Groundwater Impacted System Management Plan

Chesham, River Chess

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	KD
1-V1	Jan 2021	Version 1	DJ	APH	KD
1-V2	July 2021	Update to introductory text and infiltration potential figures	DJ	APH	KD
1-V3	July 2021	Update to infiltration potential figures	DJ	APH	KD
Annual Update 2021	October 2021	Addition of the Annual Update 2021	DJ	APH	KD
Annual Update 2022	October 2022	Addition of Annual Update 2022	MB/JH	DJ	DJ
Annual Update 2023	October 2023	Addition of Annual Update 2023	MB	DJ	DJ
Annual Update 2024	October 2024	Addition of Annual Update 2024	MW/CW	DJ	DJ
Annual Update 2025	Nov 2025	Draft for EA	AF and PP	BT and JE	MH and DS

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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 significant likely leading to the sewerage system, on occasions, to become overwhelmed.

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 centred 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 'find & fix' approach to date lacks a degree of certainty of resolution and for this reason Thames Water in 2020 undertook a different approach for long term management of groundwater, which is covered within this

1 Sewers for Adoption makes an allowance for 10% of peak 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 through the price review process as service enhancement. 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 ‘minor works’ 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 with input from the Environment Agency. Sections covered in this document include our ‘Outline Plan’ with timescales, 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.

Brief description of Chesham catchment

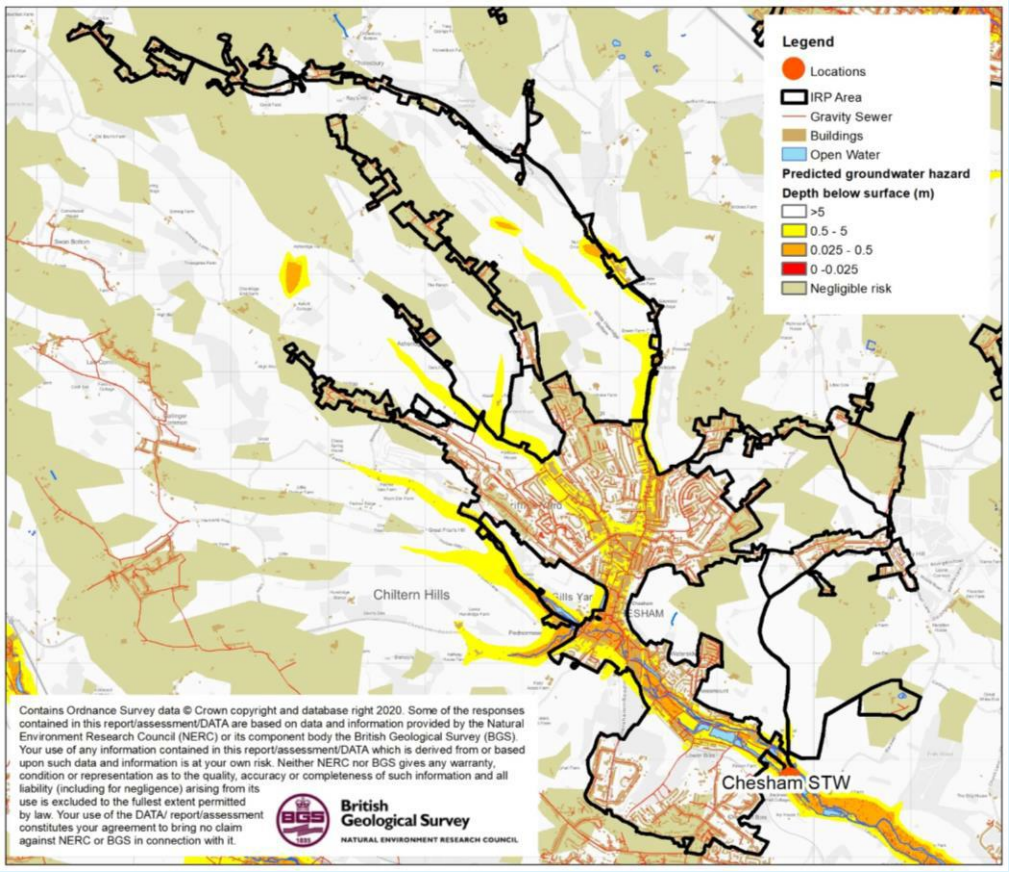

Figure 1.0 – Chesham STW catchment

Chesham is located in the Chiltern Hills, Buckinghamshire, England, 11 miles South East of the County town of Aylesbury. Chesham serves a population equivalent[3] of 37,250 with a predominantly separate sewerage network totalling some 139 km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above.

Problem Characterisation

The foul sewerage system in Chesham has become overwhelmed, in some locations for weeks at a time, in recent years following prolonged heavy rainfall, resulting in the Sewage Treatment Works (STW) at times struggling to manage the flows. We have found that the system has become overwhelmed because of a combination of groundwater infiltration into public sewers and private drainage, surface water runoff

[3] Population equivalent based on 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.

from saturated fields and surface water misconnections into the foul sewage system (such as down pipes from roofs), and also that flood water from the River Chess may also have entered sewers through manholes.

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.

In recent winters the problems associated with groundwater infiltration have been predominately at the sewage treatment works, with no known escapes from manholes in the network being reported or instances of restricted toilet use as a result of surcharged sewers. Our permit conditions for Chesham STW state: *"The discharge from a Combined Sewer Overflow ('CSO') or a sewage works storm tank shall consist solely of storm sewage effluent resulting from rainfall runoff or snowmelt into the sewerage system" and that "The discharge from a Combined Sewer Overflow ('CSO') or a sewage works storm tank shall not operate in dry weather conditions".*

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 Buckinghamshire County Council and Hertfordshire County Council as lead local flood authorities, Buckinghamshire County Council, Dacorum Borough Council as 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).

On occasions where the incoming flow has exceeded treatment capacity for sustained periods, the storm tanks have become full and spills to watercourses have occurred.

Anticipated unavoidable discharges

Within recent years no unavoidable discharges, either planned or unplanned, have occurred from the network as a direct result of the influence of unwanted flows.

General outline plan & timescale

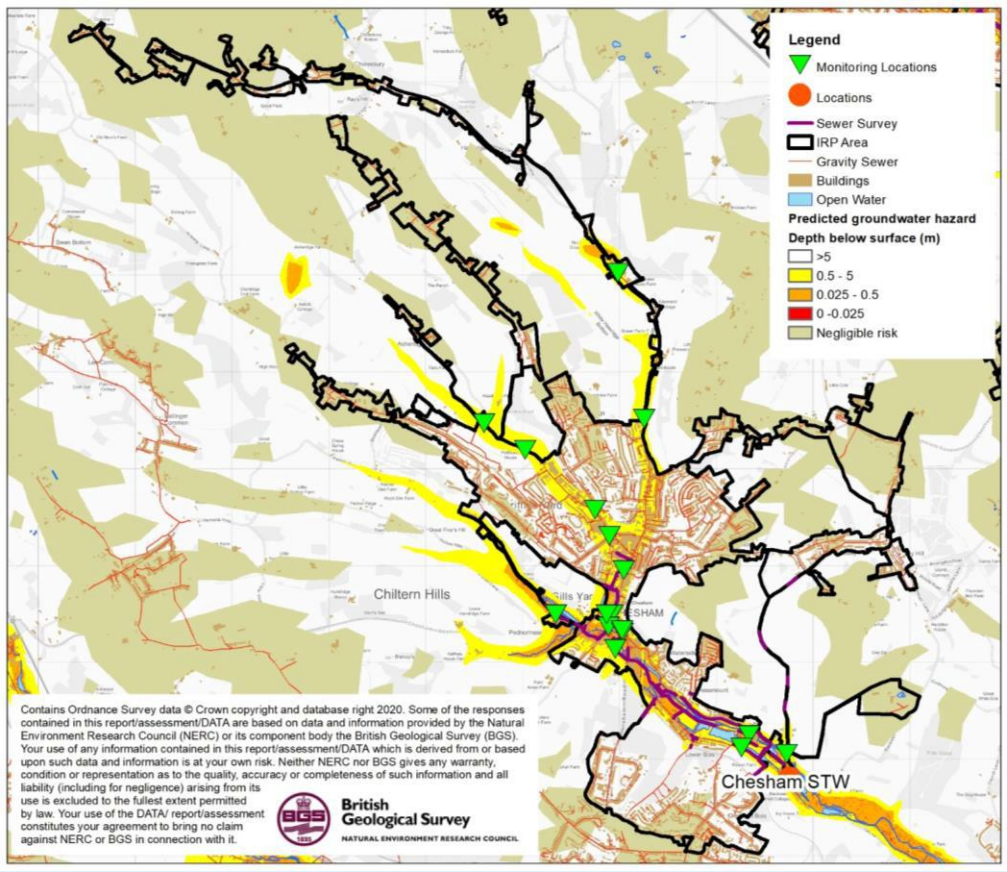

Figure 2.0 – Chesham monitoring and infiltration zones

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 Chesham 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 Chesham 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, 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.

This document sets out an unconstrained approach to resolving the impact of groundwater infiltration within the system.

Investment to address infiltration will be assessed and prioritised against other drivers e.g. STW upgrades, both in the catchment and across the region at each price review.

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

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

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 across the Thames Water region..
Install monitors	2020	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 also provide information to assist with costing any sewer lining.

[4] Decisions regarding the extent of sealing will be based on outcomes of works undertaken to date, result of monitoring and successful submission of our plans for investment.

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 / Price review	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.

Chesham Infiltration Management Plan

As detailed above the impact of Infiltration is principally experienced at the sewage treatment works.

As part of our current investment plan, we are going to be undertaking a project to increase flow to full treatment. 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 project is required to be completed by 2025, however we are looking to bring this forward to be completed by 2023.

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

High level approach statement

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

1. We will take a twin track approach of developing a solution at the sewage treatment works that involves increasing the flow to full treatment capability of the site. At present, our programme for implementation of the upgrade of Chesham STWs is completion by 2023[5].

2. 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[6] 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 (target 2020/21). 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).

3. 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. However, where viable opportunities are identified these will be included in our AMP9 (2030-35) programme of investment. Significant investment needs may need to be included in our future investment cycles.

[5] Chesham STW project is a 2025 WINEP output, we are looking to deliver earlier if possible.

[6]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 JBA Consulting have been supporting by undertaking an exercise involving assessing 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 during 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 (manholes) points on the network, make use of pumps to manage flows or deploy settlement tanks to part treat sewage before release to the environment.

With regard to Chesham we do not envisage needing to undertake mitigation work within the network.

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

Groundwater infiltration potential analysis

The sewer network classified by the groundwater infiltration risk zones. The lengths of sewers within these zones are presented in the table below.
Sewer Length by Groundwater Infiltration Risk Zones

Risk category	Description	Length (km)	Percentage
High	Predicted groundwater extreme >1m above pipe invert	10.51	8.2
Medium	Predicted groundwater extreme 0-1m above pipe invert	5.77	4.5
Low	Predicted groundwater extreme 0-1m below pipe invert	7.47	5.8
Very Low	Predicted groundwater extreme >1m below pipe invert	104.27	81.5
Total		128.02[7]	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	524	14.3
Medium	Inundation risk in 1% AEP fluvial or pluvial event	258	7.0
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	520	14.2
Very Low	All other manholes	2369	64.5
Total		3671	100.0

[7] Total of sewer length is for length of mapped sewers only and will not include unmapped S105a transferred sewers in all cases.

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.

2019/20 Survey Statistics

Elements		Units	Value	Comment
Planned Survey		m	4,614	Survey was planned for a significant part of the Chesham valley floor. It was possible to complete 80% of the survey (see Figure 2).
Survey Completed		m	3,688	
		%	80	
		Lengths (No.)	81	
Clear Flow Observed		m	940.64	25.5% of the sewer network surveyed had evidence of groundwater infiltration.
		%	25.5	
Sewer Infiltration Locations Identified	Infiltration Gushing	No.	4	30 groundwater infiltration locations were identified in the sewers. Of those 6 were identified as "gushing" and therefore should be the focus of repair as soon as possible. Target completion by 2021/22 – note two locations involve piles through the sewer and hence these will be particularly complex to address.
	Infiltration Gushing at Joint		2	
	Infiltration Running		3	
	Infiltration Running at joint		11	
	Infiltration Dripping		0	
	Infiltration Dripping at joint		4	
	Infiltration Seeping		0	
	Infiltration Seeping at joint		6	
	Grand Total		30	

Elements		Units	Value	Comment
Manhole Infiltration Locations Identified	Infiltration around pipe	No.		9 groundwater infiltration locations were identified at manhole locations.
	Infiltration through benching			
	Infiltration through chamber wall		3	Of those 2 were identified as "gushing" and therefore should be the focus of repair as soon as possible.
	Gushing		2	
	Running		3	
	Dripping			
	Seeping		1	
	Grand Total		9	
Monitoring Locations Active		No.	14	14 Water level monitoring locations have been installed within the catchment. Their locations are shown in Figure 2.
Details of other Surveys				No other surveys have occurred in the catchment during the period.

2019/20 Implementation Works

Activities	Value	Comment
Sewer Lining Length (m)	0	We are currently progressing the priority 1 locations below though our governance process for remediation, progress of which is being monitored also by the EA.
Infiltration Points Targeted (no.)	0	
Manhole Sealing (no.)	0	

Future Works

	Priority 2020/2021	Known follow On Work
Survey	See main text	
Sewer Lining	6 gushing locations identified	26 weeping locations identified in 2019/20 Locations identified in Future Surveys
Manhole Sealing – Infiltration Ingress	1 gushing location identified	7 weeping locations identified in 2019/20 Locations identified in Future Surveys
Manhole Sealing – Pluvial and Fluvial Ingress	Plan to be developed based on at risk manholes identified in JBA analysis.	
Sewage Treatment Works Upgrade	See wording in the main body of the report.	

Glossary of terms

AEP – Annual Exceedance Potential

AMP – Asset Management Plan

CCTV – Closed Circuit Television

EA - Environment Agency

IRP – Infiltration Reduction Plans

MH- Manhole

STW – Sewage Treatment Works

WINEP – Water Industry National Environment Programme

Addendum – Annual Update 2021

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Introduction

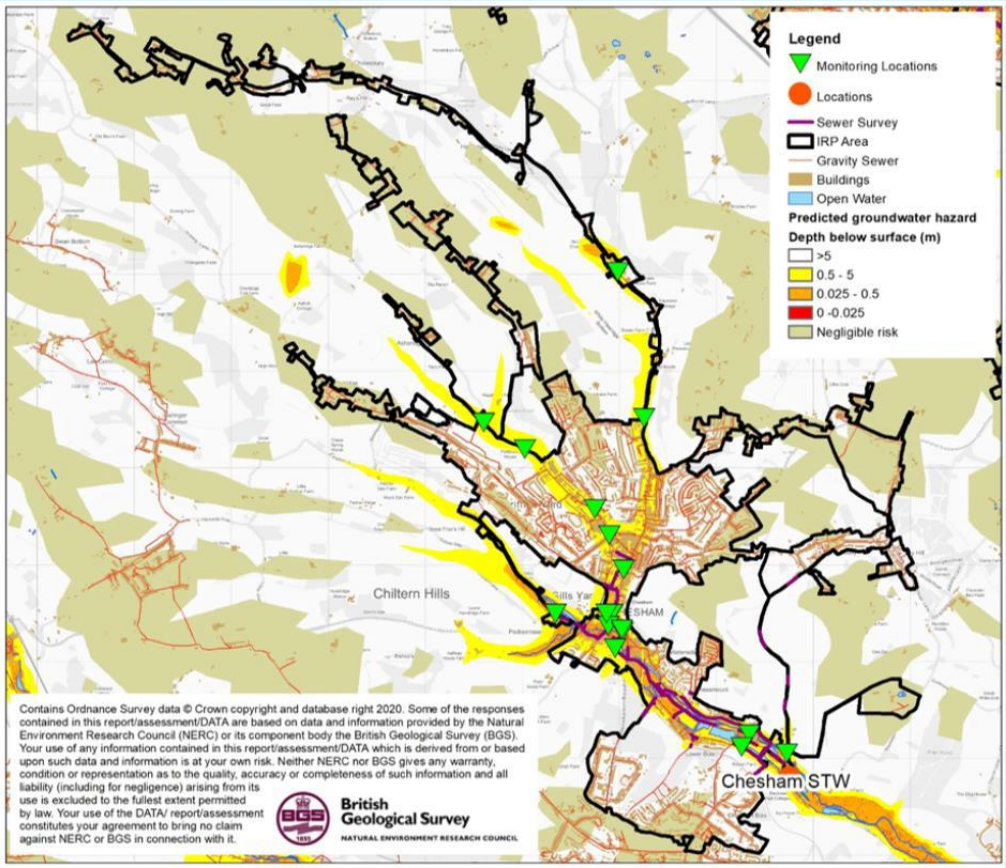

Figure 1 – Chesham monitoring and infiltration zones

This addendum to the Chesham Groundwater Infiltration System Management Plan 2020 (GISMP) provides an update on performance/work undertaken in the period from September 2020 to September 2021 (the UK Hydrological Year [1]) covered include:

- Hydrological Conditions
- How the sewerage system has performed over this period
- Mitigation / remedial measures progressed over the last year and being planned.
- Summary and next steps

[1] Happy New Water Year! | National River Flow Archive (ceh.ac.uk)

2020-21 Hydrological Review

This section summaries the hydrological conditions at Chesham in the period

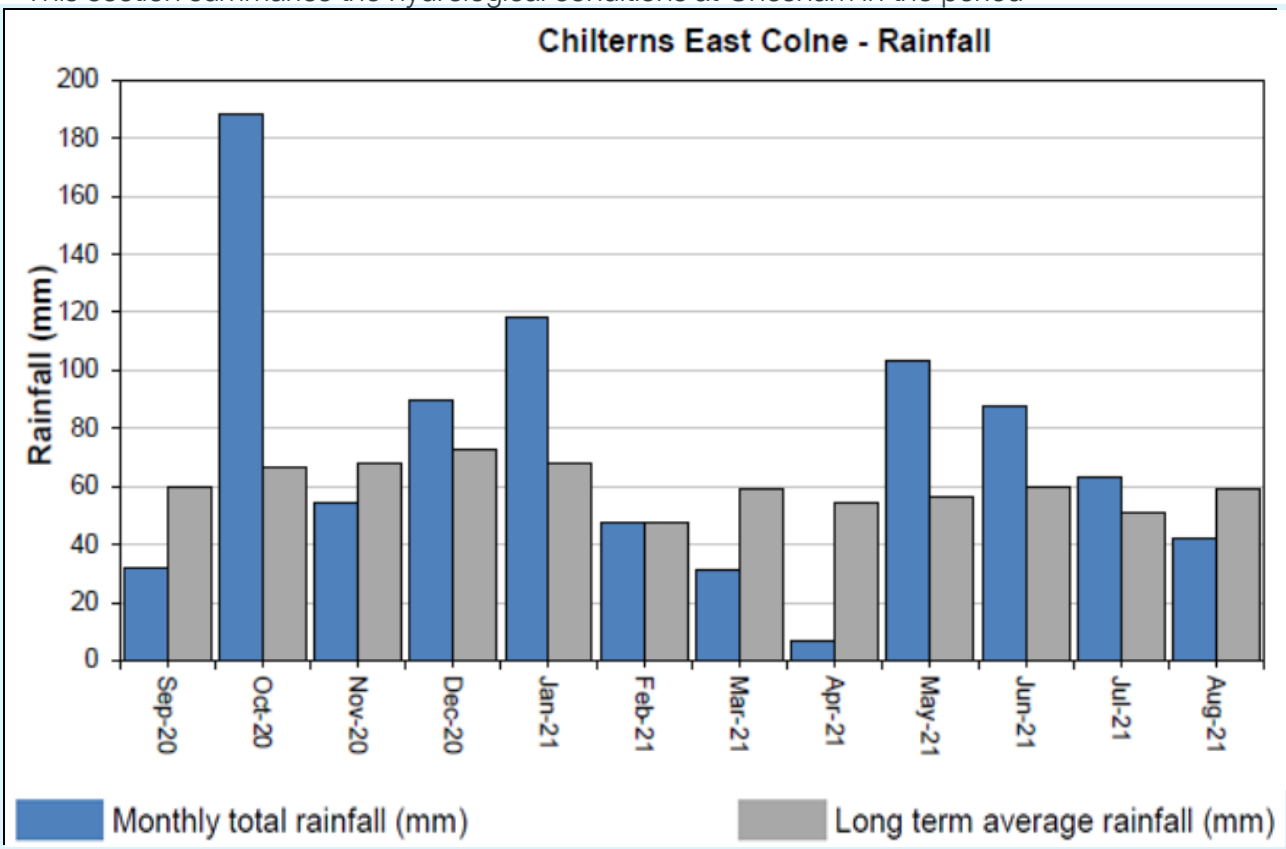

Figure 2 – Monthly rainfall depths local to the system

Chesham is situated in the Chilterns East Colne water resources area. Figure 2 shows the monthly total rainfall depths against the long-term average rainfall in the in the location of Chesham over the period taken from the [1]*Environment Agency Water Situation Report August 2021* [1]
The graph indicates that monthly rainfall at times in the last year has significantly exceeded long-term averages, this was especially notable in the winter period.

