Groundwater Impacted System Management Plan

Silchester, Silchester Brook

November 2021

Thames Water

It's everyone's water

Version control

Version	Date	Amendment	Author	Checked	Reviewed
1-d1	29/10/2021	Draft for EA	SS/NW	AJ	SE
1-v1	19/11/2021	Verion 1	SS/NW	SE	DJ
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

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 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 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 'find and 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 Silchester catchment

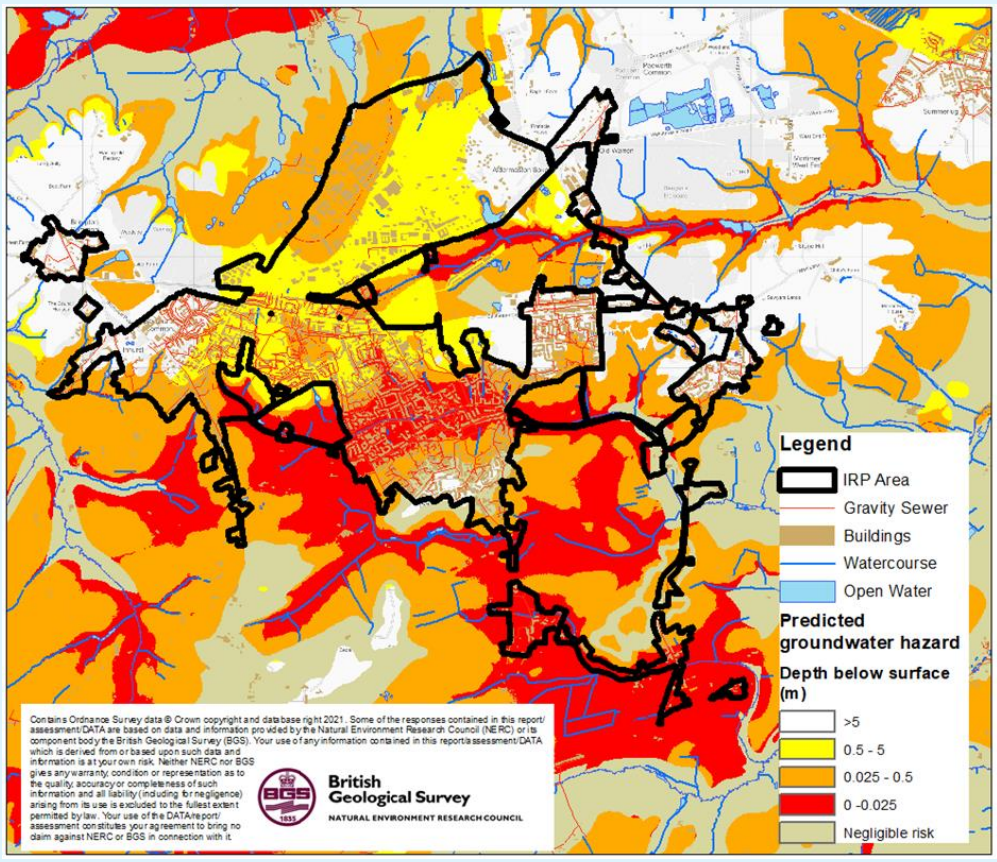


Figure 1.0 – Silchester catchment

Silchester is located in Hampshire, England, approximately 9 miles south-west of Reading. Silchester serves a population equivalent[3] of 18,842 with a predominantly separate sewerage network totaling some 190 km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above.

Problem characterisation

Groundwater has potential to enter our sewers when levels are high and a positive head above the soffit of the sewer is created. Significant groundwater ingress can impact sewer capacity and increase the risk of the network becoming overwhelmed.

There's a strong link between the rising river levels related to rising groundwater levels and the increased flows seen within the sewerage network and at the Sewage Treatment Works.

[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.

The sewerage system is identified on the public sewer records as being a largely separate foul system, rather than a combined system. It should therefore, in theory, only be accepting foul drainage rather than the combination of foul and surface water, however, there are a limited number of public surface water sewers in the area.

We believe that significant volumes of surface water runoff from surrounding saturated fields and built-up land have entered the foul sewerage network during recent wet winters, causing the network to become overloaded and surcharge (mainly through submerged manholes).

The surveys we have carried out have detected that there is some evidence of unwanted flows in the foul sewer network when groundwater levels are high, and surface water inundation from highways, public spaces and properties and fluvial flooding from local watercourses. Surface water misconnections (i.e. down pipes from roofs into the sewer network) are also suspected to be a contributing factor, hence further analysis is required to determine the extent to which this has contributed to sewer flooding.

A number of our sewerage systems include for overflows, these structures are there to protect against sewer flooding as a result of rainfall or equipment failure where appropriate. Discharges from these structures should not be impacted by excessive infiltration as detailed by the EA Regulatory Position Statement on groundwater impacted sewerage systems. The use of storm sewage overflows is accepted by our regulators, subject to conditions.

Our permit conditions for Silchester 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 snow melt." and "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 Basingstoke and Deane District Council as Lower Tier 1 and Hampshire County Council as the Higher Tier Council, Lead Local Flood Authority and Planning Authority, in addition to 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

Within recent years there have been unavoidable sewage escapes in the network as a result of surcharging manholes causing pollution.

We anticipate that this situation may continue until such time we are able to implement a long-term solution.

No mitigation in the form of temporary overflows has been undertaken in this system.

