources of ingress and fix as we find them. This approach is constrained for the reason that investigations are typically limited to periods of high groundwater and when high groundwater occurs there are limited windows of time in which investigations can be successfully undertaken before flows either subside or the system is fully surcharged meaning CCTV surveys are not possible[2]. Once sections of sewers have been lined, it will be a case of waiting until high groundwater levels reoccur to assess the effectiveness of the work undertaken, which may not be the subsequent winter but several years later.

It is recognised that the approach to date lacks a degree of certainty of resolution and for this reason Thames Water has in 2020 undertaken a different approach for the medium to long-term management of groundwater, which is covered within this

[1] Sewers for Adoption makes an allowance for 10% of normal wastewater flow to allow for unaccounted flows such as groundwater infiltration.

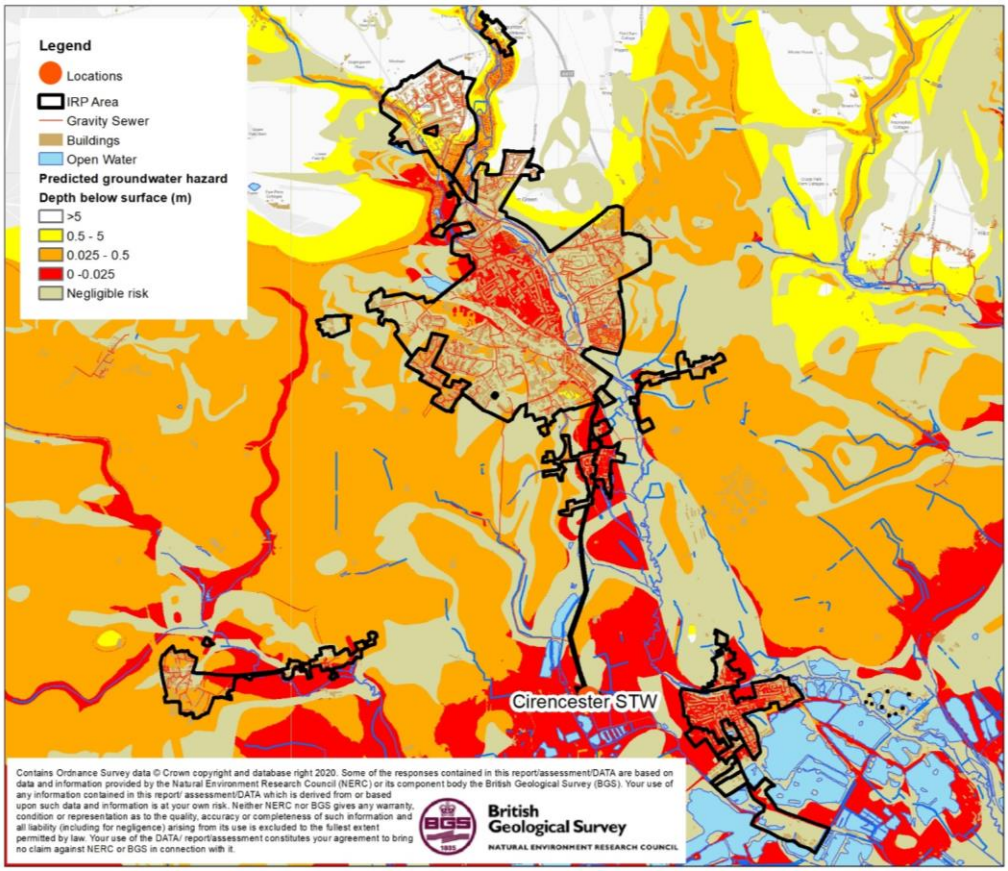
[2] On occasions it is possible to over-pump between manholes to isolate sections of sewer to survey, this is not always feasible when the flows involved are simply too great to over-pump or the location prohibits this approach.

document under the plan section. These plans require significant investment which Thames Water will seek to secure. In the meantime, we will continue to investigate sources of infiltration when it occurs and where feasible, undertake the work through our capital maintenance budgets. We refer to these as ‘quick win’ opportunities i.e. where we have high degree of certainty of reducing point sources of infiltration and can do so with reasonable costs and time.