Figure 3 shows the location of the British Geological Survey (BGS) monitoring borehole at Ashley Green which has been monitoring the same Chalk aquifer than lies beneath Chesham since 1961. Figures 4 and 5 show river levels in the River Chess at Chesham which are a good indication of local groundwater levels over time Figure 6 and 7 show the last two and ten years of groundwater level data overlain on expected ranges. This shows how recent groundwater levels have compared against the expected range.
They show that generally over the last two winters groundwater levels have been notably high, with the groundwater maximum close to the exceptionally high range..

Environment Agency Water Situation Report August 2021
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016481/Thames_Water_Situation_Report_August_2021.pdf).

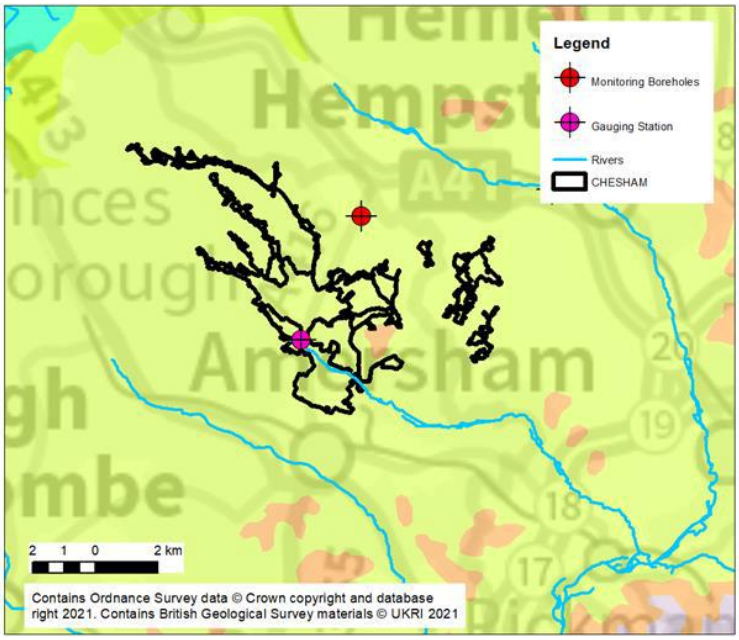

Figure 3 – Location of Ashley Green Monitoring Borehole Relative to Chesham

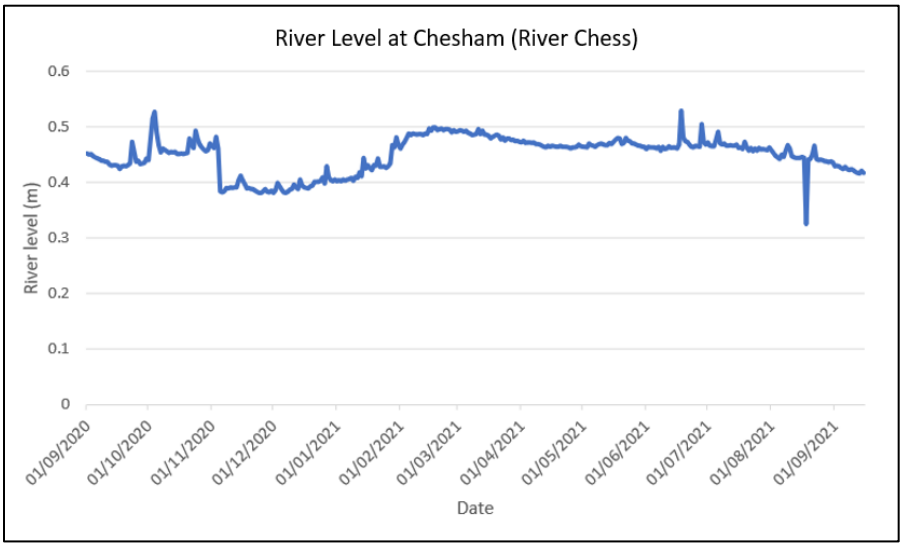

Figure 4 – 2020-2021 River levels at Chesham (River Chess) – River Levels UK (riverlevels.uk)

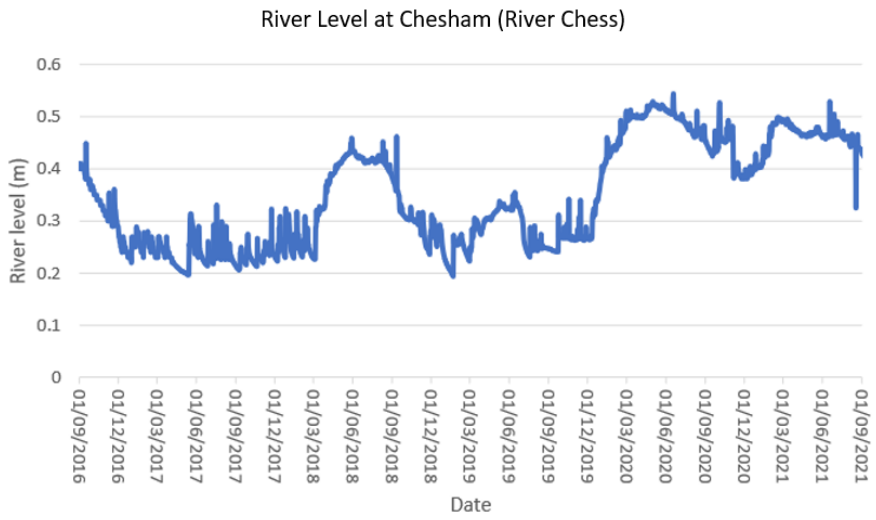

Figure 5 – 2016-2021 River levels at Chesham (River Chess) – River Levels UK (riverlevels.uk)

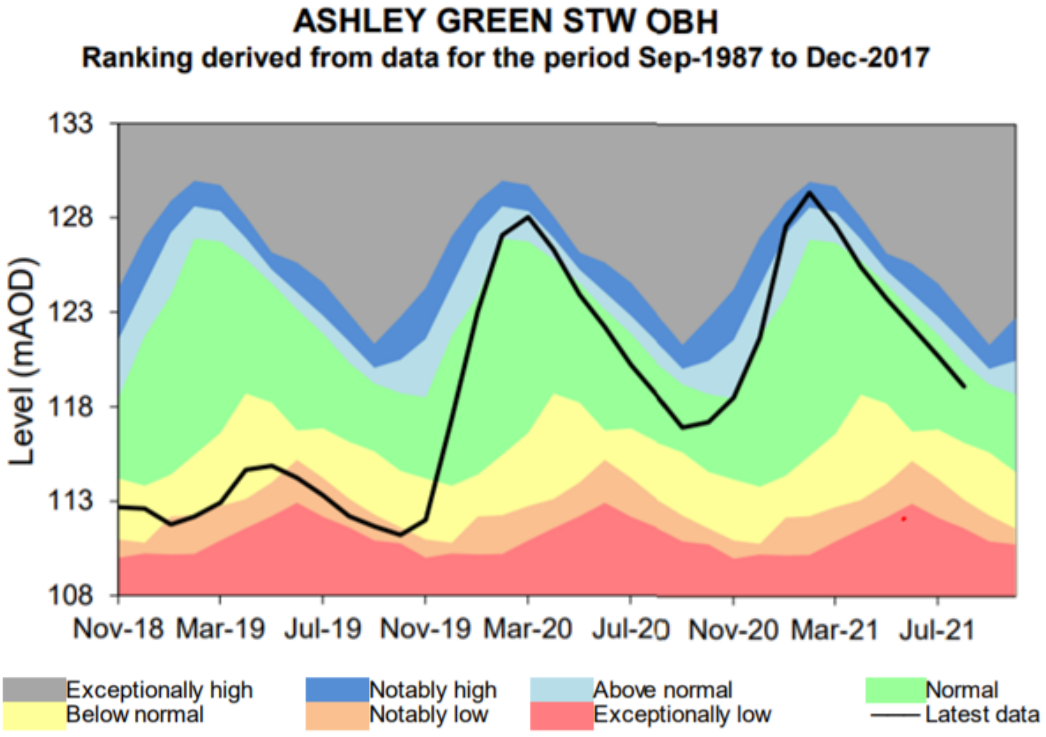

Figure 6 – 2018-2021 Groundwater levels at Ashley Green. (Environment Agency Water Situation Report August 2021

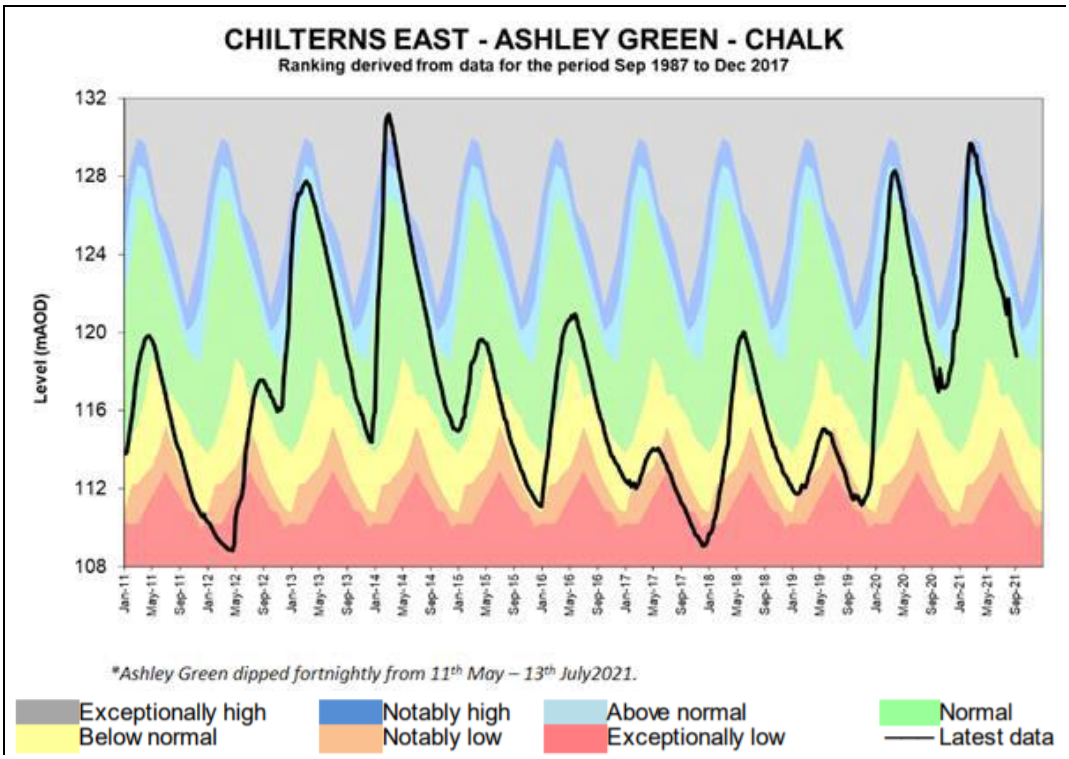

Figure 7 – 2011-2021 Groundwater levels at Ashley Green. (*Environment Agency Water Situation Report August 2021)*

(*Environment Agency Water Situation Report August 2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016481/Thames_Water_Situation_Report_August_2021.pdf*

Investigations & remedial work undertaken in the period and future work

Lift and Look and CCTV surveys will be continued over future winter periods where groundwater levels allow. A summary of findings will be provided in the next period.

The two tables below summarise remediation work undertaken in the period.

Remediation works in period

Activities	Value	Comment
Sewer Lining Length (m)	104m complete. 3 patch repairs are also complete. A further patch repair (which first requires excavation to remove a steel bar through the sewer) is due to be complete by November 2021.	Remaining work subject to site conditions being suitable. In addition to the work outlined: • A redundant pipe found to be allowing a significant amount of river water ingress has been filled. • Installation of 2 low leak manhole covers is due by November 2021. • Our operational teams are due to implement a further 40m of sewer liner within the system prior to Winter 2021.
Manhole Sealing (no.)	1 complete	

Future Works

Activity	Planned work in 2021/22	Known follow On Work
Survey	Surveys will continue over the winter periods in AMP7 (2020-2025).	To be confirmed
Sewer Lining	All known priority lining locations have been briefed and are in progress.	To be confirmed
Manhole Sealing – Infiltration Ingress	334 manholes as part of Green Recovery*	To be confirmed
Manhole Sealing – Pluvial and Fluvial Ingress	None	
Sewage Treatment Works (STW) Upgrade	As part of our current investment plan, we are undertaking a project to increase flow to full treatment through the 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 project is required to be completed by 2025, however we are looking to bring this forward to be completed by 2023.	

**Scope and procurement of this work is being finalised therefore final numbers to be delivered may change slightly.*

2020-21 Infiltration Review

This section summaries the scale of infiltration at Chesham over the period

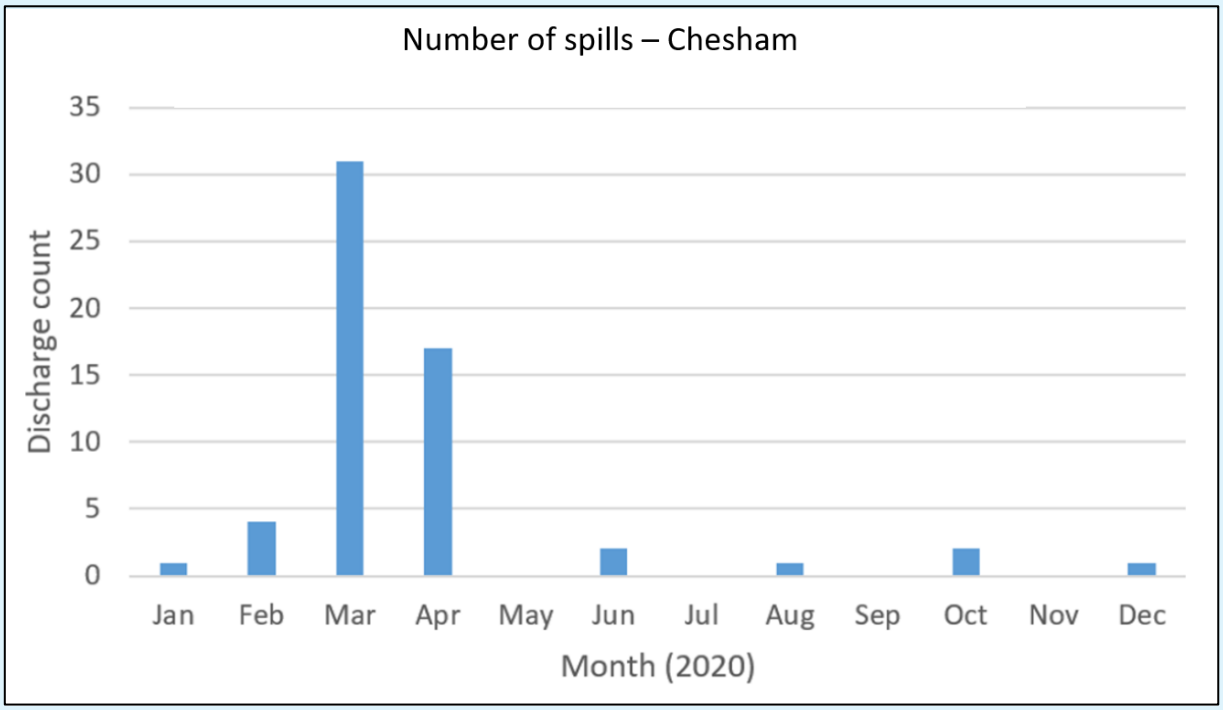

Figure 8 – Number of spills (discharge count) at Chesham Sewage treatment Works (STW) (taken from Event Duration monitor (EDM) Data).*

There was no impact in the network over the winter period in the form of property flooding or pollutions as a result of groundwater infiltration. All impact from groundwater infiltration is seen at the STW.

Figure 8 shows the number of spills per month from Chesham Sewage Treatment Works (STW). The greatest number of spills occurred in March and April which correlates with periods of high river levels in the River Chess. Levels in the River Chess are representative of local groundwater levels.

The Chesham system experiences a lag between rainfall and high levels of groundwater infiltration due to the time taken for the rainfall to percolate through the chalk and reach the river Chess.

**2020 verified and audited EDM data. 2021 calendar year data is awaiting verification before being published.*

The Green Recovery

The Chesham system has been selected to be the focus of an accelerated programme of works to reduce spills to the environment.

This programme of works is part of the Green Recovery initiative using additional investment beyond our original PR19 settlement to support economic recover from the COVID-19 pandemic.

The focus of the project in Chesham in AMP7 is to reduce groundwater infiltration (to sewers) and mapping of both surface and foul sewerage systems to detect cross connections.

The upper reaches of the River Chess has been specifically selected such that any improvement in receiving river water quality can be easily ascertained from this work. This pilot will also provide supporting evidence for expanding the approach for other systems and inclusion as part of investment in PR24 for delivery in AMP8 (2025 -2030) onwards.

The delivery of manhole chamber lining to prevent groundwater ingress is due to commence in November 2021 and conclude in June 2022 (see 'Future Works' table for further detail).

Summary

The winter of 2020-21 was a particular wet winter with groundwater levels in the chalk aquifer beneath Chesham notably high for long periods.

The Chesham system sees a lag between high groundwater levels and high flows received in the network and at the Sewage Treatment Works as a result of time taken for the rainfall to percolate through the chalk and reach the sewer network. This is reflected in the patterns of discharge (spills) seen at the Sewerage Treatment works as shown by the Event Duration Monitoring (EDM) data.

Surveys carried out to date have identified several manholes and sewers that require priority remediation. Works have been completed at a number of these locations and further works are due to be complete by November 2021.

Remedial measures will continue to be implemented as identified and a wider programme of works to remove unwanted flows from the foul system has been accelerated as part of the Green Recovery Programme. Manhole chamber lining and manhole cover sealing is due to commence in November 2021 and complete in June 2022

In addition to remediation in the network. as part of our current investment plan we are undertaking a project to increase flow to full treatment at the 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 project is required to be completed by 2025; however we are looking to bring this forward to be completed by 2023.