General outline plan & timescale

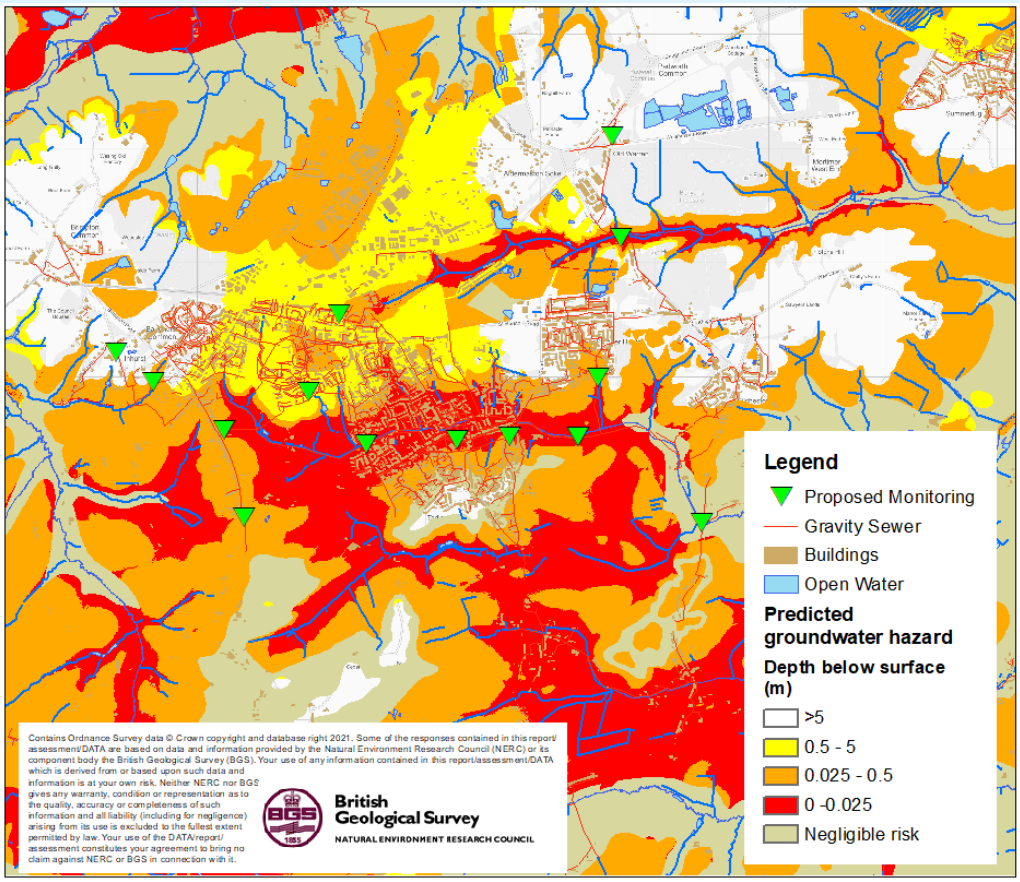


Figure 2.0 – Silchester monitoring plan area and infiltration zones

Key to bringing the impact of groundwater infiltration under control is an enhanced monitoring regime. We have identified zones and areas over which telemetered depth monitoring will be installed. Figure 2.0 presents a plan of currently proposed installation locations.

Complimenting 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 Silchester 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 will be 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 Silchester.

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 (zones) to be targeted for sealing in the 56 systems identified as being impacted by infiltration in the Thames Water region.
Install monitors	2021-2023	Monitor plans are being developed 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 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 will 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	2025-2030	Sealing of high-risk zone undertaken subject to need being demonstrated.

Silchester Infiltration Management Plan

As detailed above the impact of infiltration is experienced in the network and at the STW.

Our approach to the resolution of infiltration impacting the Silchester sewerage system is outlined below.

High level approach statement

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

1. We will investigate the network further with a view to identifying sources of ingress of infiltration that are cost effective[5] to address. To investigate the network, we have:

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

To investigate the network, we will:

- Install monitoring to back up the analysis and to aide focusing of locations for identification of infiltration (2021 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).

We will also review results of Winter 2019/20 and 2020/21 with historic data to build up evidence to support interventions in the network (Autumn 2021).

2. Where interventions can be undertaken as part of normal sewer maintenance activities these will be communicated and progressed.

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] 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 Dene-Tech and our Customer Field Services (Thames Water Operations) will include '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 will be installed in the catchment in between 2021 and 2023. 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. They will also 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 Silchester we do not envisage needing to undertake mitigation work beyond tankering 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.

Risk category	Description	Length (km)	Percentage
High	Predicted groundwater extreme >1m above pipe invert	45.75	49.6
Medium	Predicted groundwater extreme 0-1m above pipe invert	8.51	9.2
Low	Predicted groundwater extreme 0-1m below pipe invert	5.87	6.4
Very Low	Predicted groundwater extreme >1m below pipe invert	32.18	34.9
Total		92.31[6]	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	160	5.6
Medium	Inundation risk in 1% AEP fluvial or pluvial event	89	3.1
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	345	12.1
Very Low	All other manholes	2267	79.2
Total		2861	100.0

[6]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

Lift and Look and CCTV surveys have not yet commenced in the Silchester system. A summary of findings will be provided in the next update of this 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 2022

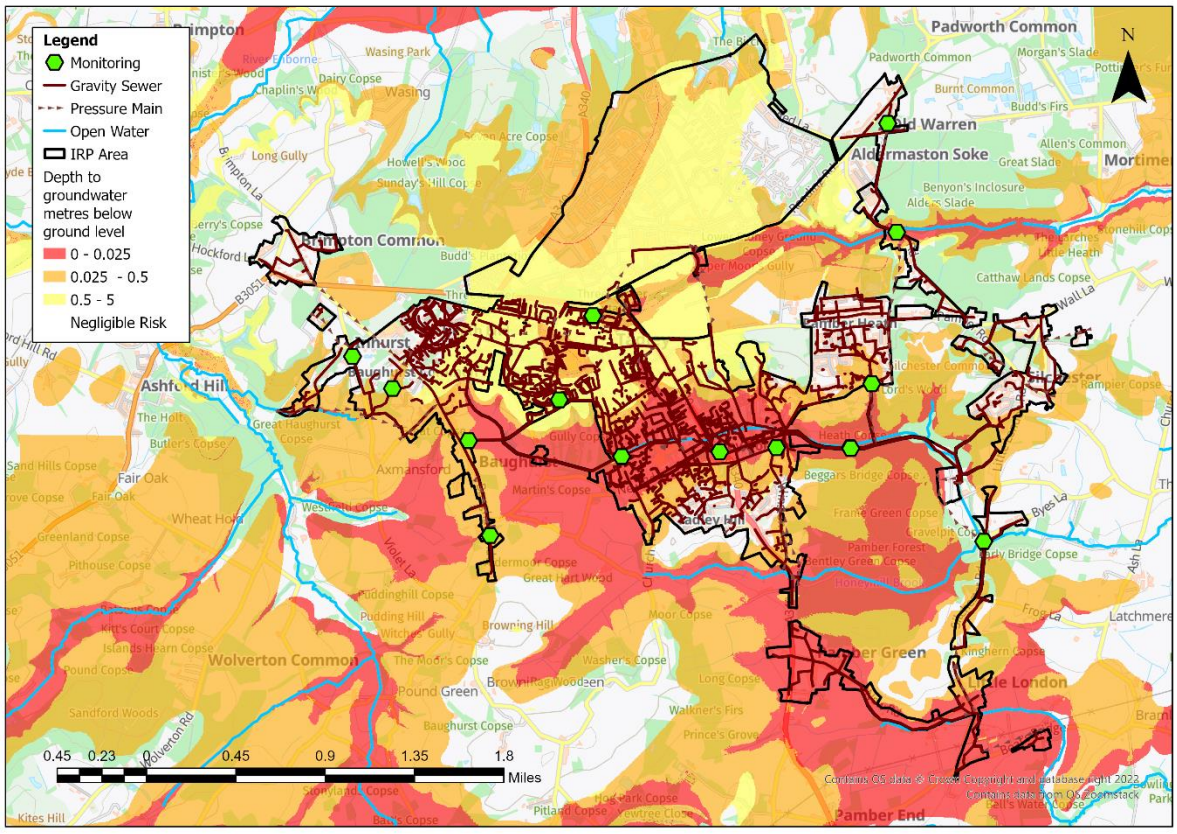
Table of contents

Overview

This addendum to the Silchester 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 – Silchester Monitoring Plan