The structure of this document has been created around the Environment Agency’s Regulatory Position Statement (RPS) for ‘Discharges made from Groundwater Surcharged Sewers’ (Dated: December 2016).

Sections covered in this document include our ‘Outline Plan’ with timescales, locations of anticipated ‘Unavoidable discharges’, Mitigation i.e. how we intend to manage the risk until our plan is fully implemented and when we will publish future updates on progress against this plan. By including these sections, we consider this document to meet the requirements set out in the RPS for ‘Discharges made from Groundwater Surcharged Sewers’, which we have sought the Environment Agency’s confirmation of.

Brief description of Cirencester catchment



1.0 – Cirencester catchment

Cirencester lies on the River Churn in Gloucestershire, England, 13 miles North West of Swindon and 16 miles South East of Gloucester. Cirencester serves a population equivalent[3] of 31,720 with a predominantly separate sewerage network totalling some 131 km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above.

Problem characterisation

Groundwater can enter our sewers when levels are high, which reduces their capacity and increases their risk of flooding. There is a strong link between the rising river and groundwater levels across the Cirencester area and the drainage issues some of our customers have experienced, including sewer flooding and restricted use of their toilets and bathrooms. The Cirencester foul sewerage catchment is at particular risk of groundwater infiltration due to its geology, made up of permeable soils.

[3] Population equivalent or unit per capita loading, (PE), in waste-water treatment is the number expressing the ratio of the sum of the pollution load produced during 24 hours by industrial facilities and services to the individual pollution load in household sewage produced by one person in the same time.

In recent years the foul sewerage system in Cirencester and South Cerney has become overwhelmed for weeks at a time in some locations, following prolonged and heavy rainfall. This has resulted in properties suffering from significant sewer flooding, spills out of many public and private manholes and periods of restricted toilet use.

The surveys we have carried out suggest that there is evidence of groundwater infiltration into the foul sewerage network, from both public and private drainage, when groundwater levels are high. CCTV surveys of the local sewer network have identified issues and defects at, or near, Gloucester Road & Cheltenham Road, Gloucester Street, Spitalgate Lane, Victoria Road, Watermoor Road, Roman Road & City Bank Road, and Siddington Road & Cherry Tree Drive where groundwater is entering the sewer network. Surveys also show evidence of inundation from highways, public spaces and properties, surface water runoff from saturated fields and inundation from river water overflowing from the River Churn. Surface water misconnections (i.e. downpipes from roofs), into the foul sewerage network may also be a contributing factor, however further analysis is required to determine the extent to which this has contributed to sewer flooding.

Historically we have implemented a temporary overpump to an adjacent foul system on Station Road in South Cerney. This overpump allows us to reduce levels in the foul system in order to protect properties from flooding internally.

The root causes of sewer surcharges are therefore numerous and resolution of issues complex, requiring all stakeholders responsible for drainage in the catchment to work together to resolve them. Cirencester STW includes a storm land area to handle excess flows above the treatment capacity during storms that discharges to the Cerney Wick Brook, when it is full. We have already dedicated both a mobile treatment unit and a mobile pumping unit specifically for the Hereward Road and Blake Road area. The units will help us to prevent flooding or loss of drainage services for our customers in this area when required during wet weather conditions.

Our permit conditions for Cirencester STW state:

“The discharge shall only occur when and only for as long as the flow passed forward is equal to or greater than the overflow setting indicated due to rainfall and/or snowmelt. Off-line storm storage must be fully utilised before a discharge occurs. It shall only fill when the flow passed forward is equal to or greater than the overflow setting indicated due to rainfall and/or snow melt and shall be emptied and its contents returned to the continuation flow as soon as reasonably practicable. The minimum off-line storm storage required is specified in table S3.3.” (Table within the permit).