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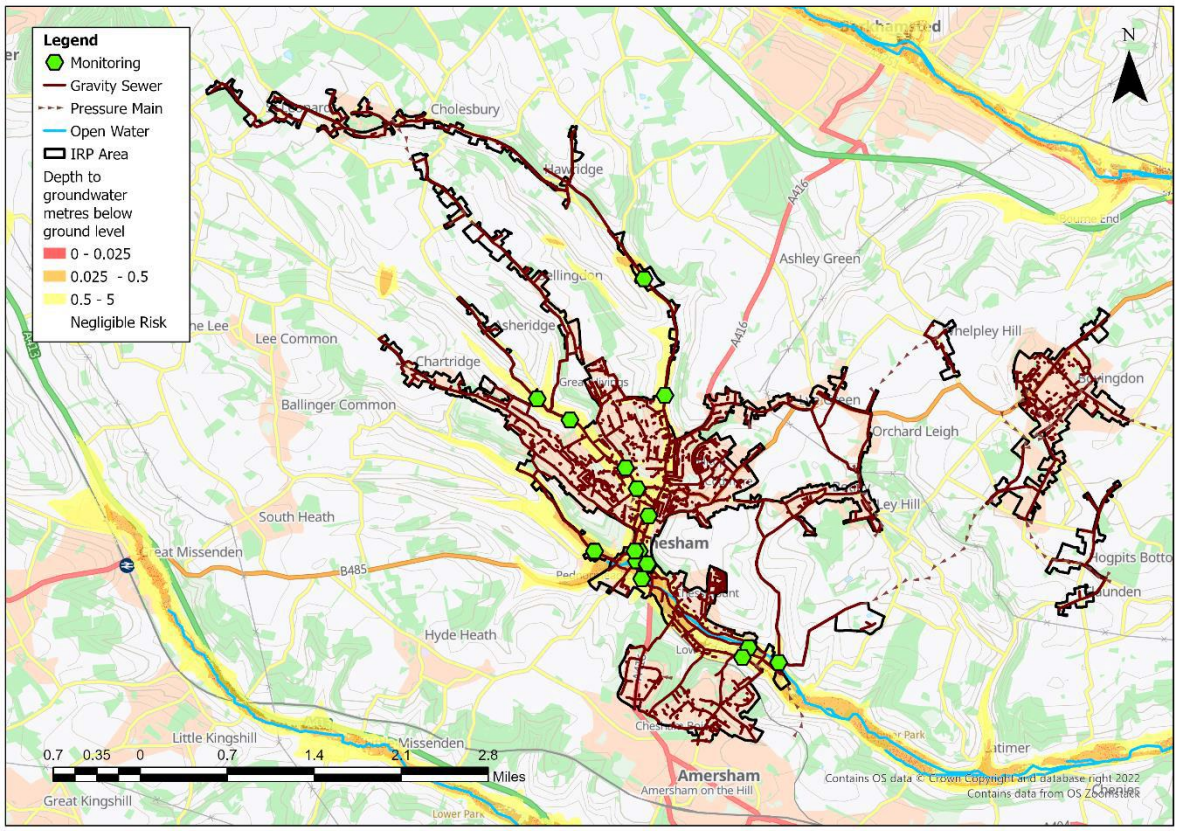
Overview

This addendum to the Chesham Groundwater Impacted System Management Plan 2021 (GISMP) provides an update on performance/work undertaken in the Hydrological Year October 2021 to September 2022. The key points covered include:

- Hydrological conditions
- How the sewerage system has performed over this period
- Mitigation / remedial measures progressed over the last year and being planned
- Summary and plan for 2022/23

Figure 1 – Chesham Monitoring Plan



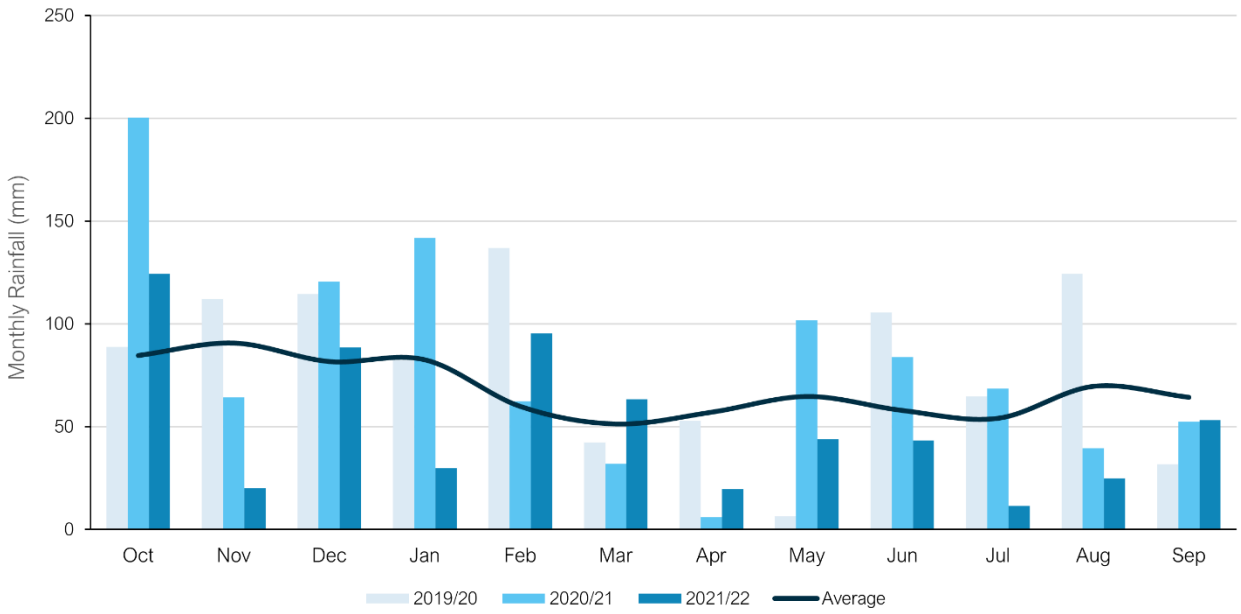
Hydrological Review – 2021-2022

This section summarises the hydrological conditions within the Chesham catchment within the period under investigation and provides comparison against previous year's performance to put the annual performance into context. The hydrological review has been undertaken based on the Hydrological Year which runs October 1st to September 30th.

Catchment Rainfall

Representative Radar rainfall has been used to generate monthly data at catchment level for comparison with average data generated by local Met Office Weather Station Records. Figure 2 presents the comparison of this data for the last three hydrological years to support longer term trends within the local system.

Figure 2 – Monthly Rainfall Performance



Average Values taken from Met Office Weather Station at High Wycombe based on the period 1991-2020

The total rainfall for the 2021/22 hydrological year is 23% below the annual average total. Total rainfall values are presented in Table 3 below.

Table 3 –Total Rainfall Based on Hydrological Year

Average (mm)	2019/20 (mm)	2020/21 (mm)	2021/22 (mm)
817	963	973	629

Groundwater / Local River Level

The Chesham catchment is situated in the Chilterns - East – Colne water resources areas. The extended Chesham catchment is situated across a number of different rock types within its base geology; however, the predominant rock type is sedimentary bedrock within the Holywell Nodular Chalk formation and New Pit Chalk formation. All the local chalk formations, which comprise a majority of the Chesham catchment, lie within a designated principal aquifer within the UK.

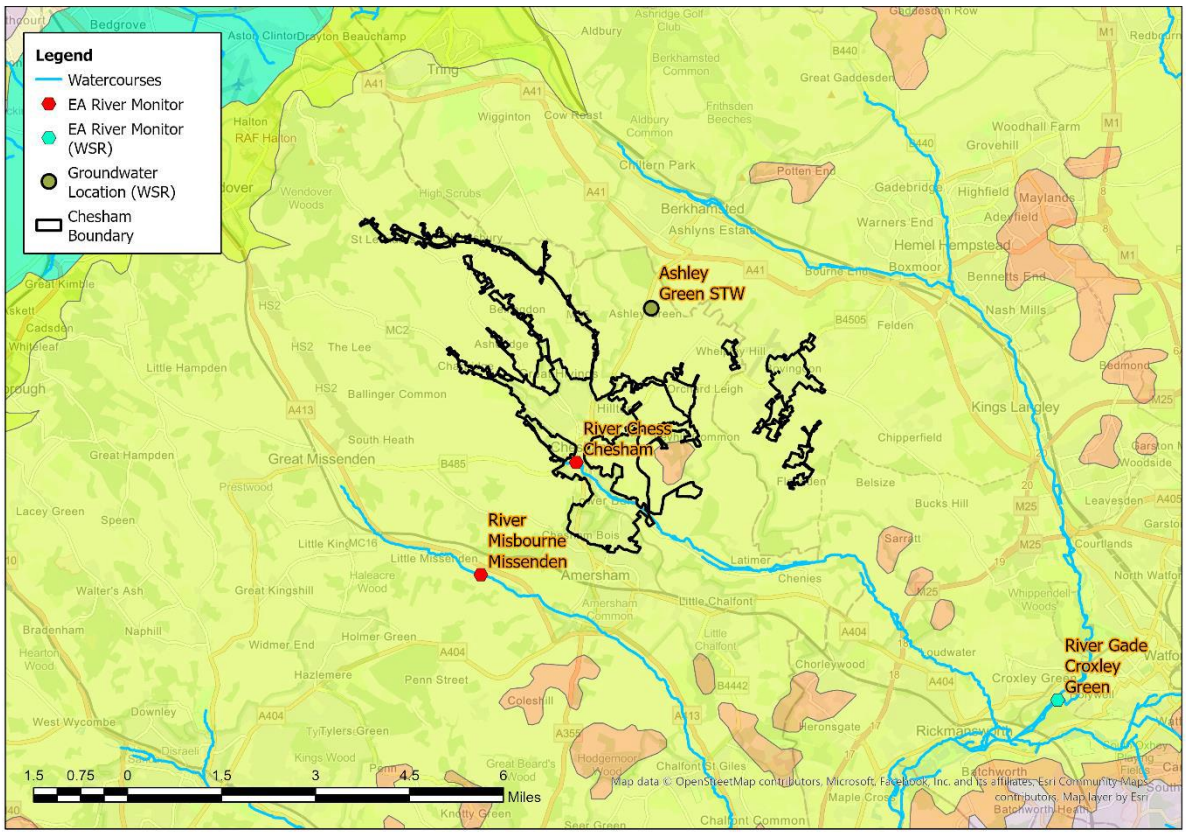
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

From previous investigations we have identified the following sites are good indicators of groundwater levels within the catchment.

- River Chess, Chesham.
- River Misbourne, Missenden.

These sites are illustrated in the figure below, alongside the closest groundwater reference station and closest gauging station from the Water Situation Report.

Figure 4 – Local Monitoring Stations



The following figures represent the last three hydrological years of level information at the indicator sites to build a picture of the relative conditions prevalent in the current year. It is presented against both the daily total rainfall values for the catchment and a rolling 15-day total rainfall.

Figure 5A – River Chess, Chesham

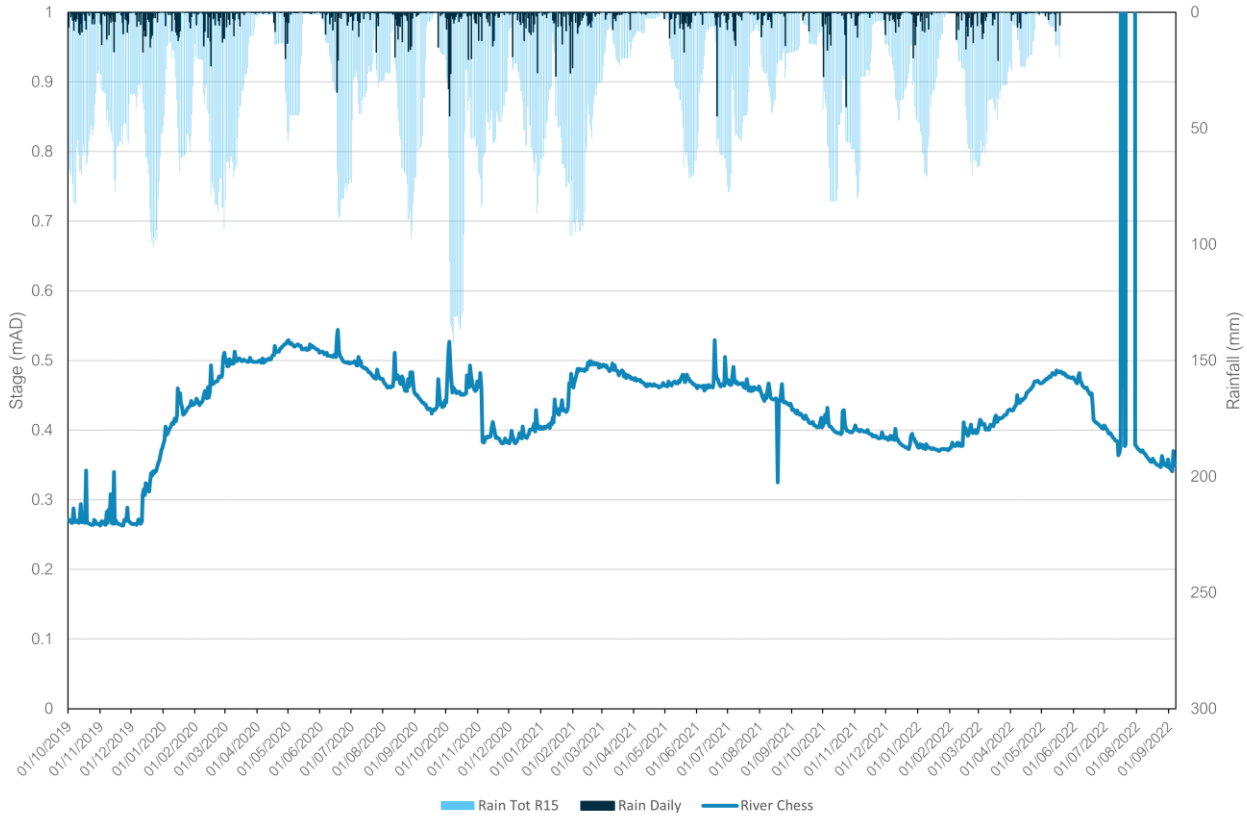
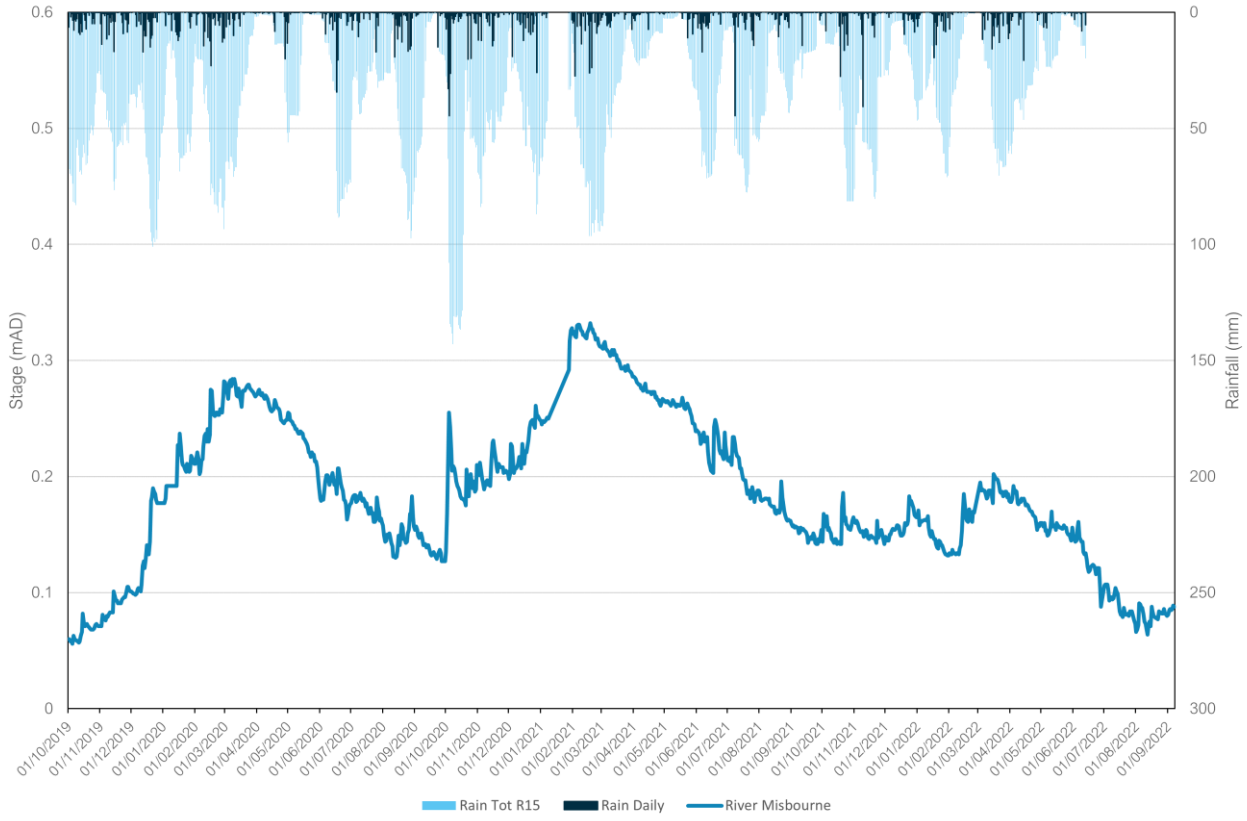


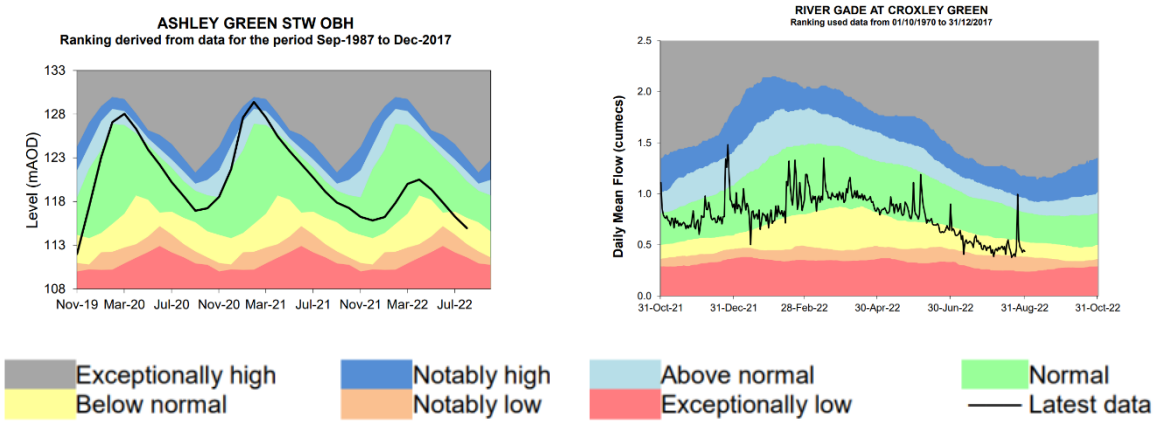
Figure 5B – River Misbourne, Missenden



In addition to these specific stations, the wider groundwater context is illustrated in the Water

Situation Report for Chilterns - East – Colne. The nearest groundwater reference station is Ashley Green STW. This site shows significantly lower overall groundwater than the previouyear. This can be seen in the figure below alongside the river indicator Croxley Green on the River Gade.

Figure 6 – Water Situation Report



Extract from - [Water Situation Report (publishing.service.gov.uk)]

Network Performance

Within the Chesham catchment there is one site detailed within the Environment Agency Consents Database which has an Event Duration Monitor (EDM) fitted.