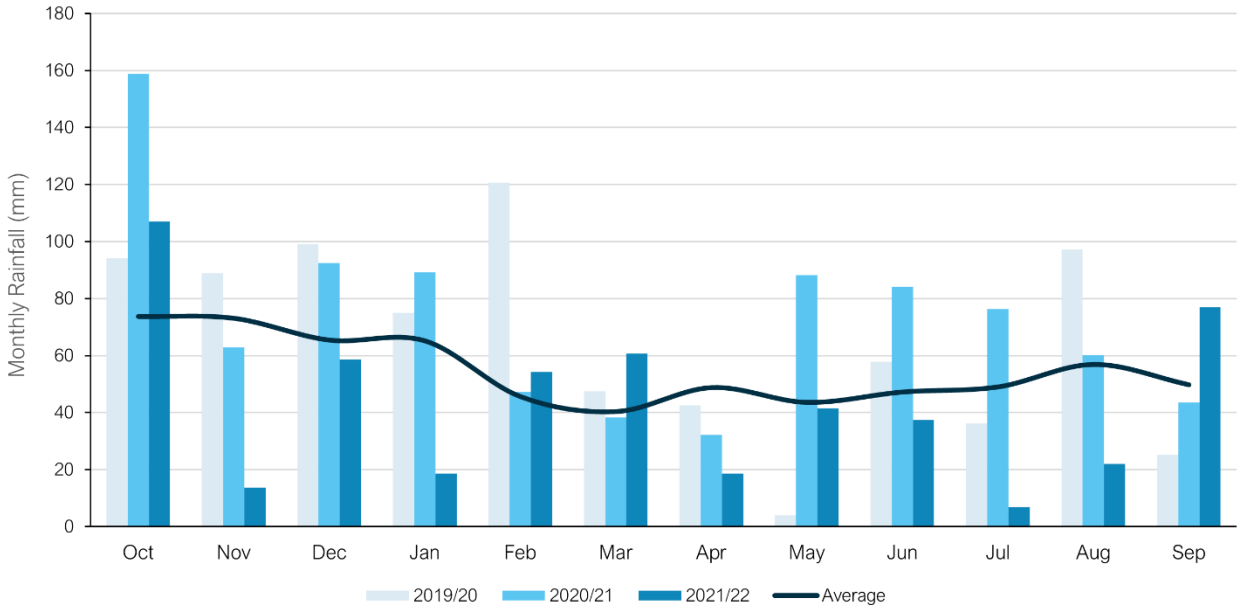
Hydrological Review – 2021-2022

This section summarises the hydrological conditions within the Silchester 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 Reading University based on the period 1991-2020

The total rainfall for the 2021/22 hydrological year is 21% 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)
658	788	873	521

Groundwater / Local River Level

The Silchester catchment is situated in the Enborne and Loddon water resources area. It sits in the sedimentary bedrock of the London Clay formation of sand; the London Clay formation of clay, silt, and sand; and the Windlesham formation of sand, silt and clay. The Silchester catchment is not part of a designated principal aquifer within the UK.

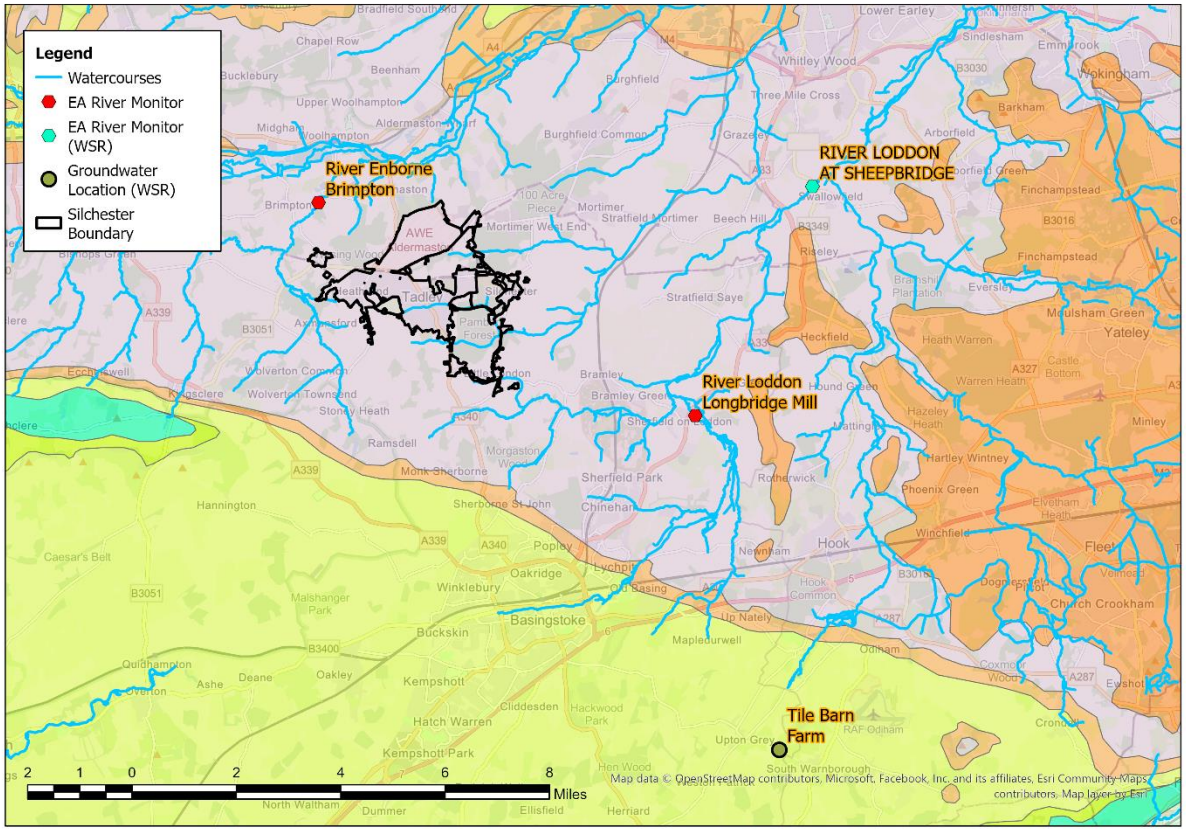
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

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

- River Enborne, Brimpton.
- River Loddon, Longbridge Mill.