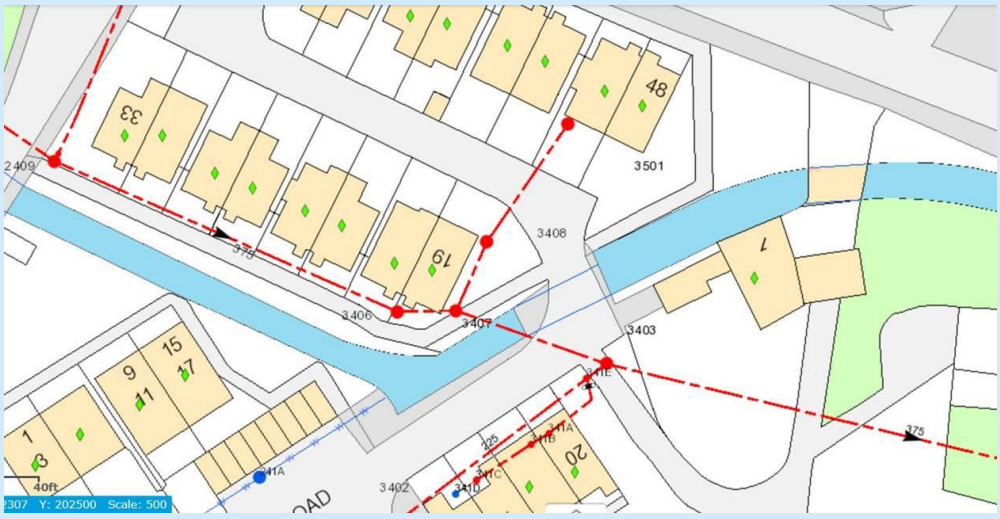
The Flood and Water Management Act 2010 places a responsibility on Lead Local Flood Authorities (LLFAs), to manage flood risk from surface and groundwater, plus a duty on all Risk Management Authorities (RMAs), to cooperate regarding flood risk. In our role as an RMA, Thames Water will work with Gloucestershire County Council as the lead local flood authorities, planning authorities, and the Environment Agency to ensure that a collaborative approach can be developed to address the problems.

Thames Water also has a statutory obligation to comply with environmental legislation. 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).

Anticipated unavoidable discharges

Surcharges from groundwater infiltration currently affect the Hereward Road and Blake Road area. The works identified within this plan should reduce groundwater infiltration and the risk of surcharges. However, in the short to medium terms these unavoidable discharges may continue to occur in times of high groundwater levels. The strategy to deal with temporary surcharges involves the deployment of an ATAC Biofilter at Hereward Road to treat wastewater prior to discharge into the River Churn (see table below for further details).

Anticipated unavoidable discharges

Location	20 Hereward Road, Cirencester, GL7 2EQ 
Discharges	10-20l/s
Likely Periods	When sewer surcharge places properties at risk of internal flooding and/or operation will reduce pollution risk through sewage escapes reaching watercourses.

Anticipated unavoidable discharges

Mitigation	In order to ensure the current system is working to maximum capability the following actions will be carried out: • Regular sewer investigations (and resultant sewer cleaning) to remove any blockages. • Ongoing investigations and remediation of priority infiltration sources as outlined in this document. • Identifying and taking actions to minimise where surface water ponding may be inundating manholes. • Tankering where appropriate in other areas of the system. In order to minimise the impact on the watercourse the discharges will be treated via an ATAC Biofilter which removes solids and biological loading from wastewater influents, whilst also adding dissolved oxygen into the effluent flow. Should flows stay within the sewer, and not reach the volume to discharge from the sewer, no discharge to the River Churn will take place.
Monitoring	During periods of discharge daily samples of water quality will be taken upstream and downstream to assess impact on the river amenity, use and quality. The following parameters at a minimum will be tested: - Biological Oxygen Demand - ammonia, - solids - phosphorus - and bacterial quality including E. Coli
Contact	If discharges occur the Environment Agency will be informed (by logging through the Agency's National Incident Communication Service). For any other reporting please use the Environment Agency pollution reporting number 0800 807060. In addition, local community representatives will be informed. If the ATACs are deployed, signage will be placed in the locality and local letter drops carried out to inform residents. An example of the type of signage and information displayed is shown in the appendix of this document.