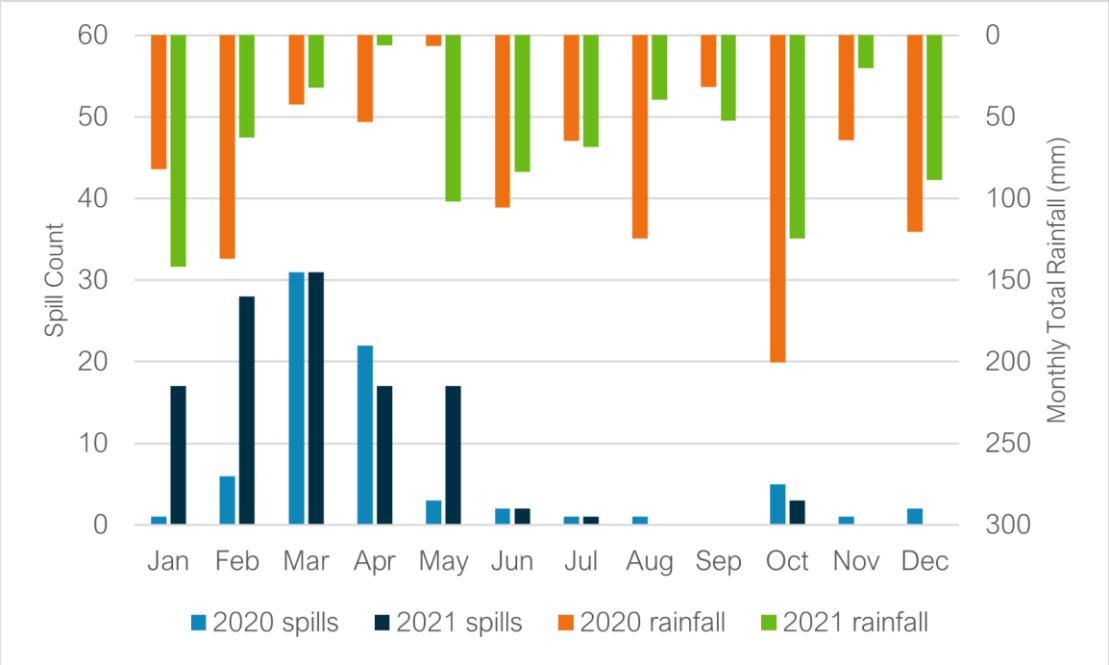
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2020		2021	
	Spills	Duration (hours)	Spills	Duration (hours)
Chesham STW	75	963.30	116	1814.05

A critical part of the assessment of EDM performance and its relation to groundwater inundation is to review the month-on-month spill performance, against previous years and the monthly total rainfall values to give context to the performance. Note a spill frequency of 75 is stated for 2020, which is higher than the published spill count of 59. The data has been revalidated/ corrected and the revised spill count of 75 will be included in the re-submission to the EA. Figure 8 below presents the EDM performance trend and rainfall for recent years.

Figure 8 – EDM Monthly Performance



The trend in spill performance across the two recorded years does show variation in spills, with an overall focus on spills during the winter and spring months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency.

Investigations & Interventions

This section details the activities that have been undertaken within the catchment within the Hydrological Year 2021-22.

Monitor Installations

The sewer depth monitor (SDM) programme supports long term groundwater understanding within GISMP catchments. Currently, there are a total of 17 monitors installed within the Chesham catchment. There are currently no further monitor installs planned.

The data from these will be cross-referenced with other long-term records (where available) within the catchment.

Remediation Works Undertaken this Hydrological Year

Table 9 below provides a summary of the investigations and remediation works undertaken or planned within the Chesham catchment in the 2021-22 Hydrological Year.

Table 9 – Works Undertaken in the 2021/22 Hydrological Year

Investigation/ remediation type	Number/ length undertaken
CCTV survey	N/A
Look and lift survey	N/A
Sewer lining	N/A
Patch lining	N/A
Manhole sealing	184 manholes, further 71 planned by end of November 2022.
Manhole sealing plates	N/A
Manhole covers and frames replaced	103 manhole covers replaced, further 399 planned by end of November 2022.

As the River Chess is an environmentally sensitive chalk stream, Chesham has been identified as a priority catchment to reduce unwanted flows in the sewer network. This is reflected in the extensive manhole sealing and manhole cover replacement planned in the catchment in the 2021/2022 hydrological year, which is being undertaken as part of the Green Recovery project.

Summary

Rainfall in the Chesham catchment over the 2021/22 hydrological year has been below average, with groundwater levels in the aquifer beneath Chesham not reaching the levels seen in previous years which triggered groundwater ingress into the sewerage network and elevated flow/depth readings at monitoring sites.

Lift and look and CCTV surveys will continue throughout the remaining wet winter periods with the aim of finding further priority locations for remediation and investigating/justifying the need for future larger scale lining as part of our Price Review (PR) process if required.

Addendum - Annual Update 2023

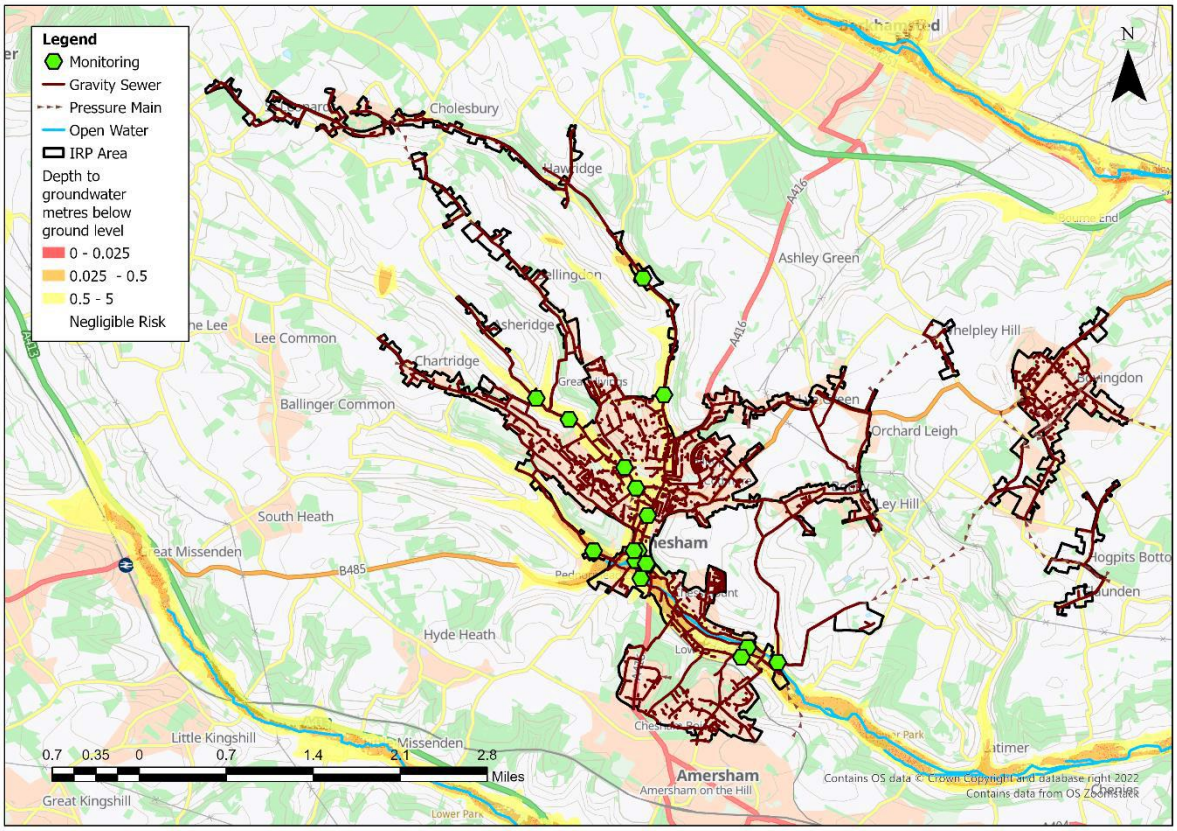
Table of contents

Overview

This addendum to the Chesham Groundwater Impacted System Management Plan 2021 (GISMP) provides an update on work undertaken in the Hydrological Year October 2022 to September 2023. The key points covered include:

- Hydrological conditions
- Performance of the sewerage system
- Mitigation / remedial measures progressed over the last year and those being planned
- Summary and plan for 2023/24

Figure 1 – Chesham Monitoring Plan



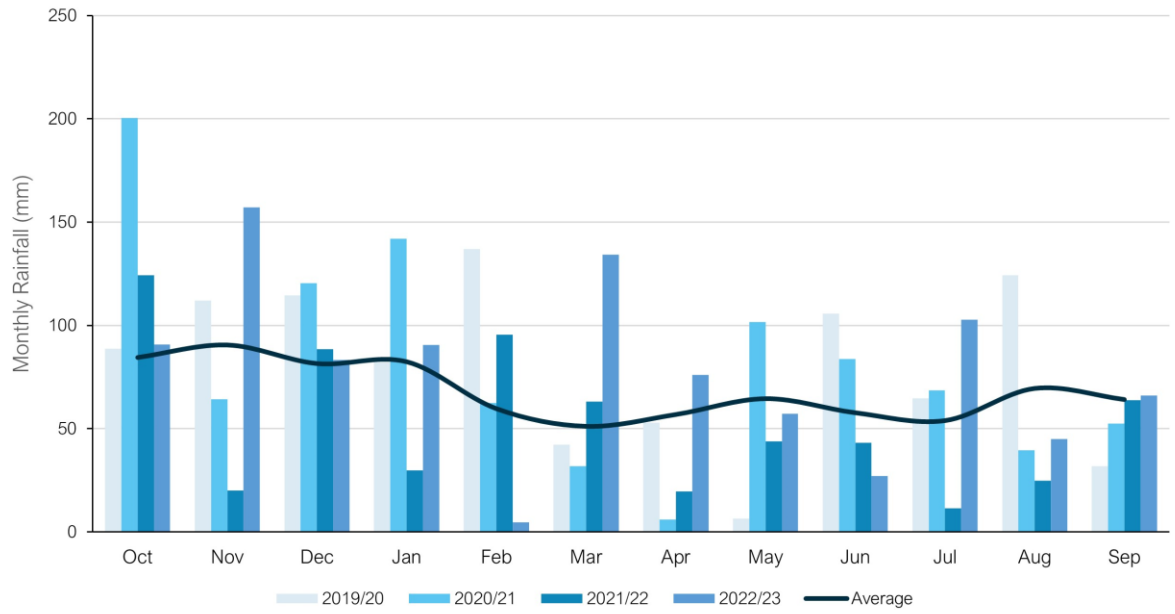
Hydrological Review – 2022-2023

This section summarises the hydrological conditions across the Chesham catchment within the period under investigation and provides comparison against previous year's performance to put the annual performance into context. The hydrological review has been undertaken based on the Hydrological Year which runs October 1st to September 30th.

Catchment Rainfall

Representative Radar rainfall has been used to generate monthly data at catchment level for comparison with average data generated by local Met Office Weather Station Records. Figure 2 presents the comparison of this data for the last four hydrological years to support longer-term trends within the local system.

Figure 2 – Monthly Rainfall Performance



Average Values taken from Met Office Weather Station at High Wycombe based on the period 1991-2020

The total rainfall for the 2022/23 hydrological year is 14% above the annual average total. Total rainfall values are presented in Table 3 below.

Table 3 –Total Rainfall Based on Hydrological Year

Average (mm)	2019/20 (mm)	2020/21 (mm)	2021/22 (mm)	2022/23 (mm)
817	963	973	629	935

Groundwater / Local River Level

The Chesham catchment is situated in the Chilterns - East – Colne water resources areas. The extended Chesham catchment is situated across a number of different rock types within its base geology; however, the predominant rock type is sedimentary bedrock within the Holywell Nodular Chalk formation and New Pit Chalk formation. All the local chalk formations, which comprise a majority of the Chesham catchment, lie within a designated principal aquifer within the UK.

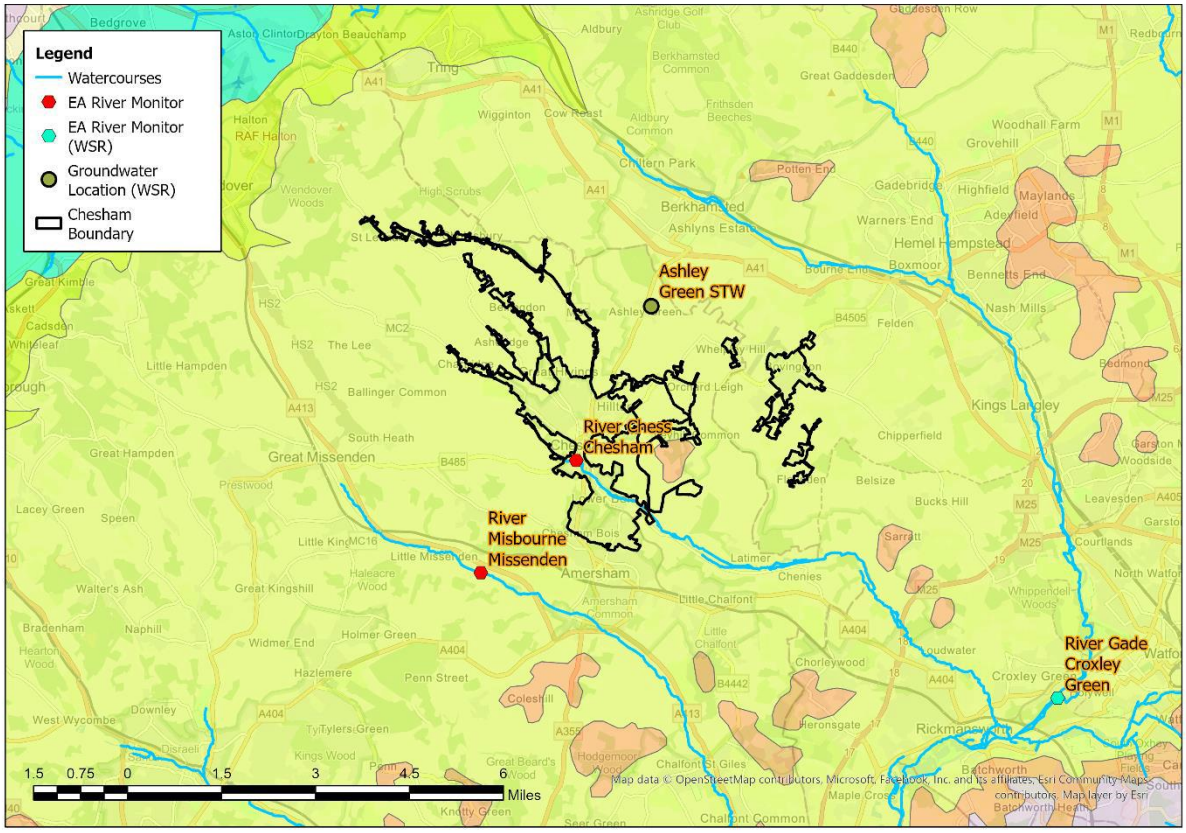
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes (OBH) measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

From previous investigations we have identified the following sites as good indicators of groundwater levels within the catchment.

- River Chess, Chesham.
- River Misbourne, Missenden.

These sites are illustrated in the figure below, alongside the closest groundwater reference station and closest gauging station from the Water Situation Report.

Figure 4 – Local Monitoring Stations



The following figures represent the last three hydrological years of level information at the indicator sites to build a picture of the relative conditions prevalent in the current year. It is presented against both the daily total rainfall values for the catchment and a rolling 15-day total rainfall.

Figure 5A – River Chess, Chesham

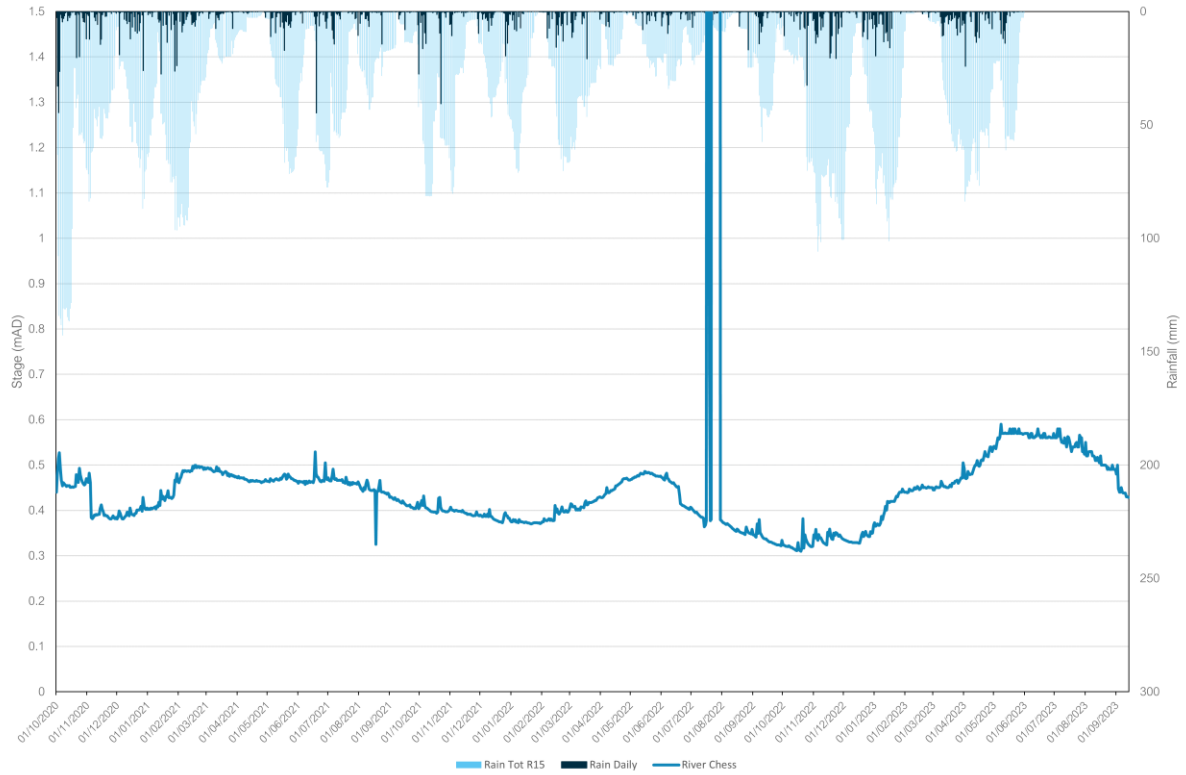
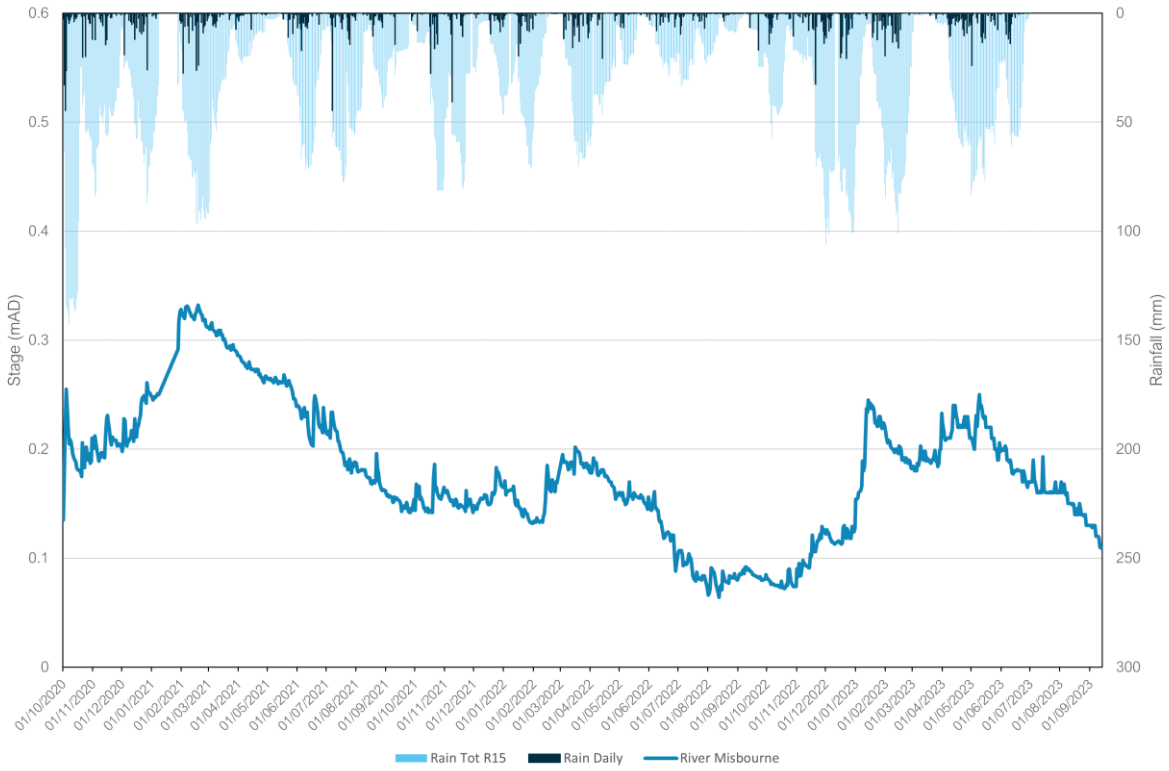
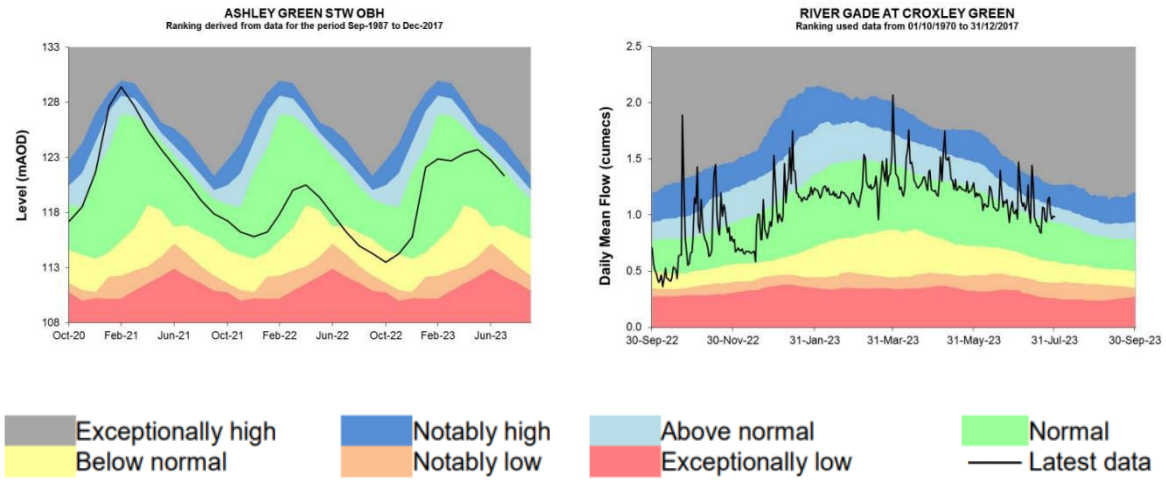


Figure 5B – River Misbourne, Missenden



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for Chilterns - East – Colne. The nearest groundwater reference station is Ashley Green STW. This site shows groundwater levels at normal or below normal in 2022. Groundwater levels have been observed at normal levels in 2023, however have reached higher levels than in 2022. This can be seen in the figure below alongside the river indicator located at Croxley Green on the River Gade.