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 Enborne, Brimpton

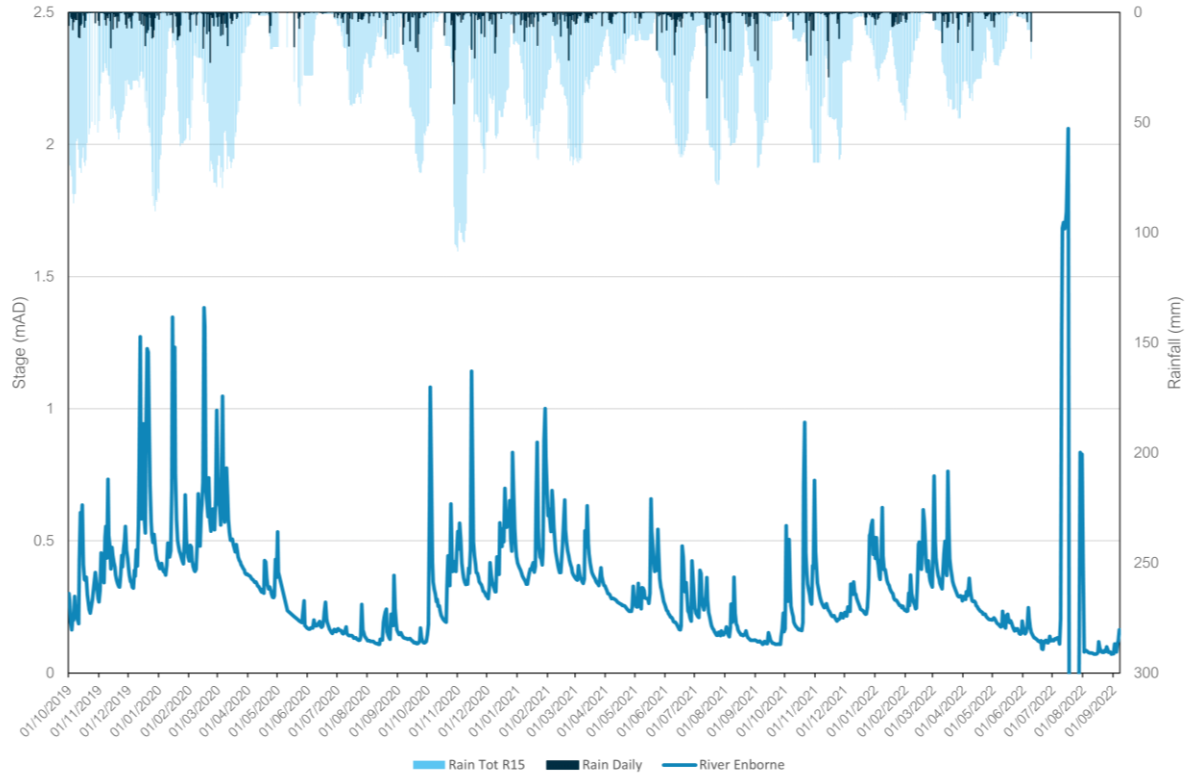
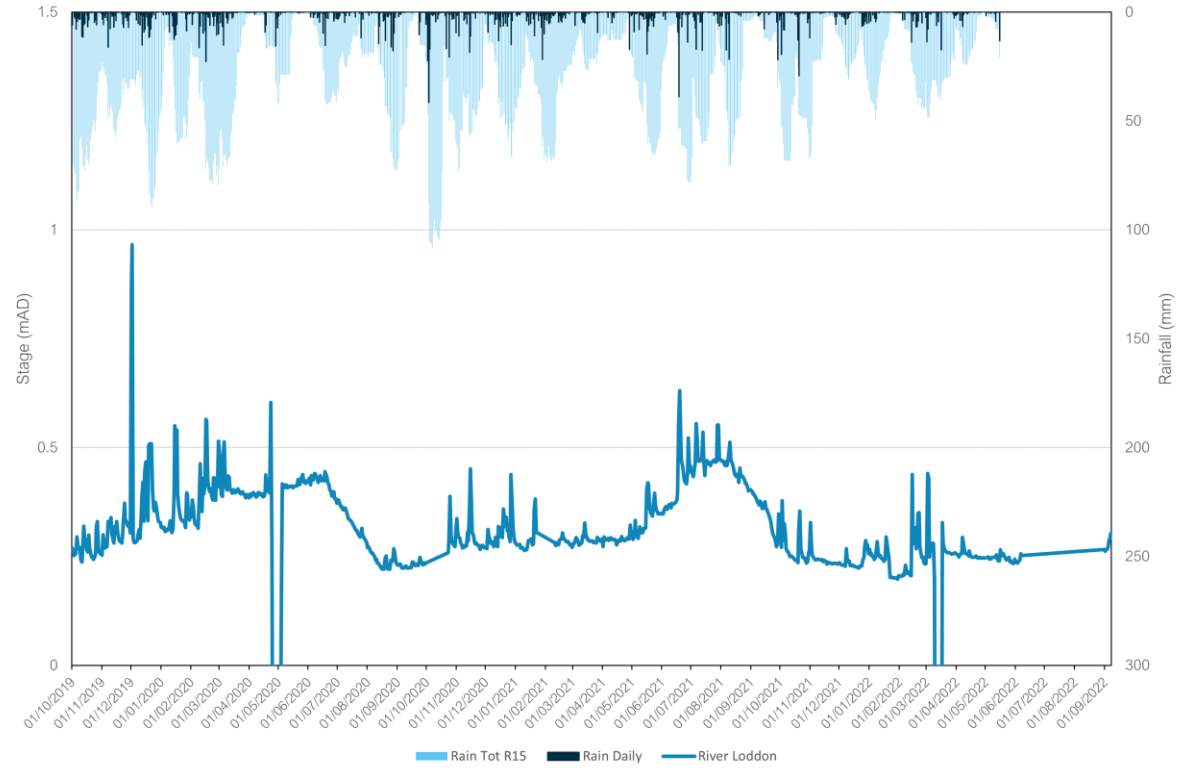
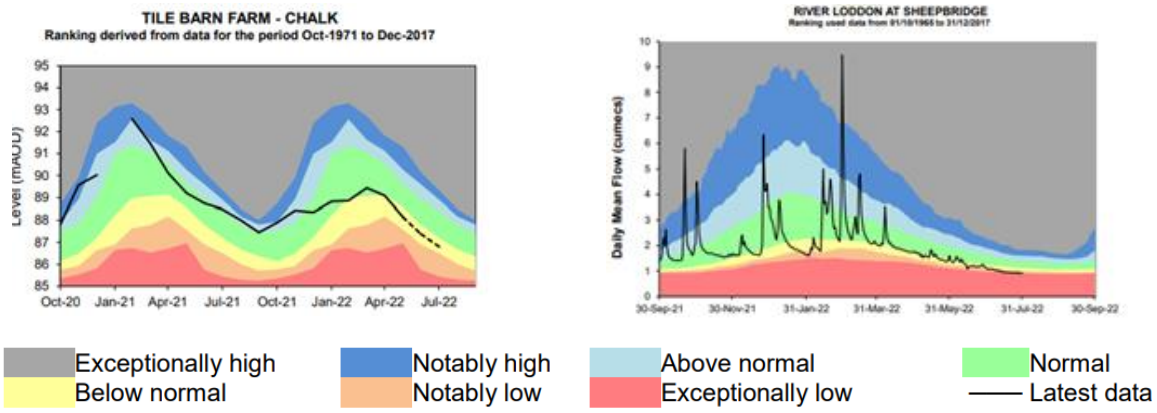