General outline plan & timescale

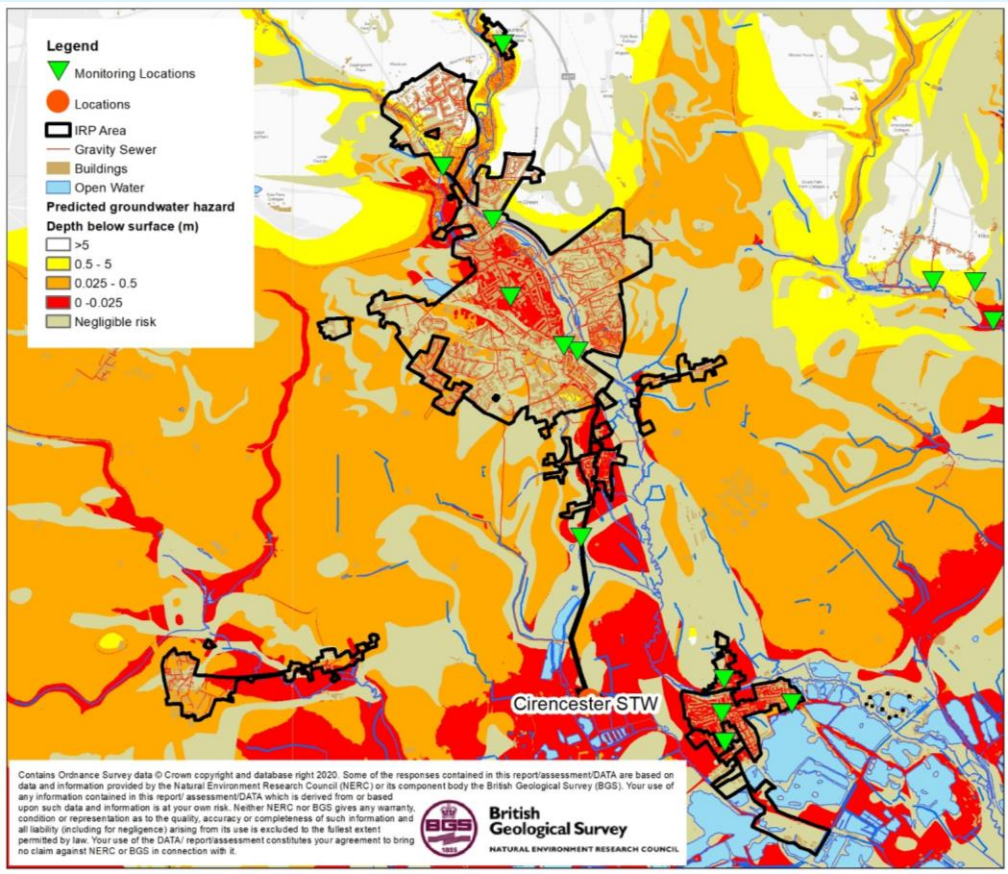


Figure 2.0 – Cirencester monitoring and infiltration zones

Key to bringing the impact of groundwater infiltration under control will be an enhanced monitoring regime. We have identified and have installed several telemetered depth monitor locations around the Cirencester system – see Figure 2.0.

Complementing the flow [at the treatment works] and depth measurement [in the sewer network] we will use pumping station run time data, rainfall data, river level data, and groundwater level data to create a full picture of movement and source of flows around the catchment.

Zones of Groundwater Risk

We engaged with JBA Consulting to develop plans for Cirencester that identify zones of groundwater risk, see Figure 2.0. These zones are modelled areas where the groundwater has been determined to be above the sewer and hence pose a potential risk for groundwater ingress.

The sewer depth monitors referred to earlier are being sited in and around these zones to verify and calibrate the risk in each of the zones.

If following the proposal to the sealing in part or wholly[4] of the high risk zones in AMP8[5], should it be required, the system is found to be still experiencing excessive infiltration we would then look to potentially seal 'private' laterals and/or drains along with starting to seal the medium to low risk zones. The decision on this will be based on information obtained from the monitors and depending on the scale of further work required this may need to form part of PR29[6] investment planning.

The monitors are also to be used to monitor change within the system hence even should we determine that infiltration has been brought under control, we will continue to monitor for potential trends in infiltration suggesting the need for further work. We also anticipate monitoring the response of the catchment to surface water and where appropriate will use the monitor data to address this source of storm flow.

With this plan we remain committed to minimising the impact of groundwater on the sewerage system in Cirencester.