Figure 6 – Water Situation Report



Extract from - [Water Situation Report (publishing.service.gov.uk)]

Network Performance

Within the Chesham catchment there is one site detailed within the Environment Agency Consents Database which has an Event Duration Monitor (EDM) fitted.

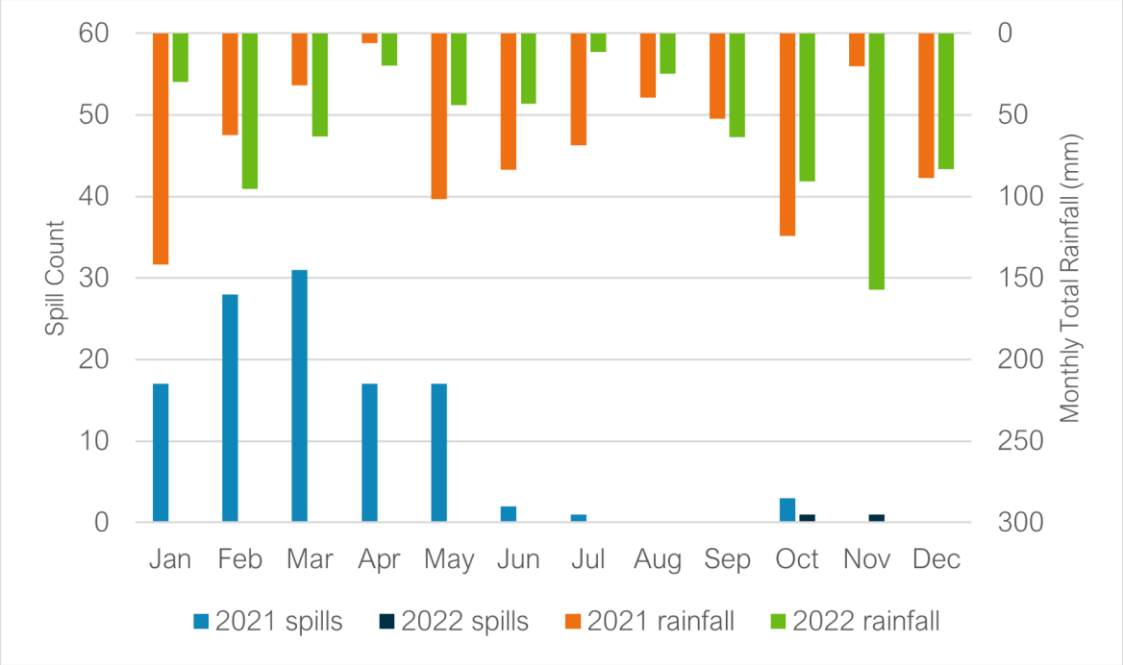
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Chesham STW	116	1814.05	2	3.68

A critical part of the assessment of EDM performance and its relation to groundwater infiltration, is to review the month-on-month spill performance against previous years and the monthly total rainfall values to give context to the performance. Figure 8 below presents the EDM performance trend and rainfall for recent years.

Figure 8 – EDM Monthly Performance



The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. An elevated groundwater level observed in the first half of 2021 (see Figures 5 and 6), coincides with a significant number of spills recorded January – May. For 2022, Figure 6 suggests groundwater levels in the catchment remained at a normal level in the first half of the year and were significantly lower than the same period in 2021. This corresponds with an absence of any recorded spills during the first half of 2022, despite a higher rainfall total in February, March and April 2022.

Investigations & Interventions

This section details the activities that have been undertaken within the catchment within the Hydrological Year 2022-23.

Monitor Installations

The sewer depth monitor (SDM) programme supports long term groundwater understanding within GISMP catchments. Currently, there are a total of 17 monitors installed within the Chesham catchment. There are currently no further monitor installs planned.

The data from these will be cross-referenced with other long-term records (where available) within the catchment.

Remediation Works Undertaken this Hydrological Year

Table 9 below provides a summary of the investigations and remediation works undertaken or planned within the Chesham catchment in the 2022-23 Hydrological Year, as well as works undertaken in the 2021-22 Hydrological Year.

Table 9 – Works Undertaken in the 2022/23 Hydrological Year & in the 2021/22 Hydrological Year

Investigation/ remediation type	Number/ length undertaken 21/22	Number/ length undertaken 22/23
CCTV survey	N/A	696 metres
Look and lift survey	N/A	34 surveys
Sewer lining	N/A	N/A
Patch lining	N/A	N/A
Manhole sealing	184 manholes	71 manholes*
Manhole sealing plates	N/A	N/A
Manhole covers and frames replaced	103 manhole covers replaced	399 manholes*

**Marked as outstanding in last year's Addendum Report and completed this hydrological year.*

As the River Chess is an environmentally sensitive chalk stream, Chesham was identified as a priority catchment to reduce unwanted flows in the sewer network. This is reflected in the extensive manhole sealing and manhole cover replacement undertaken in the catchment during the 2021/22 Hydrological Year, which was undertaken as part of the Green Recovery project.

CCTV along the public sewers this hydrological year, identified several connections with clear flows discharging into the main sewer. Most of the time, these clear flows (infiltration) were found to be entering through private inspection chambers and connecting property level lateral connections. No interventions are planned at this stage as these are private assets. Nine gushers (infiltration points) were identified on the main sewer network, these are planned to be rectified.

Chesham STW is being upgraded at a cost of more than £20 million. These projects will provide a major increase in treatment capacity, reducing the need for untreated discharges to the environment, and also ensure a higher quality of treated effluent going to the river. The treatment capacity upgrade completed in early 2023 and the quality effluent upgrade is expected to complete in 2024.

Summary

Indicator site data suggests groundwater levels in the Chesham catchment were generally lower in 2022 than in 2021, with EDM data indicative of the role of groundwater infiltration on spills in the catchment. This hydrological year, indicator site data suggests groundwater levels in the catchment have reached higher levels than the previous hydrological year, and EDM data for 2023 will be analysed once available to continue to examine the relationship between groundwater levels and overflow spills in the catchment.

Lift and look and CCTV surveys will continue throughout the remaining wet winter periods with the aim of finding further priority locations for remediation and investigating/justifying the need for future larger scale lining as part of our Price Review (PR) process if required.

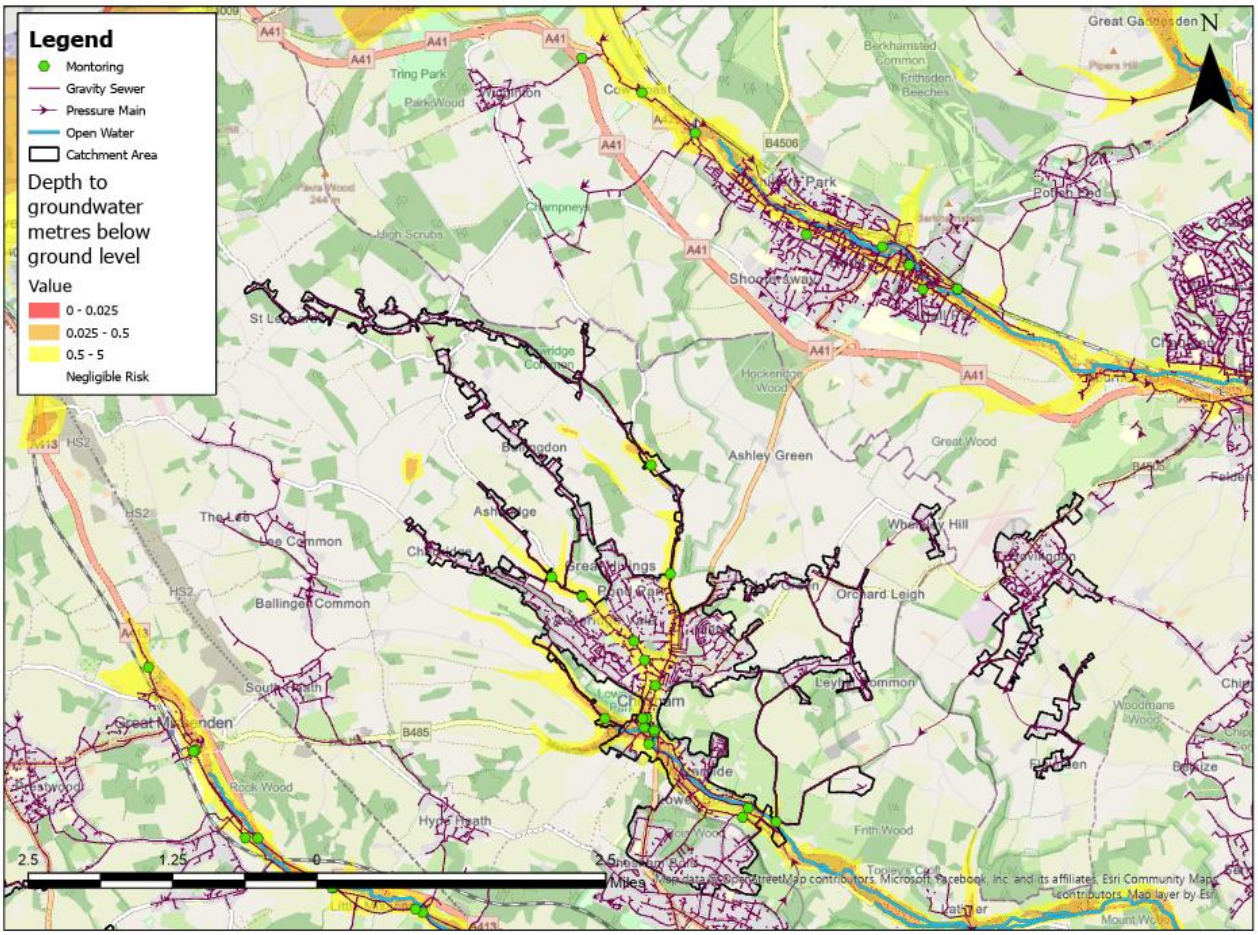
Addendum - Annual Update 2024 Table of contents

Overview

This addendum to the Chesham Groundwater Impacted System Management Plan 2021 (GISMP) provides an update on work undertaken in the Hydrological Year October 2023 to September 2024. The key points covered include:

- Hydrological conditions
- Performance of the sewerage system
- Mitigation / remedial measures progressed over the last year and those being planned
- Summary and plan for 2024/25

Figure 1 – Chesham Monitoring Plan



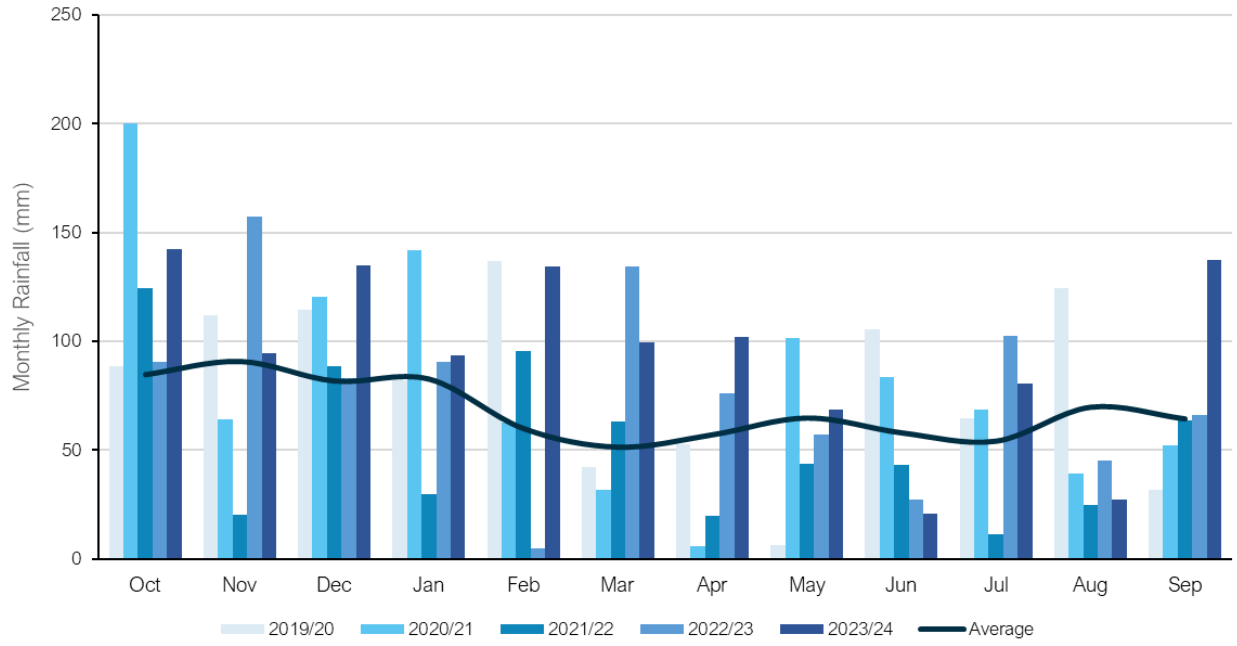
Hydrological Review – 2023-2024

This section summarises the hydrological conditions across the Chesham catchment within the period under investigation and provides comparison against previous year's performance to put the annual performance into context. The hydrological review has been undertaken based on the Hydrological Year which runs October 1st to September 30th.

Catchment Rainfall

Representative Radar rainfall has been used to generate monthly data at catchment level for comparison with average data generated by local Met Office Weather Station Records. Figure 2 presents the comparison of this data for the last five hydrological years to support longer term trends within the local system.

Figure 2 – Monthly Rainfall Data



Average Values taken from Met Office Weather Station at High Wycombe based on the period 1991-2020

The total rainfall for the 2023/24 hydrological year is 39% above the annual average total. Total rainfall values are presented in Table 3 below.

Table 3 –Total Rainfall Based on Hydrological Year

Average (mm)	2019/20 (mm)	2020/21 (mm)	2021/22 (mm)	2022/23 (mm)	2023/24 (mm)
817	963	973	629	935	1136

Groundwater / Local River Level

The Chesham catchment is situated in the Chilterns - East – Colne water resources area. The extended Chesham catchment is situated across a number of different rock types within its base geology; however, the predominant rock type is sedimentary bedrock within the Holywell Nodular Chalk formation and New Pit Chalk formation. All the local chalk formations, which comprise a majority of the Chesham catchment, lie within a designated principal aquifer within the UK.

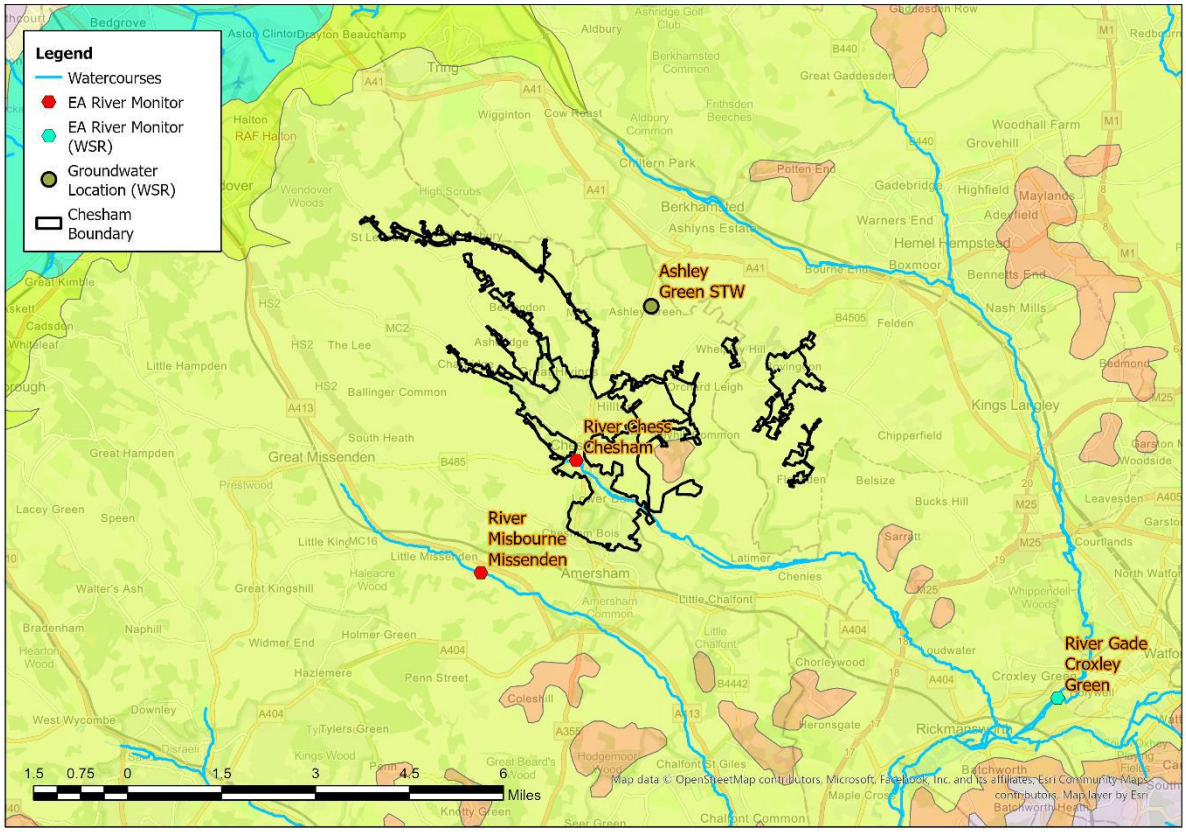
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes (OBH) measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

From previous investigations we have identified the following sites as good indicators of groundwater levels within the catchment.

- River Chess, Chesham.
- River Misbourne, Missenden.

These sites are illustrated in Figure 4, alongside the closest groundwater reference station and closest gauging station from the Water Situation Report.

Figure 4 – Local Monitoring Stations



Figures 5A-5B represent the last three hydrological years of level information at the indicator sites to build a picture of the relative conditions prevalent in the current year. It is presented against both the daily total rainfall values for the catchment and a rolling 15-day total rainfall.