Figure 5B – River Loddon, Longbridge Mill.



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for Enborne and Loddon. The nearest groundwater reference station is Tile Barn Farm. This site shows significantly lower overall groundwater than the previous year. This can be seen in the figure below alongside the river indicator Sheepbridge on the River Loddon. Note recent groundwater levels at Tile Barn Farm have been estimated based on nearby boreholes due to site monitoring issues.

Figure 6 – Water Situation Report



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

Network Performance

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

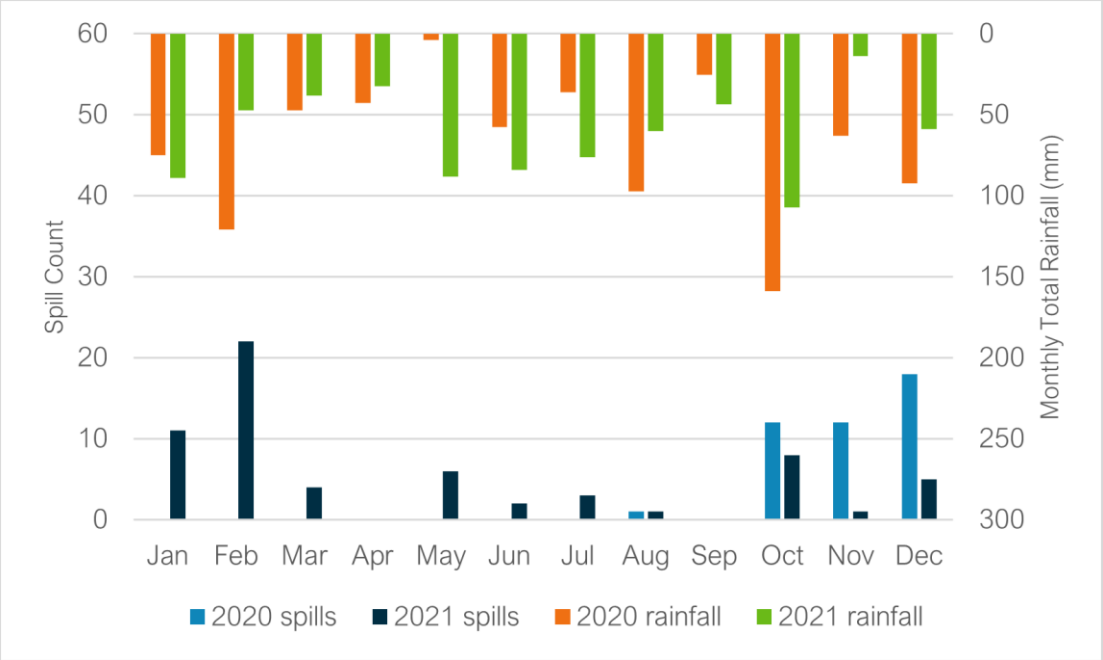
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2020		2021	
	Spills	Duration (hours)	Spills	Duration (hours)
Silchester STW	43	828.18	63	968.32

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. It should be noted that 2020 was the first year of EDM reporting, and that reporting therefore is from April 2020 onwards. 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 autumn and winter months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. Despite broadly similar rainfall, significantly more spills were recorded at Silchester STW in December 2020, compared to December 2021. The indicator sites suggest groundwater levels in the catchment were higher in December 2020.

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 10 monitors installed within the Silchester catchment. There are currently 5 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 Silchester 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	N/A
Manhole sealing plates	N/A
Manhole covers and frames replaced	N/A

With the seasonal trends in groundwater being low in comparison with previous years and the SDM installations ongoing, the larger scale survey, identification and remediation of the sewerage network has not been possible within the 2021/2022 hydrological year.

Summary

Rainfall in the Silchester catchment over the 2021/22 hydrological year has been below average, with groundwater levels in the aquifer beneath Silchester not reaching the levels seen in previous years which triggered groundwater ingress into the sewerage network and elevated flow/depth readings at monitoring sites. This is indicated by the lower number of EDM spills recorded at Silchester STW in December 2021, compared to December 2020, when the indicator sites suggest groundwater levels in the catchment were higher.

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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Table of contents