Our general medium to long term plan is therefore to apply a hierarchy to sealing the sewer as follows:

Activity	When	Description
Model Zones	2020/21	JBA have been engaged to undertake modelling activities to identify the areas to be targeted for sealing in the 56 systems identified as being impacted by infiltration.
Install monitors	2020/21 – 2021/22	Monitors have been installed in the zones to help calibrate and validate the zones. Each year completeness / coverage monitors will be reviewed and added to / or modified as necessary.
Calibrate zones	Refined each year	Following each winter, we intend to review the data from the monitors and if necessary, redefine the zones.
Look & Lift	Each winter	The look & lift surveys have two purposes, firstly to compliment the monitoring and secondly to identify 'quick fixes' that we would address through our normal capital maintenance.
CCTV	2020-2023	Required to confirm sewer condition and provide information to assist with costing any sewer lining.

[4] Decision of extent of sealing will be based on outcomes of works undertaken in AMP7, results of monitoring and successful submission of our plans for investment for AMP8.

[5] Asset Management Plan 8 – covering work between 2025-2030

[6] Price Review 2029

Activity	When	Description
Minor works	2020-2023	As mentioned, if we detect minor works being required, we would look to resolve these as and when we find them.
PR24	2023/24	Ideally through monitoring and on-going investigations work towards managing the infiltration risk, in AMP7, will be successful. However, in the absence of evidence justifying the need not to undertake sealing of the high-risk zone this is to be included as part of PR24 investment plan. This work will be subject to Cost Benefit Analysis and Best Technical Knowledge Not Entailing Excessive Cost (BTKNEEC) assessments.
High risk zone sealing	2025-30	Sealing of high-risk zone undertaken subject to need being demonstrated.

Cirencester Infiltration Management Plan

As detailed above infiltration causes a range of issues.

As part of our current investment plan, we have projects to increase the flow to full treatment and storm tank capacity at Cirencester STW. The main driver for the upgrade is growth, however the rate of maximum observed infiltration is considered as part of the calculation for the new treatment flow rates. This work is programmed to be completed by 31/03/2024 (note the storm tanks are planned to be completed a year early).

In the intervening period we intend to continue to monitor the network for potential sources of infiltration that may improve the performance prior to upgrade of the sewage treatment works.

High level approach statement

For Cirencester our approach to tackling infiltration will be undertaken as follows:

1. Our programme for implementation of the upgrade of Cirencester STWs is due for completion by 2024.

2. Implementation of a permanent and less intrusive over pumping system at Station Road in South Cerney by March 2022.

3. In parallel to the progression of the STWs solution to deal with the infiltration received we will investigate the network with a view to identifying sources of ingress of infiltration that are cost effective[7] to address. To investigate the network, we/will

   - Have undertaken a desktop analysis to determine infiltration high to low risk zones (October 2020);

   - Installed additional monitoring to back up the analysis (a) and to aide focusing of locations for identification of infiltration (2020 to 2023). Each year we will assess the completeness of monitoring and if required add to or modify the current locations.

   - Undertake sample CCTV in the high to low risk zones to assess the general asset health of the sewers and manholes (ongoing).

   - Review results of Winter 2019/20 and 2020/21 with historic data to build up evidence to support interventions in the network (Summer 2021).

4. Where interventions can be undertaken as part of normal sewer maintenance activities these will be communicated and progressed. If significant investment is identified as being required, then this will need to be considered in terms of relative need compared to other systems being investigated for infiltration reduction and need. Significant investment needs may need to be included in our next investment planning cycle at PR24.

[7] Assessment of cost effectiveness is based on assessment of the ratio of the cost of a solution to the monetised benefit gained from implementing the solution i.e. reduction in flood/pollution risk and/or reduced operating costs.

Investigations

As mentioned above we have commissioned JBA Consulting to undertake an exercise involving groundwater elevation data to determine which areas of the network are potentially below the groundwater table during high groundwater periods.

Site investigations, undertaken by DeneTech and our Customer Field Services (Thames Water Operations) have included 'look & lift' surveys, CCTV and where necessary dye tracing to confirm connectivity.

A table of the work undertaken is included in the appendix to this report.

Monitoring

Sewer Depth Monitors have been installed in the catchment in 2020 (see Figure 2.0). These devices are telemetered and provide real time data on the level of flow in the sewer.

The purpose of these units is to act as alerts for high groundwater impact in the sewer, calibration of the zones of infiltration risk and to demonstrate benefit gained from work undertaken to reduce infiltration.