Figure 5A – River Chess, Chesham

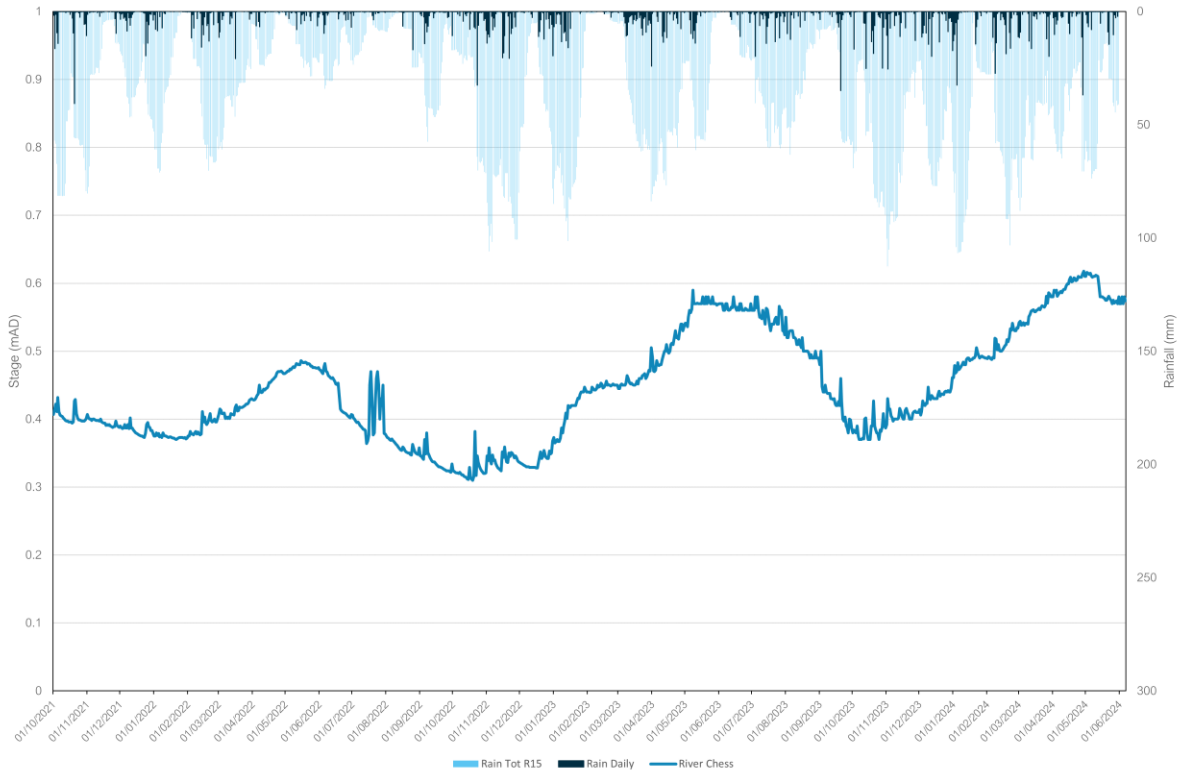
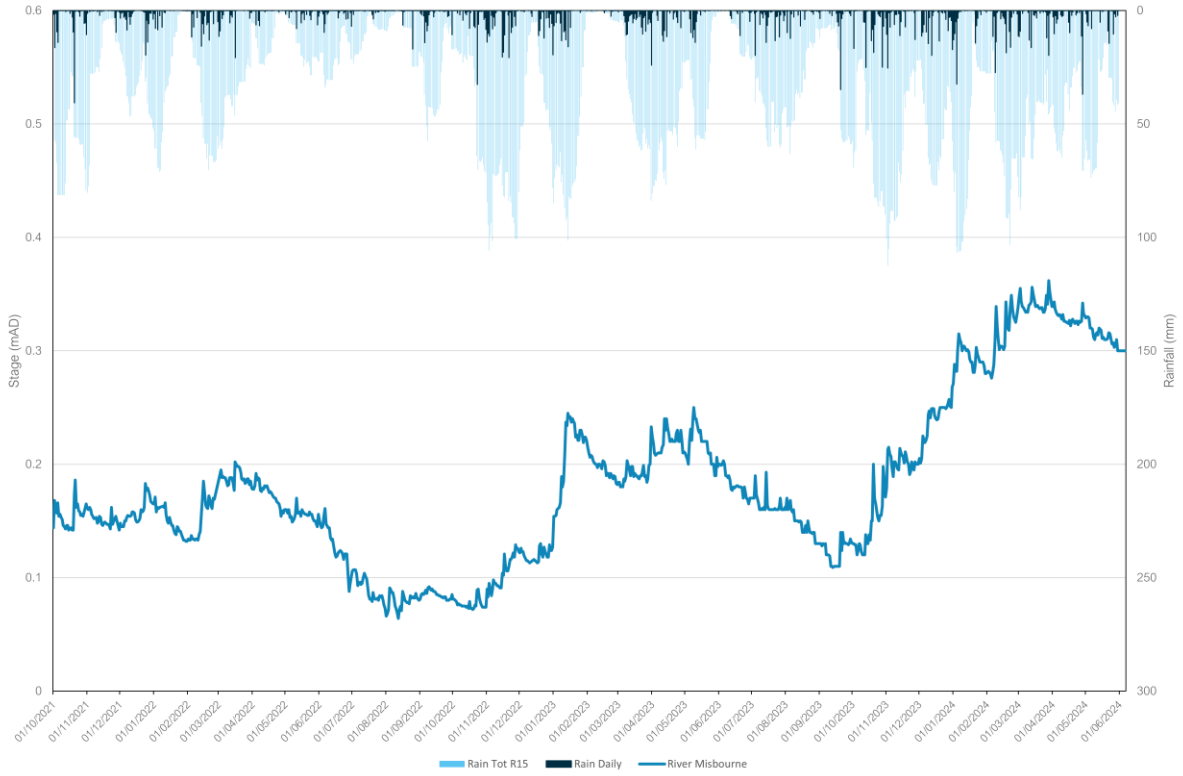
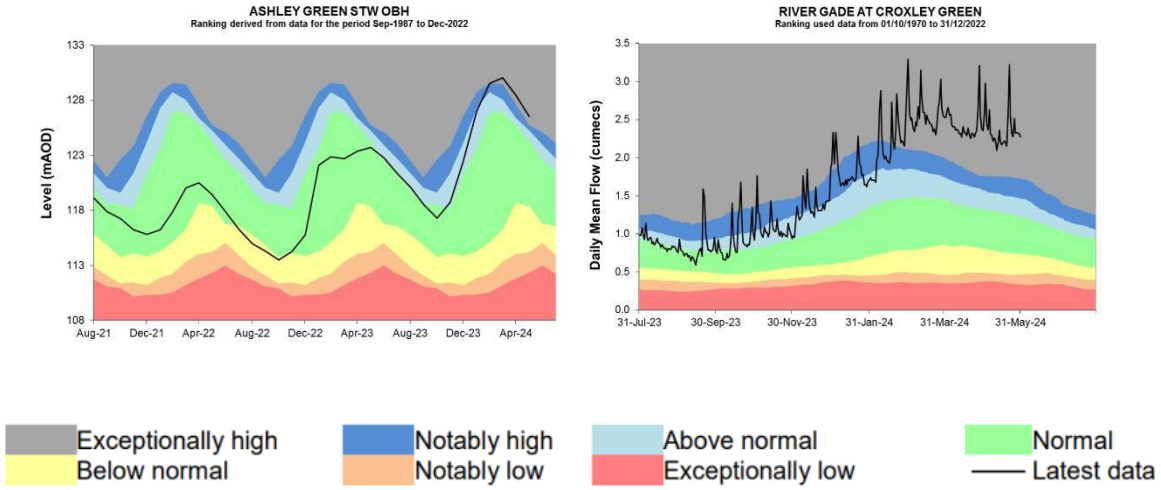


Figure 5B – River Misbourne, Missenden



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for Chilterns - East – Colne. The nearest groundwater reference station is Ashley Green STW OBH. This site shows groundwater levels to be at normal levels throughout 2023, whereas groundwater levels in 2024 are seen to rise to notably high / exceptionally high levels. This can be seen in Figure 6 alongside the river indicator located at Croxley Green on the River Gade.

Figure 6 – Water Situation Report



Extract from - [Water Situation Report (publishing.service.gov.uk)]

Network Performance

Within the Chesham catchment there is one site detailed within the Environment Agency Consents Database which has an Event Duration Monitor (EDM) fitted.

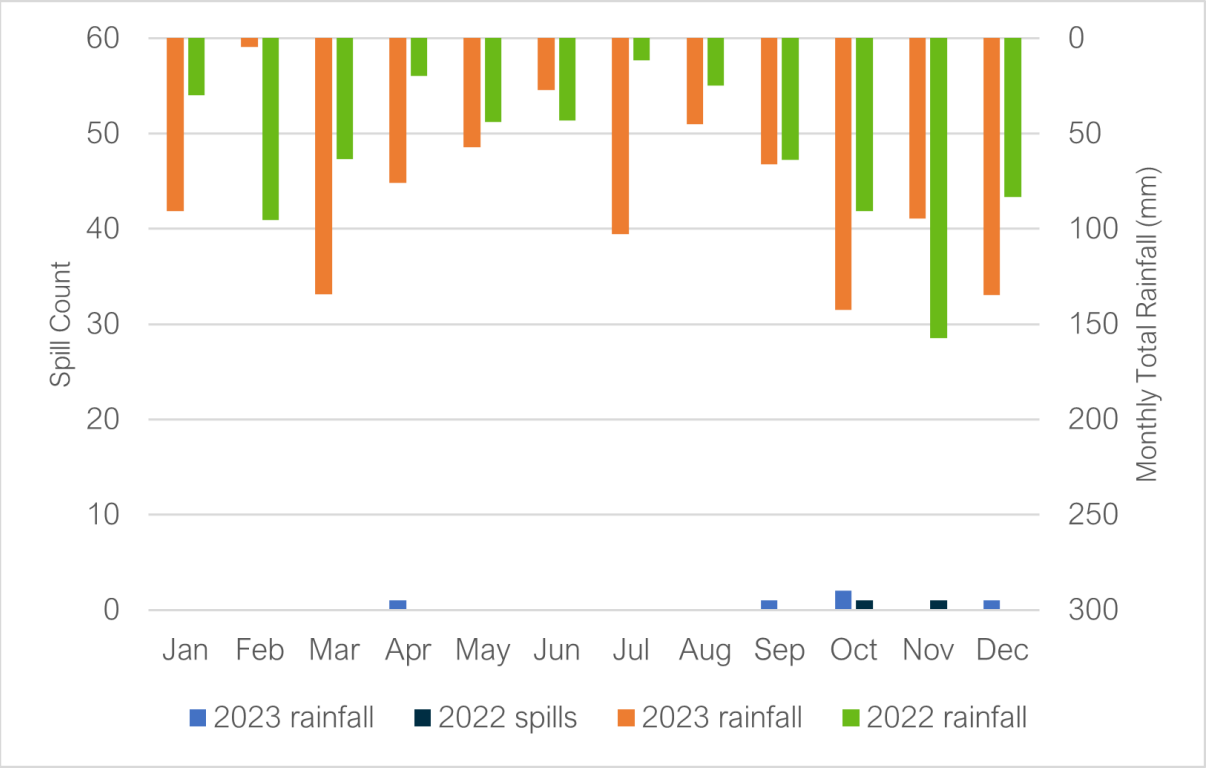
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Chesham STW	2	3.68	5	19.25

A critical part of the assessment of EDM performance and its relation to groundwater infiltration, is to review the month-on-month spill performance against previous years and the monthly total rainfall values to give context to the performance. Figure 8 below presents the EDM performance trend and rainfall for recent years.

Figure 8 – EDM Monthly Performance



A low number of spills were recorded at Chesham STW across 2022 and 2023, this compares to a long-term average spill count of 35. The indicator site data shown in Figures 5 and 6, suggests that groundwater levels in the catchment remained relatively low in 2022, however rose significantly in 2023. The high threshold level for groundwater infiltration in the catchment, which is when significant levels of groundwater infiltration in the network begin to occur, has been assigned as 0.48 mAD at the River Chess at Chesham indicator site. As can be seen in Figure 5A, this level was significantly exceeded for a sustained period in 2023, however this is not reflected in recorded spills at the STW. A major treatment capacity upgrade was completed at Chesham STW in early 2023. The low number of spills that occurred at the site in 2023, when

groundwater levels exceeded threshold level, indicates that the capacity upgrade completed has had a significant impact on reducing spills at the STW. In addition to the treatment capacity upgrade, several manholes have been sealed in the catchment to reduce unwanted flows in the foul network. These are detailed in Table 9. The manhole sealing works completed may have also contributed to the spill reduction observed at the STW, and analysis is ongoing to understand the impact of the works completed.

The EDM data for 2024 will be analysed once available to continue to understand the impact of the works completed on spills at the STW, as the indicator site data shown in Figure 6 suggests that groundwater levels in the catchment reached exceptionally high levels in 2024.

Investigations & Interventions

This section details the activities that have been undertaken within the catchment within the Hydrological Year 2023-24.

Monitor Installations

The sewer depth monitor (SDM) programme supports long term groundwater understanding within GISMP catchments. Currently, there are a total of 17 monitors installed within the Chesham catchment. There are currently no further monitor installs planned.

The data from these will be cross-referenced with other long-term records (where available) within the catchment.

Remediation Works Undertaken this Hydrological Year

Table 9 below provides a summary of the investigations and remediation works undertaken or planned within the Chesham catchment in the 2023-24 Hydrological Year, as well as works undertaken in the previous two hydrological years.

Table 9 – Works Undertaken in the 2023/24, 2022/23 & 2021/22 Hydrological Year

Investigation/ remediation type	Number/ length undertaken 21/22	Number/ length undertaken 22/23	Number/ length undertaken 23/24
CCTV survey	N/A	696 metres	7.65 kilometres planned*
Look and lift survey	N/A	34 surveys	47 manholes**
Sewer lining	N/A	N/A	N/A
Patch lining	N/A	N/A	N/A
Manhole sealing	184 manholes	71 manholes	N/A
Manhole sealing plates	N/A	N/A	N/A
Manhole covers and frames replaced	103 manhole covers replaced	399 manholes	TBC

*These surveys were not undertaken as priority was made to survey the manholes in the catchment to determine the efficacy of previous remediation works in the 2022-2023 hydrological year.
**The purpose of these surveys was to determine the efficacy of previous lining / sealing works carried out across the Chesham catchment. Survey data has recently been received from the contractor and results will be analysed.

Tables 10 and 11 below summarise the lift and look surveys of manholes undertaken in Chesham in the 2023-24 Hydrological Year and gives details on the infiltration identified.

Table 10 – Total number of manholes surveyed by lift and look in the 2023-2024 hydrological year

Investigation	Length (m)
Planned Lift and look surveys	47
Survey Completed	11
Total surveyed with clear flow	7

Table 11 – Number of points of infiltration found and assessed severity from lift and look surveys

Infiltration severity	No. of manholes
Gushing	0
Running	3
Dripping	0
Seeping	0
Total	3

As the River Chess is an environmentally sensitive chalk stream, Chesham was identified as a priority catchment to reduce unwanted flows in the sewer network. This is reflected in the extensive manhole sealing and manhole cover replacement undertaken in the catchment.

CCTV along main public sewer network has identified several connections with clear flows discharging into the main sewer. Most of the time, these clear flows (infiltration) were found to be entering through private inspection chambers and connecting property level lateral connections. No interventions are planned at this stage as these are private assets. Nine gushers (infiltration points) were identified on the main sewer network; these are planned to be rectified.

Chesham STW is being upgraded at a cost of more than £20 million. The treatment capacity upgrade completed in early 2023 and the quality effluent upgrade is expected to complete in 2024.

It is expected that the Chesham catchment will meet all government targets for storm overflows by 2030 – 2035.

Summary

This hydrological year, indicator site data suggests groundwater levels in the Chesham catchment have reached higher levels than the previous hydrological year, and EDM data for 2024 will be analysed once available to continue to understand the impact of the works completed in the catchment on spills at Chesham STW.

Lift and look and CCTV surveys will continue throughout the remaining wet winter periods with the aim of finding further priority locations for remediation and investigating/justifying the need for future larger scale lining as part of our Price Review (PR) process if required.

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Colne river basin summary

The Thames Water region covers the length of the River Thames from its source down to Tilbury including all its tributaries. The sewer network has overflows that discharge along the River Thames and its associated tributaries. The role of storm overflows in the network is to protect against property flooding from the sewerage system. Storm overflows, which may be augmented with settlement tanks, are employed to optimise the split between wastewater treatment and the management of rainfall. Storm separation is typically designed in accordance with regulatory guidance.

Aligned with our Drainage and Wastewater Management Plan (DWMP) approach, the Thames Water region has been split into River Basins, each contains a varying number of localised sewer networks. Taking this approach allows alignment to the different drivers in each river basin and provides and efficient way to investigate, tackle performance and protect the environment. This report covers the performance of the sewer networks within the Colne River Basin which are heavily influenced by groundwater infiltration into the network.

The Colne River Basin covers the upper reaches of the River Thames including its associated tributaries and streams. The river basin contains four heavily groundwater impacted Thames Water localised sewer systems that interact with various rivers and streams forming the tributaries to the River Thames. Each localised sewer system contains one or more storm overflows located at sewage treatment works (STW) and/or in the network. Figure 1 shows the relationship between the sewer systems and the associated rivers and streams. Figure 2 shows the location of each localised sewer system within the Colne River Basin with an insert showing the location of the Colne River Basin in relation to the Thames Water Region.

Sewer System	Associated River / Stream	Relationship to the River Thames
Berkhamsted STW	River Bulbourne	Indirect tributary of the River Thames via River Colne
Chesham STW	River Chess	Indirect tributary of the River Thames via River Colne
Maple Lodge STW	River Colne	Direct tributary of the River Thames
Markyate STW	River Ver	Indirect tributary of the River Thames via River Colne

Figure 1: Relationship of the Sewer Systems to Associated Rivers

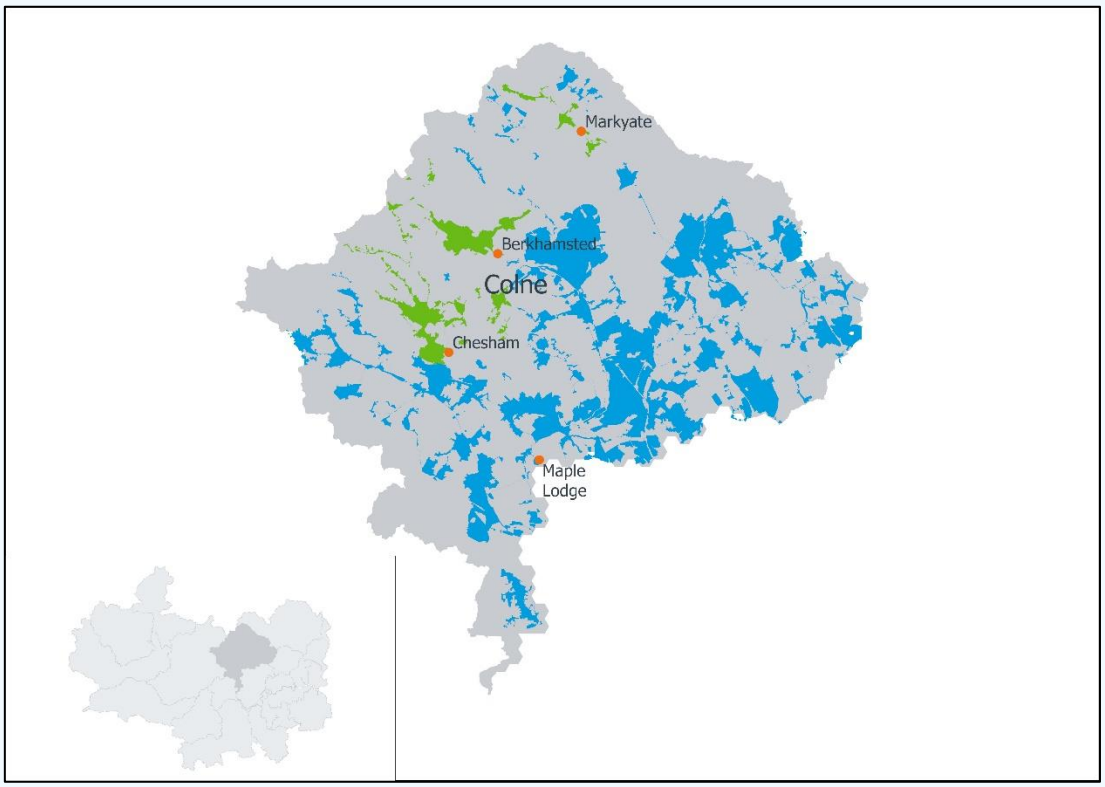

Figure 2: Location of Sewer Systems Within the Colne River Basin

Berkhamsted

Berkhamsted is located in the Bulbourne Valley, Hertfordshire, approximately 5 miles West of Hemel Hempstead.