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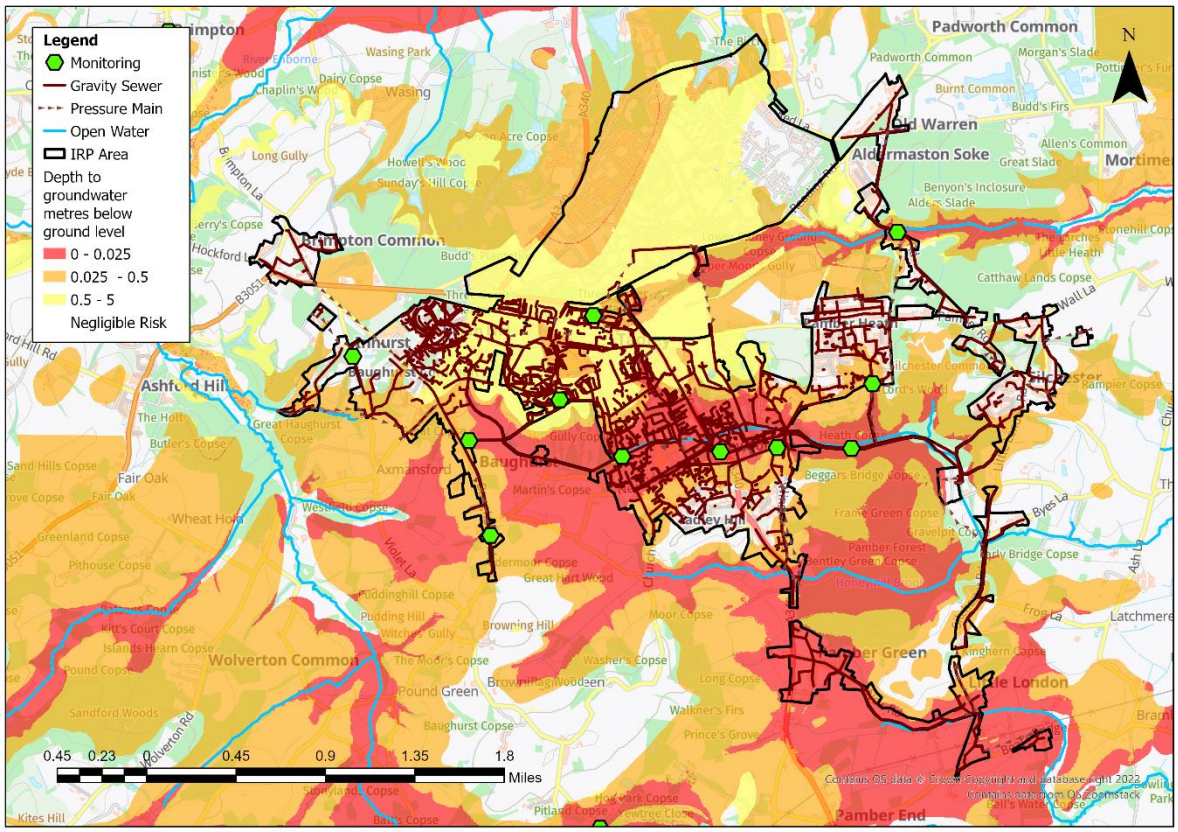

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Representative Radar rainfall has been used to generate monthly data at catchment level for comparison with average data generated by local Met Office Weather Station Records. Figure 2 presents the comparison of this data for the last four hydrological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

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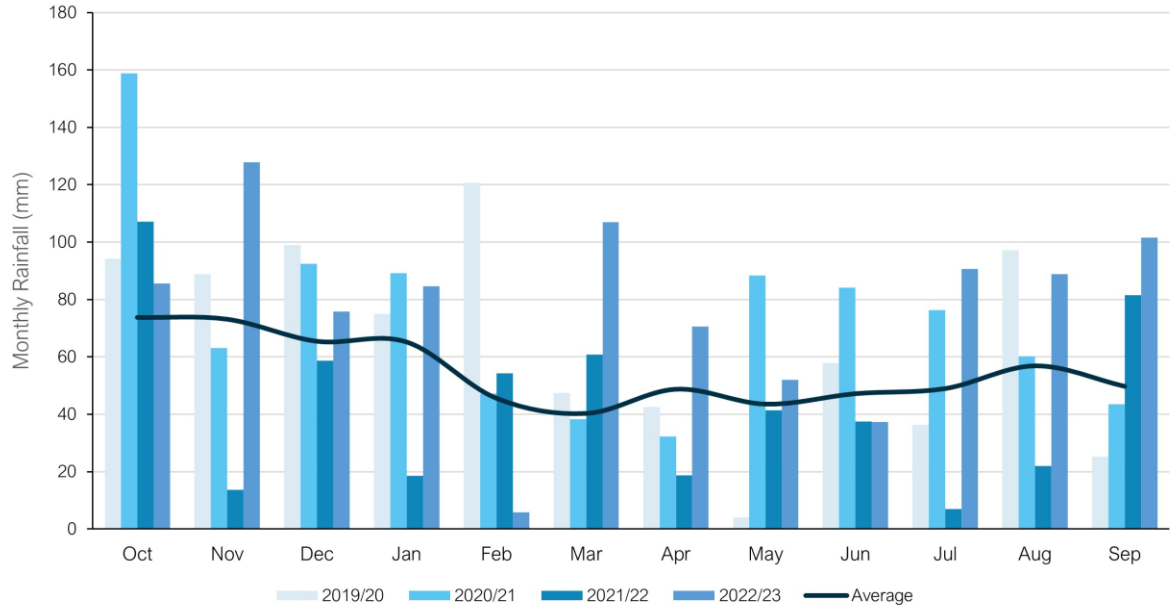

Average Values taken from Met Office Weather Station at Reading University based on the period 1991-2020

The total rainfall for the 2022/23 hydrological year is 41% above the annual average total. Total rainfall values are presented in Table 3 below.

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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 are good indicators of groundwater levels within the catchment.