To provide evidence in the future of further need to manage the impact of infiltration.

Mitigation

On occasions to avoid flooding of properties or to manage the risk of damage to the environment we may undertake tankering from within the network, make use of pumps to contain flows as described for South Cerney, or deploy settlement tanks to part treat sewage before release to the environment.

With regard to Cirencester, we are considering the deployment of an ATAC unit as detailed in the sections above. We would only look to deploy this mitigation either where all other approaches have ceased to be effective or where property flooding and / or pollution would be a likely risk had we not undertaken the mitigations.

Updates

Work on the Groundwater infiltration management plan will continue, and we will aim to provide updates annually by the end of October each year.

Appendix

Investigations & remedial work undertaken since 2019/20 and future plans

The three tables below summarise the findings of the survey and implementation work identified in the 2019/20 period. The final table summarises our current known plans for remediating groundwater infiltration issues.

The table below presents a summary of the JBA groundwater infiltration analysis which identifies the sewers and manholes which are likely to be vulnerable to groundwater infiltration

Sewer Length by Groundwater Infiltration Risk Zones

Risk category	Description	Length (km)	Percentage
High	Predicted groundwater extreme >1m above pipe invert	29.88	21.7
Medium	Predicted groundwater extreme 0-1m above pipe invert	2.45	1.8
Low	Predicted groundwater extreme 0-1m below pipe invert	0.53	0.4
Very Low	Predicted groundwater extreme >1m below pipe invert	104.98	76.2
Total		137.83	100.0

In addition, the table below presents the surface water flood risk classification for manholes within the catchment

Manholes by Surface Water Inundation Risk Category

Risk category	Description	Number	Percentage
High	Inundation risk in 3.3% AEP fluvial or pluvial event	620	9.9
Medium	Inundation risk in 1% AEP fluvial or pluvial event	48	0.8
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	204	3.3

Risk category	Description	Number	Percentage
Very Low	All other manholes	5,397	86.1
Total		6,269	100.0

2019/20 Implementation Works

Activities	Value	Comment
Sewer Lining Length (m)	2450m	This work was completed in September – December 2020. In addition to the lengths lined we have carried out 19 patch repairs.
Infiltration Points Targeted (no.)	49	
Manhole Sealing (no.)	4	

Future Works

	Priority 2020/2021	Known follow On Work
Survey	Plans to be developed when further monitoring can be undertaken or analysed - we will carry out further surveys across the winter periods where viable	
Sewer Lining		
Manhole Sealing – Infiltration Ingress		
Manhole Sealing – Pluvial and Fluvial Ingress		
Sewage Treatment Works Upgrade	See Main Text	
South Cerney (Temporary over pump arrangement)	Implementation of a permanent and less intrusive over pumping system at Station Road in South Cerney – due for completion by March 2022.	

Example information and signage

Below is an example of the type of signage you would expect to see if we needed to deploy the ATAC biofilter.

Your reference ~~number~~
BB973534

thameswater.co.uk

0800 316 9800
We're open 24/7

03 April 2020

Working in Aldbourne

This ATAC Eco filter is a mobile sewage filtering unit which will operate 24 hours a day.

How it works?
The Eco filter works using the same basic principles as our traditional Sewage Treatment Works. A pump will feed dirty water into the unit so it can be filtered. Any contaminants within the water are broken down and once water has passed through the Eco filter it can safely be returned to the environment.

Why is this needed?
The high groundwater levels experienced recently have caused extra water to enter our sewers and overwhelm them causing sewer flooding. This is one of the measures being put in place to address the issue and by installing this unit, we will improve the quality of the water which we are not able to prevent from escaping.

What does it look like?

Outside view:

Dirty water entering the filter unit to be treated and then pumped to the top of the unit

Treated water leaving the unit and returning to the environment

Page 1 of 2

Inside view:

Dirty water being pumped into the unit and working its way through the filter system.

Glossary of terms

AEP – Annual Exceedance Potential

AMP – Asset Management Programme

CCTV – Closed Circuit Television

EA - Environment Agency

IRP – Infiltration Reduction Plans

MH – Manhole

STW – Sewage Treatment Works

WINEP – Water Industry National Environment Programme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