This addendum provides an update on work undertaken in the hydrological year October 2024 to September 2025 for the Berkhamsted sewerage system. The key points covered include:

- Hydrological conditions
- Performance of the sewerage system
- Mitigation / remedial measures progressed over the last year

Figures 1 to 5 illustrate the relationship between rainfall and spills at CSOs. As shown in Figure 1, the decrease in rainfall from 2023/24 to 2024/25 correlates with reduced river levels (Figures 2 and 3), as well as a decline in the number and duration of CSO spills shown in Figure 5.

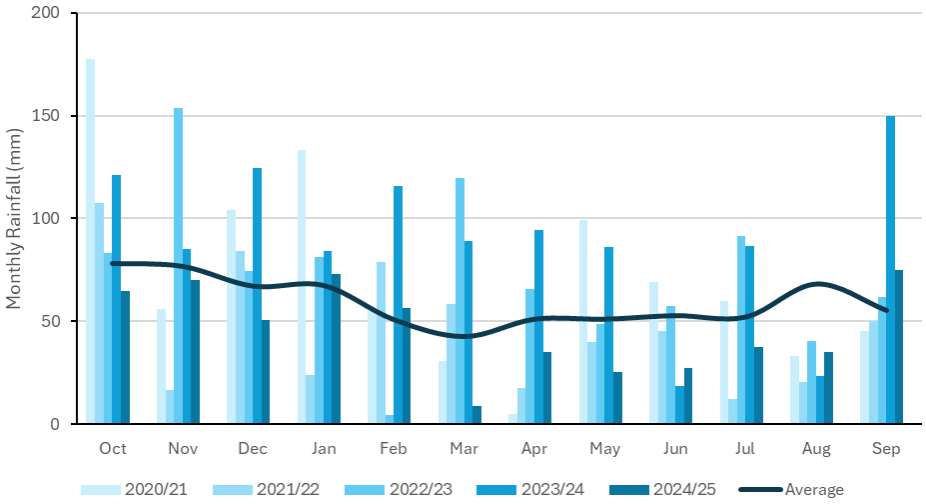

Figure 1: Monthly rainfall data 2020/21 to 2024/25

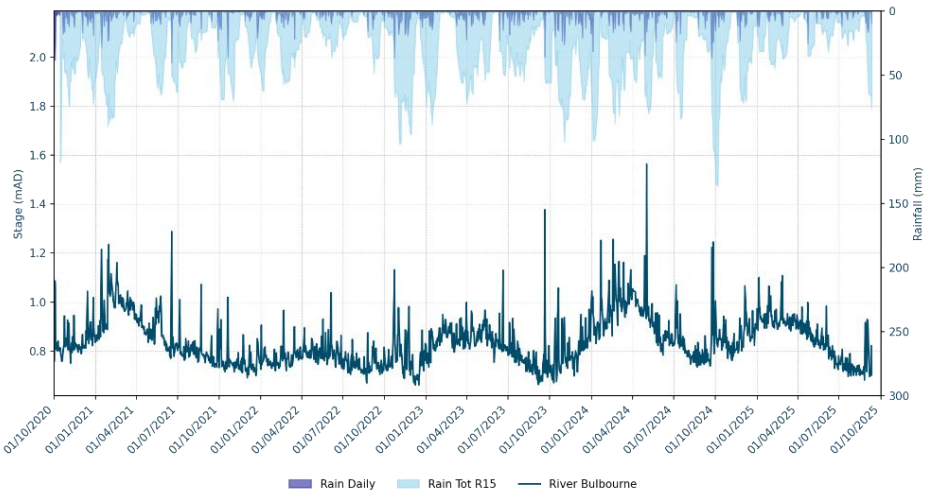

Figure 2: Rivel Level data for River Bulbourne, Hemel Hempstead, Old Fishery Lane

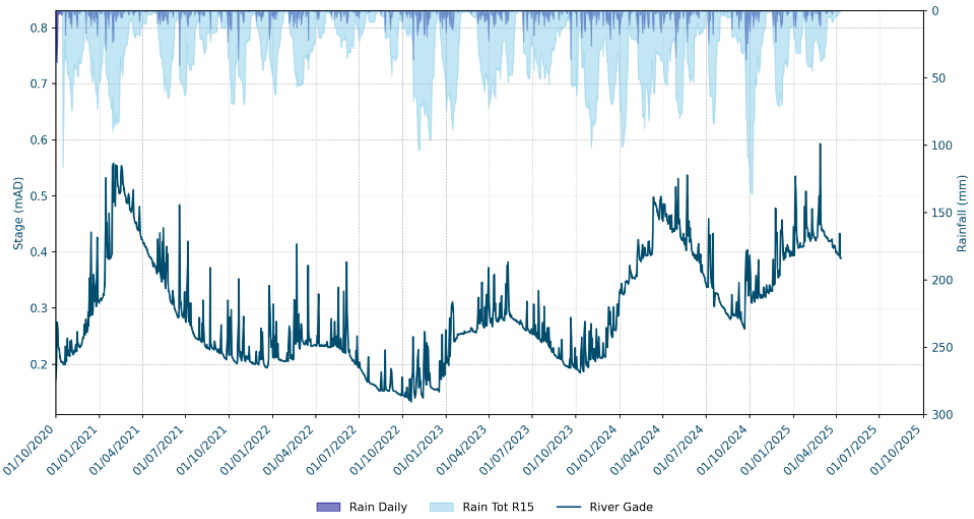

Figure 3: River Level data for River Gade Hemel Hempstead, Bury Mill

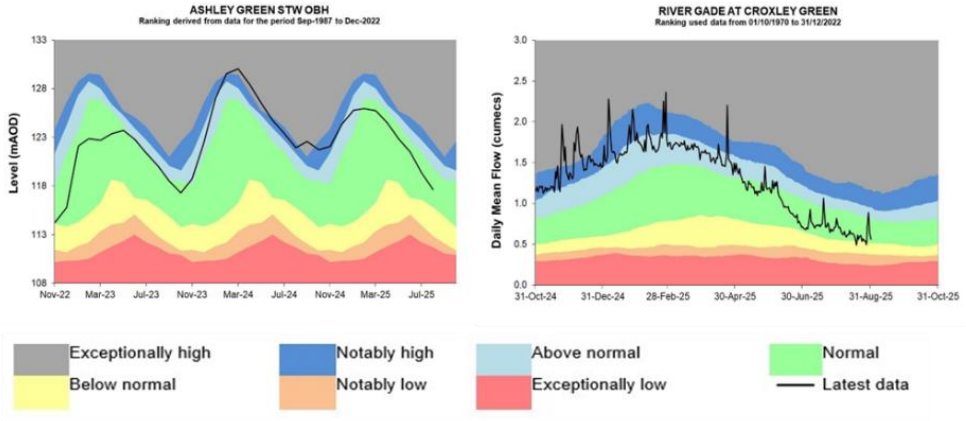

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Figure 4: Ground Water situation Report

Table 1 below details the last 2 years performance of overflows in the catchment. To assess EDM performance and its relation to groundwater infiltration, a review of the month-on-month spill performance in 2023 and 2024 against the monthly total rainfall values has been undertaken, as observed in Figure 5.

Event Duration Monitoring	2023		2024	
Overflow	Annual Spills	Duration (hours)	Annual Spills	Duration (hours)
Berkhamsted STW	33	227.25	157	1775.45

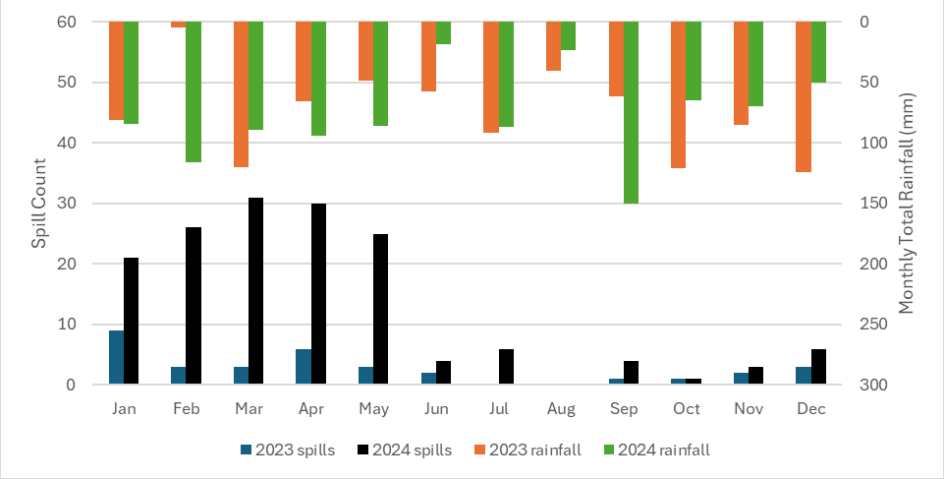

Figure 5: Monthly rainfall data versus monthly spill count for 2023 and 2024 – Berkhamsted STW

Table 2 below outlines the remediation works undertaken to address infiltration in the catchment, and enhancements to treatment works and/or pumping stations. Please note that this table only refers to work completed in the previous year.

Investigation / remediation type	2020/21	2021/22	2022/23	2023/24	2024/25
CCTV surveys	-	-	-	-	-
Look and lift surveys	-	-	-	-	-
Sewer lining	-	104m	-	-	-
Patch lining	-	-	-	-	-
Manhole sealing / plates / covers and frames replaced	-	3	-	-	-
ATAC unit deployment	-	-	-	-	-
Treatment Works / Pumping Station Upgrades	-	-	-	Increased STW capacity	Upgraded treatment processes

Summary

The groundwater and river level has increased in 2023/24 compared to previous years. This increase is due to higher average rainfall in 2024 compared to the average rainfall levels of the previous year. The number and duration of spills have increased in 2024 compared to 2023. The higher number of annual spills and river and groundwater levels could be a result of the increased rainfall in 2024 (seen in Figure 5).

To mitigate any potential spills that do not comply with government targets, Thames Water has introduced a scheme, completed in 2024, which provided upgraded treatment processes to increase the quality of treated effluent discharging into the river.

Chesham

Chesham is located in the Chiltern Hills, Buckinghamshire, 11 miles Southeast of the County town of Aylesbury.

This addendum provides an update on work undertaken in the hydrological year October 2024 to September 2025 for the Chesham sewerage system. The key points covered include:

- Hydrological conditions
- Performance of the sewerage system
- Mitigation / remedial measures progressed over the last year

Figures 1 to 5 illustrate the relationship between rainfall and spills at CSOs. As shown in Figure 1, there is decrease in rainfall from 2023/24 to 2024/25. However, river levels follow a similar pattern as previous year (Figures 2 and 3), along with a decline in both the number and duration of CSO spills shown in Figure 5.

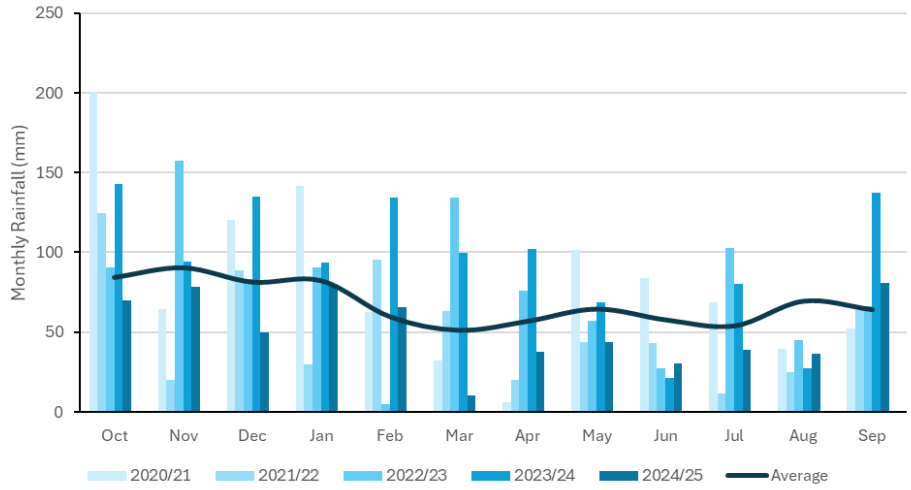

Figure 1: Monthly rainfall data 2020/21 to 2024/25

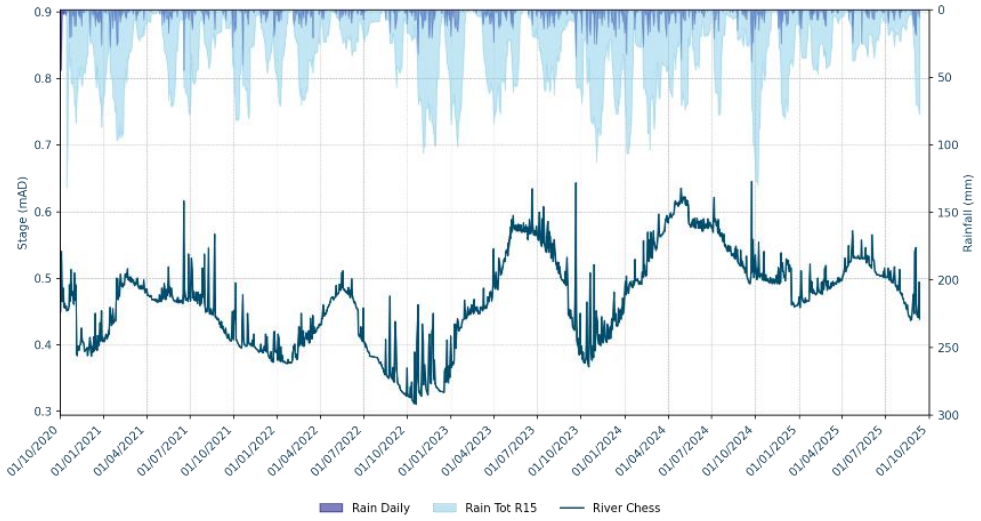

Figure 2: River Level data for River Chess, Chesham

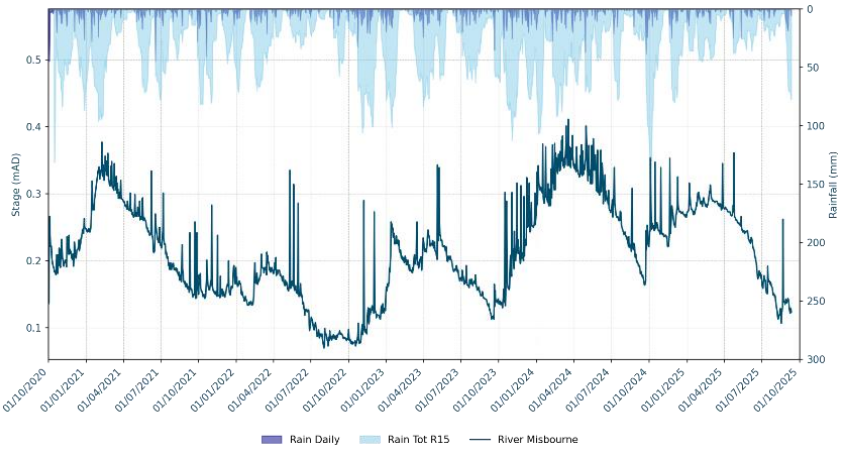

Figure 3: River Level data for River Misbourne, Missenden

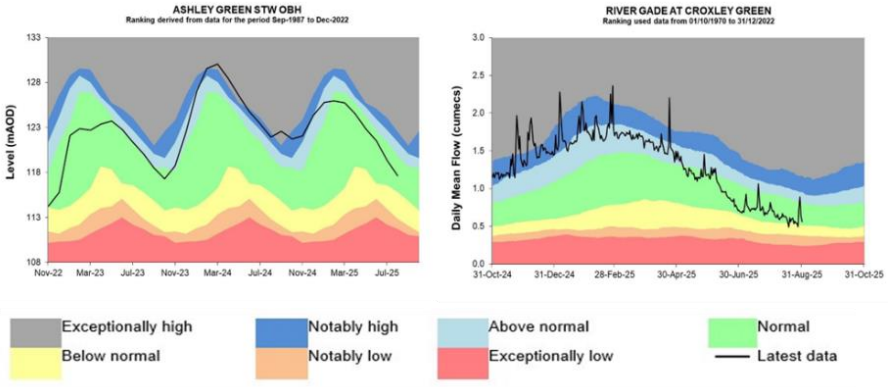

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Figure 4: Ground Water situation Report

Table 1 below details the last 2 years performance of overflows in the catchment. To assess EDM performance and its relation to groundwater infiltration, a review of the month-on-month spill performance in 2023 and 2024 against the monthly total rainfall values has been undertaken, as observed in Figure 5.

Event Duration Monitoring	2023		2024	
Overflow	Annual Spills	Duration (hours)	Annual Spills	Duration (hours)
Chesham STW	5	19.25	141	2681.15

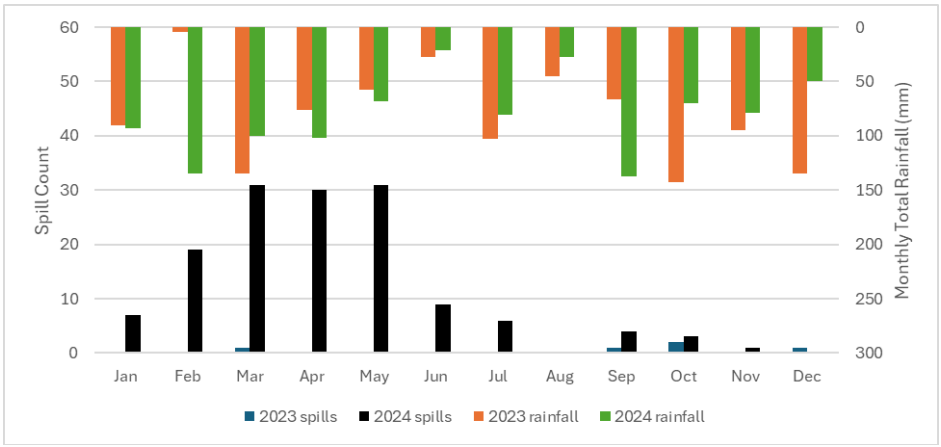


Figure 5: Monthly rainfall data versus monthly spill count for 2023 and 2024 – Chesham STW

Table 2 below outlines the remediation works undertaken to address infiltration in the catchment, and enhancements to treatment works and/or pumping stations. Please note that this table only refers to work completed in the previous year

Investigation / remediation type	2020/21	2021/22	2022/23	2023/24	2024/25
CCTV surveys	-	-	696m	1,000m	-
Look and lift surveys	-	-	34	12	550m
Sewer lining	104m	40m	-	-	-
Patch lining	3	-	-	-	-
Manhole sealing / plates / covers and frames replaced	-	287	470	-	-
ATAC unit deployment	-	-	-	-	-
Treatment Works / Pumping Station Upgrades	-	-	-	STW Upgraded	-

Summary

The groundwater and river level has increased in 2023/24 compared to previous years. This increase is due to higher average rainfall in 2024 compared to the average rainfall levels of the previous year. The number and duration of spills have increased in 2024 compared to 2023. The higher number of annual spills, river and groundwater levels could be a result of the increased rainfall in 2024 (seen in Figure 5). Following significant investment in the STW we are now in a stage of monitoring performance.

Maple Lodge

Maple Lodge is located in the Colne Valley, Hertfordshire, south of Rickmansworth.