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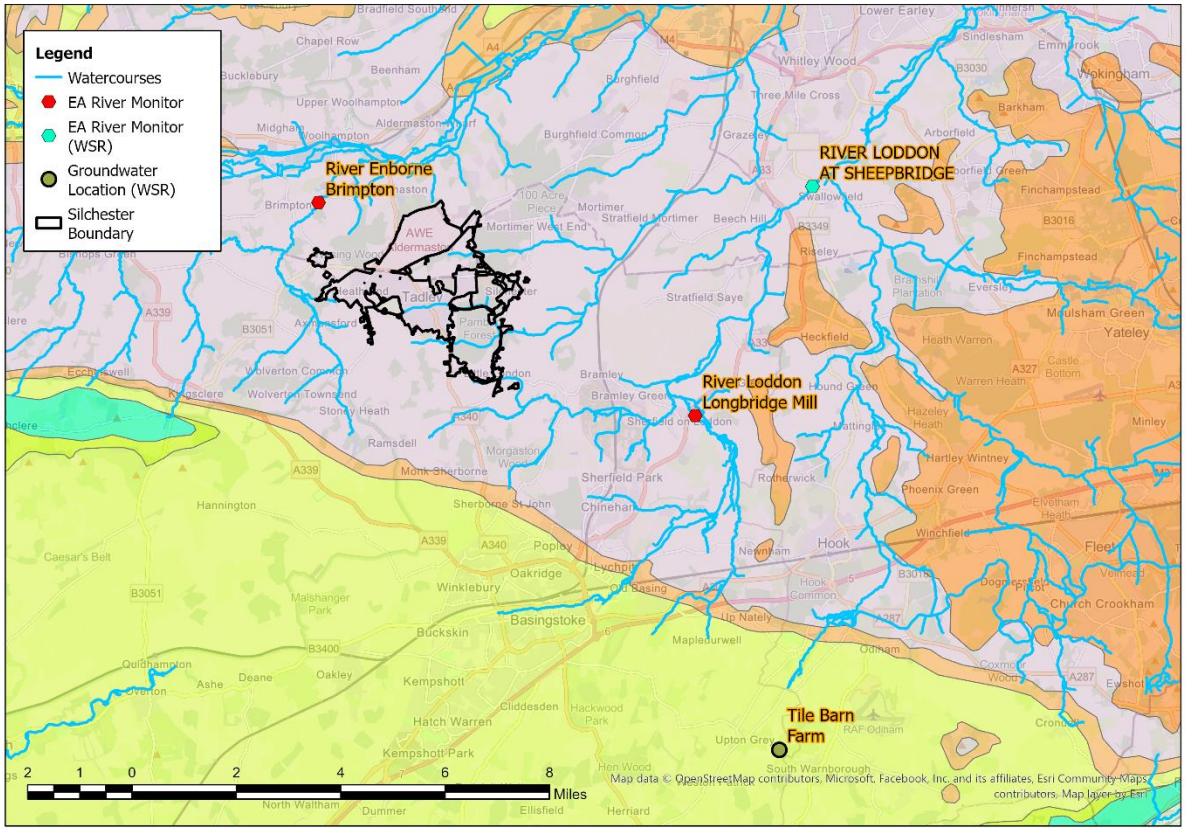
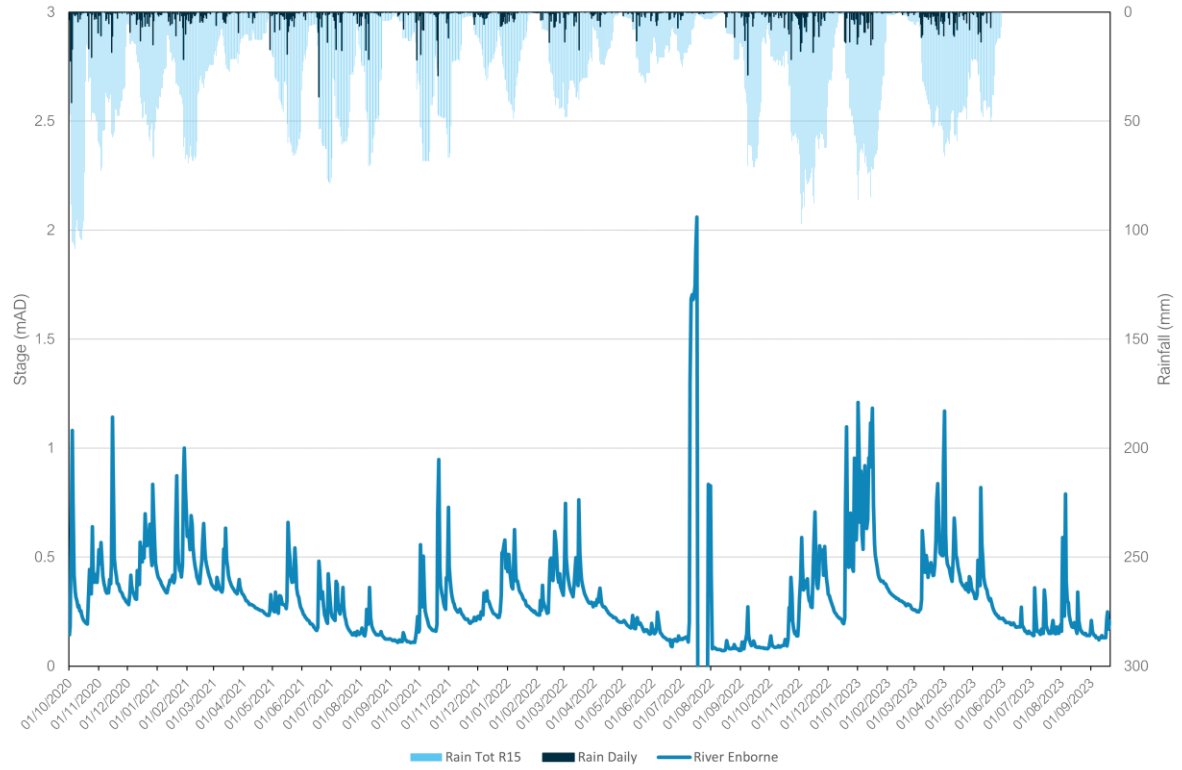


The following figures represent the last three hydrological years of level information at the indicator sites to build a picture of the relative conditions prevalent in the current year. It is presented against both the daily total rainfall values for the catchment and a rolling 15-day total rainfall.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