This addendum provides an update on work undertaken in the hydrological year October 2024 to September 2025 for the Maple Lodge sewerage system. The key points covered include:

- Hydrological conditions
- Performance of the sewerage system
- Mitigation / remedial measures progressed over the last year

Figures 1 to 7 illustrate the relationship between rainfall and CSO spills. As shown in Figure 1, the reduction in rainfall from 2023/24 to 2024/25. However, river levels follow a similar pattern as previous year (Figures 2 to 5), along with a decline in both the number and duration of CSO spills shown in Figure 7.

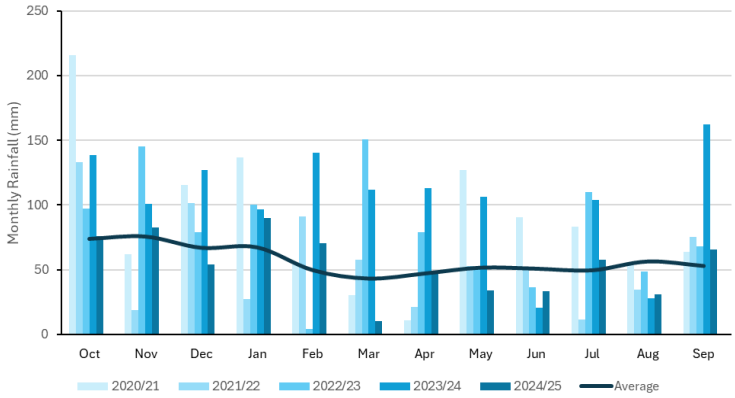
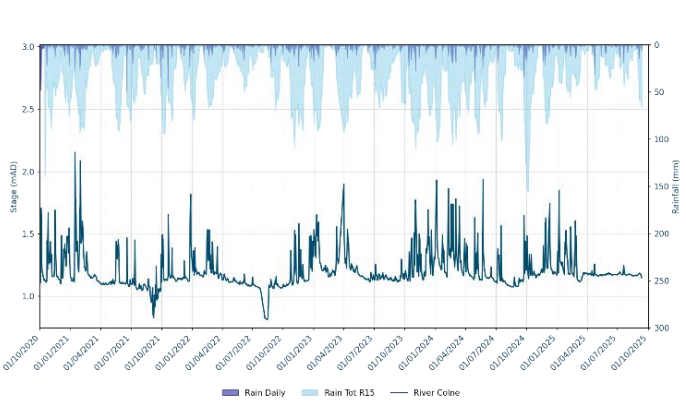


Figure 1: Monthly rainfall data 2020/21 to 2024/25



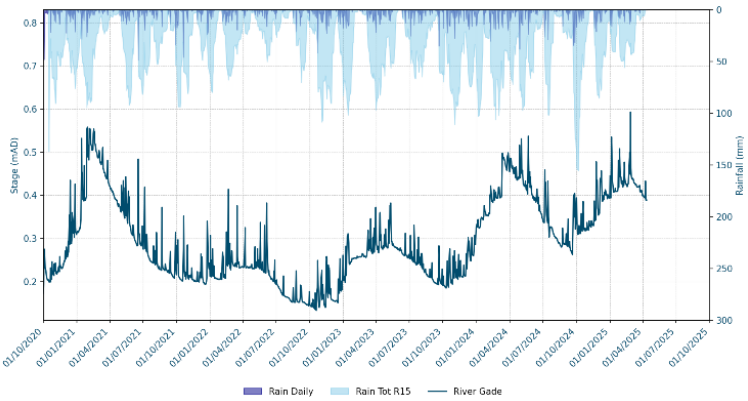
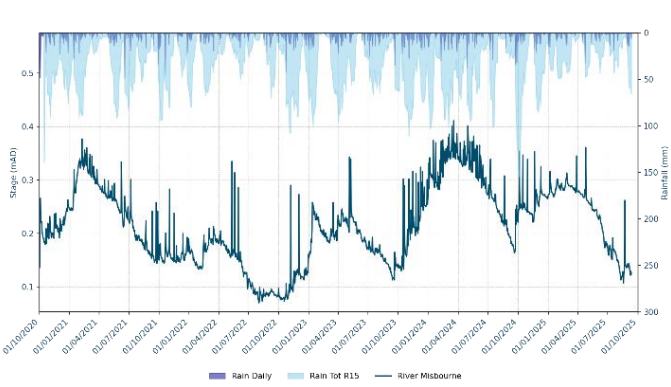


Figure 2: River Level data for River Colne, London Colney / Figure 3: River Level data for River Gade, Hemel Hempstead, Bury Mill



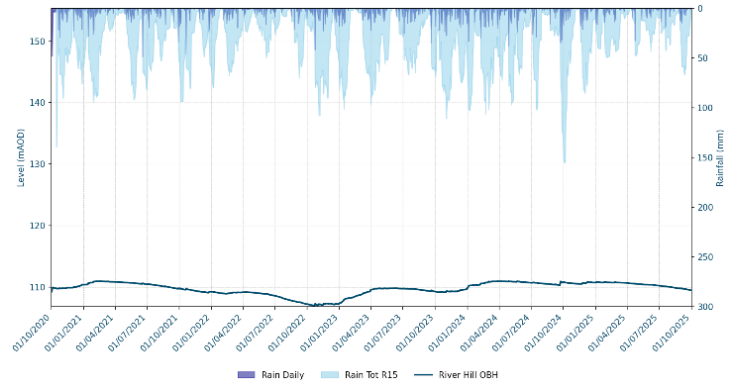


Figure 4: River Level data for River Misbourne, Missenden / Figure 5: River Level data for River Hill OBH

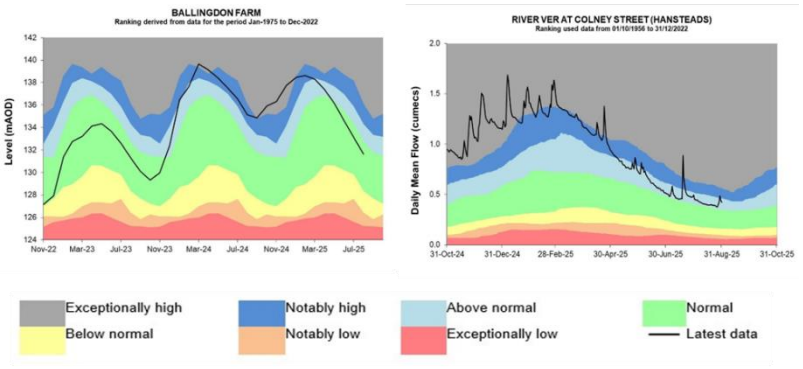


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Figure 6: Ground Water situation Report

Table 1 below details the last 2 years performance of overflows in the catchment. To assess EDM performance and its relation to groundwater infiltration, a review of the month-on-month spill performance in 2023 and 2024 against the monthly total rainfall values has been undertaken, as observed in Figure 7.

Event Duration Monitoring	2023		2024	
Overflow	Annual Spills	Duration (hours)	Annual Spills	Duration (hours)
Maple Lodge STW STK8/STK9	52	650.5	124	1916.15

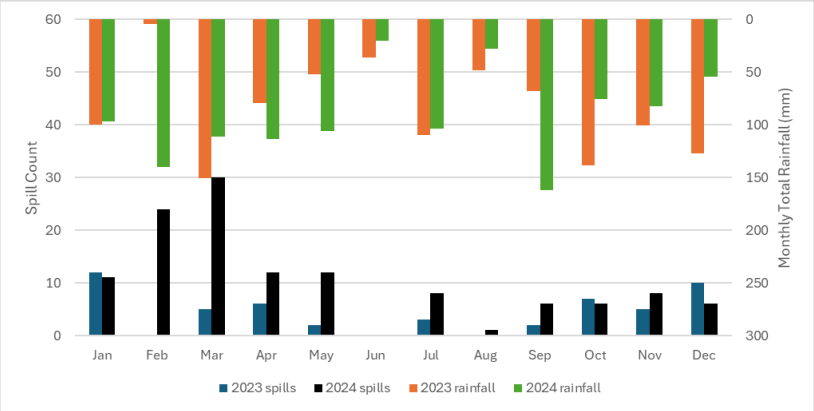

Figure 7: Monthly rainfall data versus monthly spill count for 2023 and 2024– Maple Lodge STW

Table 2 below outlines the remediation works undertaken to address infiltration in the catchment, and enhancements to treatment works and/or pumping stations. Please note that this table only refers to work completed in the previous year.

Investigation / remediation type	2020/21	2021/22	2022/23	2023/24	2024/25
CCTV surveys	-	-	-	408m	1,606m
Look and lift surveys	-	-	2	-	-
Sewer lining	-	90m	-	-	-
Patch lining	-	-	-	-	-
Manhole sealing / plates / covers and frames replaced	-	18	-	-	29
ATAC unit deployment	-	-	-	-	-

Summary

The groundwater and river level has increased in 2023/24 compared to previous years. This increase is due to higher average rainfall in 2024 compared to the average rainfall levels of the previous year. The number and duration of spills for STK9 and STK8 have increased in 2024 compared to 2023. The higher number of annual spills, river and groundwater levels could be a result of the increased rainfall in 2024 (seen in Figure 5).

To mitigate any potential spills that do not comply with government targets, Thames Water is upgrading the sewer system to ensure a higher quality of treated effluent going to the river. The upgrade work relates to the work at Amersham storm tanks to build in additional filtration at this location before spills to the watercourse.

Markyate

Markyate is located in north-west Hertfordshire, approximately 3 miles southwest of Luton.

This addendum provides an update on work undertaken in the hydrological year October 2024 to September 2025 for the Markyate sewerage system. The key points covered include:

- Hydrological conditions
- Performance of the sewerage system
- Mitigation / remedial measures progressed over the last year

Figures 1 to 5 illustrate the relationship between rainfall and CSO spills. As shown in Figure 1, the decrease in rainfall from 2023/24 to 2024/25. However, River levels follow a similar pattern as previous year (Figures 2), along with a decline in both the number and duration of CSO spills shown in Figure 5.

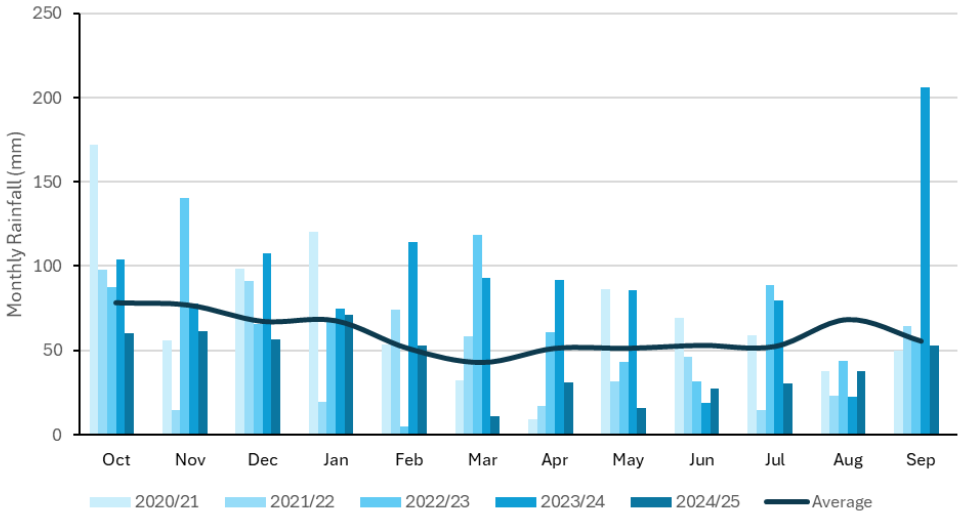

Figure 1: Monthly rainfall data 2020/21 to 2024/25

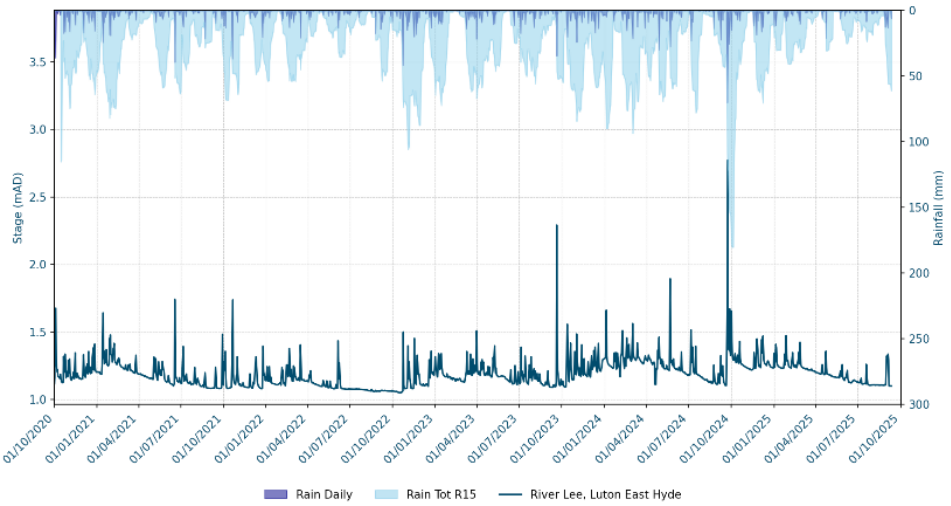

Figure 2: River Level data for River Lee, Luton East Hyde

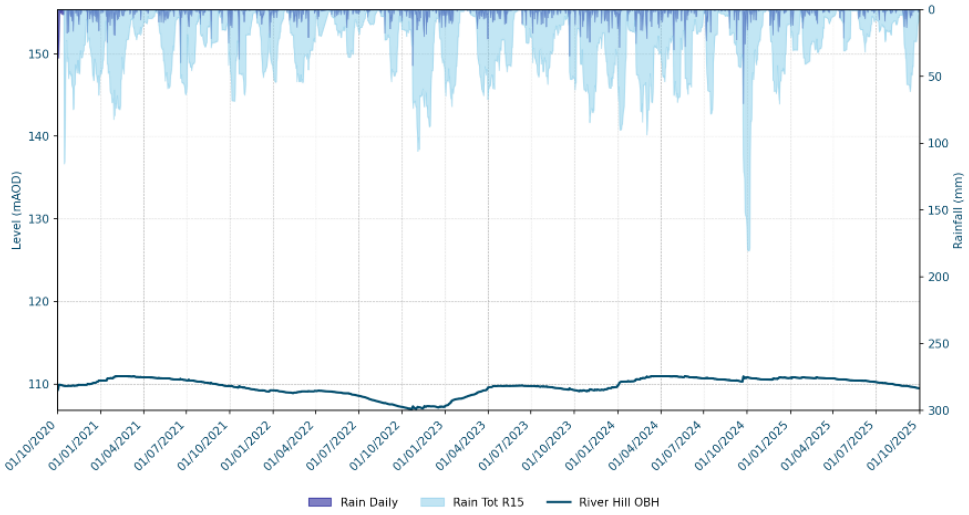

Figure 3: River Level data for River Hill OBH

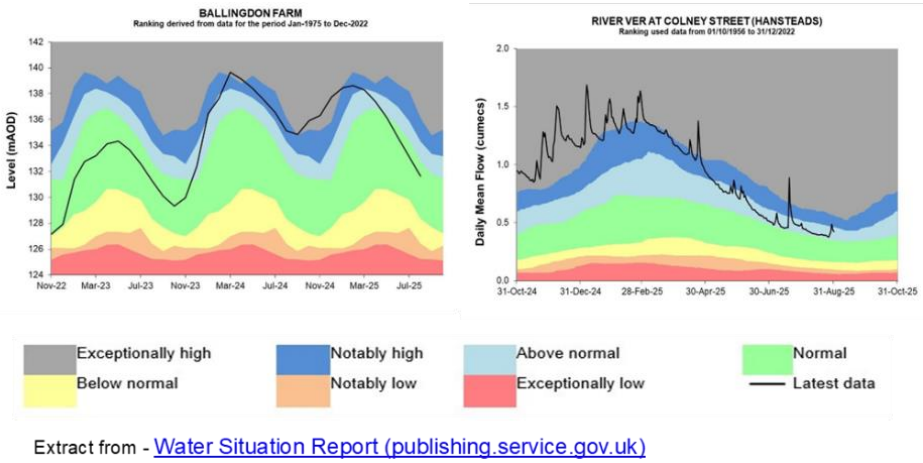

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Figure 4: Ground Water situation Report

Table 1 below details the last 2 years performance of overflows in the catchment. To assess EDM performance and its relation to groundwater infiltration, a review of the month-on-month spill performance in 2023 and 2024 against the monthly total rainfall values has been undertaken, as observed in Figure 5.

Event Duration Monitoring	2023		2024	
Overflow	Annual Spills	Duration (hours)	Annual Spills	Duration (hours)
Markyate STW	4	10	187	3383

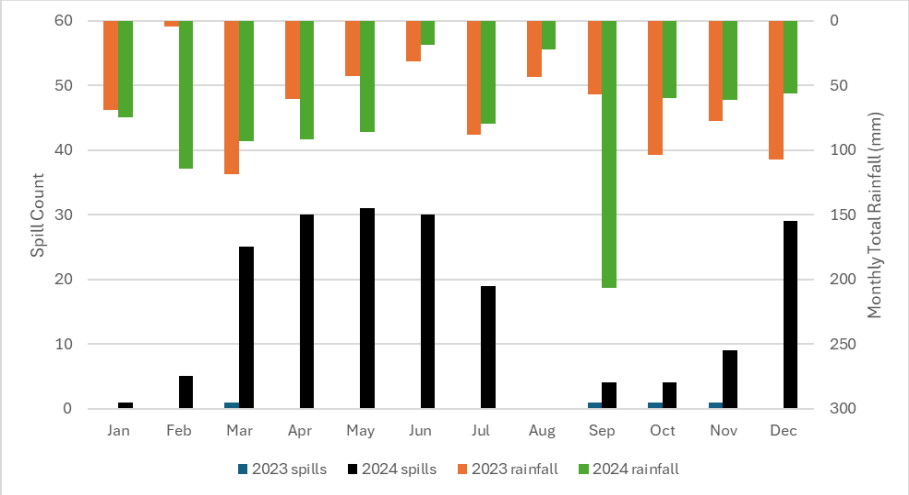

Figure 5: Monthly rainfall data versus monthly spill count for 2023 and 2024– Markyate STW

Table 2 below outlines the remediation works undertaken to address infiltration in the catchment, and enhancements to treatment works and/or pumping stations. Please note that this table only refers to work completed in the previous year.

Investigation / remediation type	2020/21	2021/22	2022/23	2023/24	2024/25
CCTV surveys	-	-	294m	-	-
Look and lift surveys	-	-	-	-	-
Sewer lining	-	-	-	-	-
Patch lining	-	-	-	-	-
Manhole sealing / plates / covers and frames replaced	-	2	-	-	-
Tankering undertaken	-	-	-	-	Tankering undertaken in 2024
ATAC unit deployment	-	-	-	-	-

Summary

A review of river level data over 2023/24 shows a similar pattern being followed compared to previous years. However, groundwater levels have increased in 2023/24 compared to previous years. This increase is due to higher average rainfall in 2024 compared to the average rainfall levels of the previous year. The number and duration of spills have increased in 2024 compared to 2023. The higher number of annual spills and groundwater levels could be a result of the increased rainfall in 2024 (seen in Figure 5).

However, months March to July 2024 (Figure 5) show no strong correlation between rainfall and number of spills as spill count stays at an average of 30 spills throughout that period, while rainfall decreases significantly in some months. We can deduce that rivel levels have a correlation with the number of spillages, as the highest number of spillages happened during a period of high river levels (see Figure 2 & 3). Tankering has been undertaken at the STW during 2024 due to high groundwater levels.

Strategic level improvements to the sewer network identified as part of the GISMP approach, to reduce infiltration, are currently being undertaken and are due to be completed in AMP8. These works include sealing 97 manholes and replacing 44 standard manhole covers and frames, in locations where rainwater can potentially accumulate with leak tight covers and frames. The works also include sealing an estimated 6.1km of sewers with “Leak Tight” Cured in Place Pipelining in locations where the risk of high ground water levels has been identified.


Thames
Water