Figure 5A – River Enborne, Brimpton



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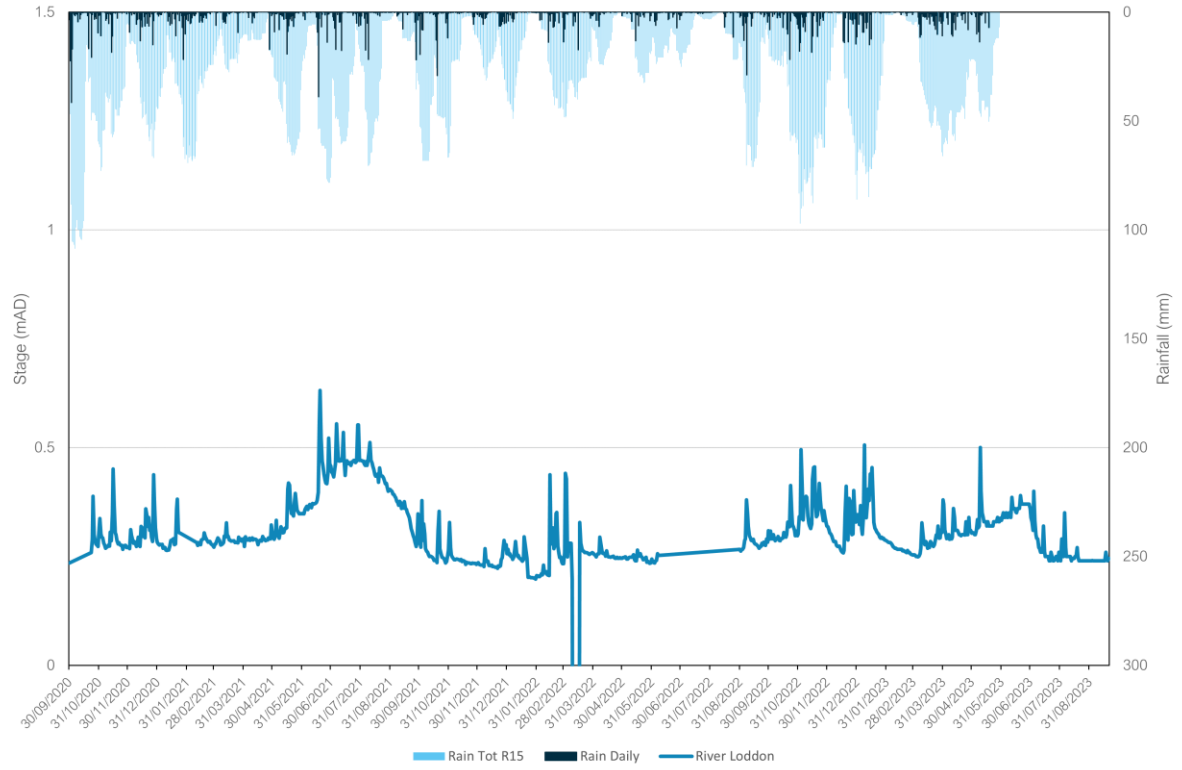
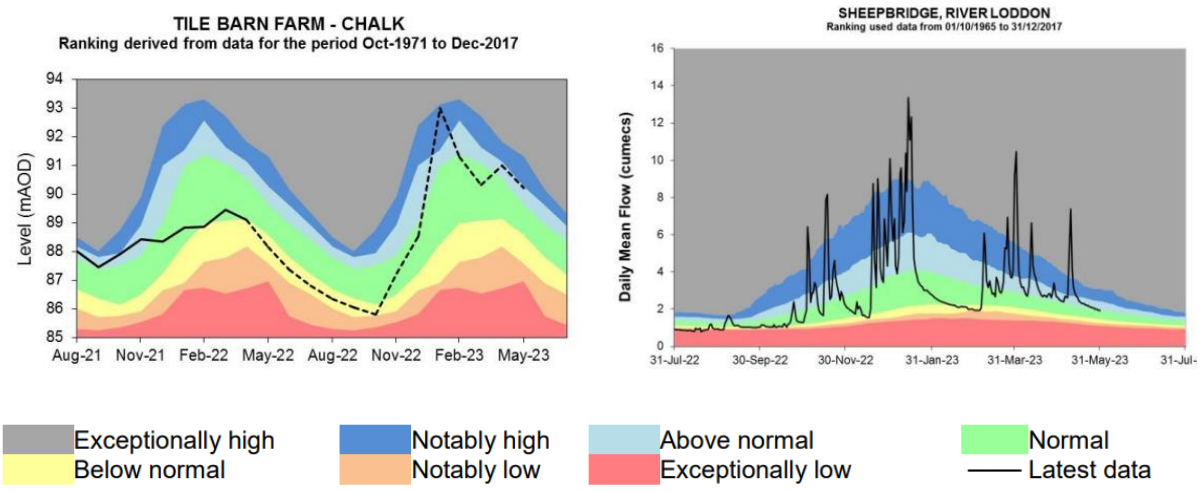


In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for Enborne and Loddon. The nearest groundwater reference station is Tile Barn Farm. This site shows groundwater levels at or around below normal levels in 2022, before rising towards the end of the year, to reach notably high levels in early 2023. For 2023, groundwater levels have been observed at higher levels than the equivalent periods in 2022. This can be seen in the figure below alongside the river indicator Sheepbridge on the River Loddon. Note recent groundwater levels at Tile Barn Farm have been estimated based on nearby boreholes due to site monitoring issues.

Figure 6 – Water Situation Report



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

Network Performance

Within the Silchester catchment there are three sites detailed within the Environment Agency Consents Database which have an Event Duration Monitor (EDM) fitted. As part of the process of matching GISMP catchments to EDM sites, two additional EDM sites have been identified in the Silchester catchment, that were not included in last year's addendum report.

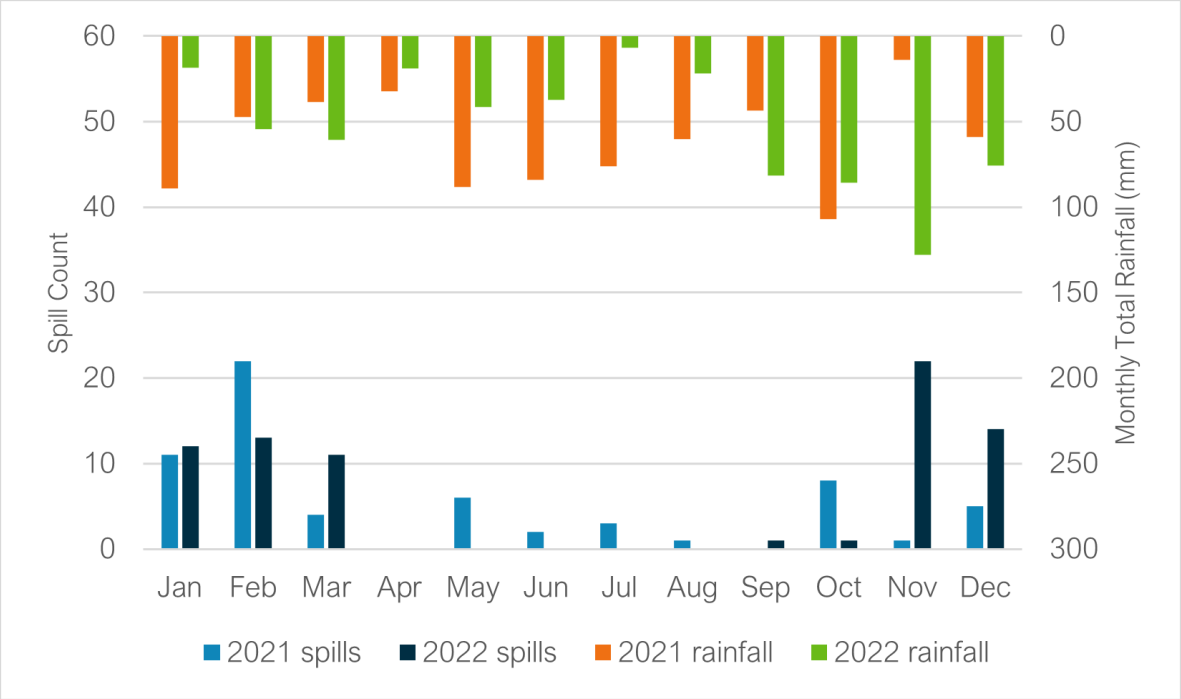
Table 7 below details the last 2 years performance of overflow 'Silchester STW'.

Table 7 – Event Duration Monitoring – Silchester STW

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Silchester STW	63	968.32	74	1239.36

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 – Silchester STW



The trend in spill performance across the two recorded years does show variation in spills, with an overall focus on spills during the autumn and winter months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. For example, despite broadly similar rainfall totals, significantly more spills were recorded at Silchester STW in December 2022 compared to December 2021. The indicator site data shown in Figures 5 and 6, suggests groundwater levels became elevated during this period in 2022.

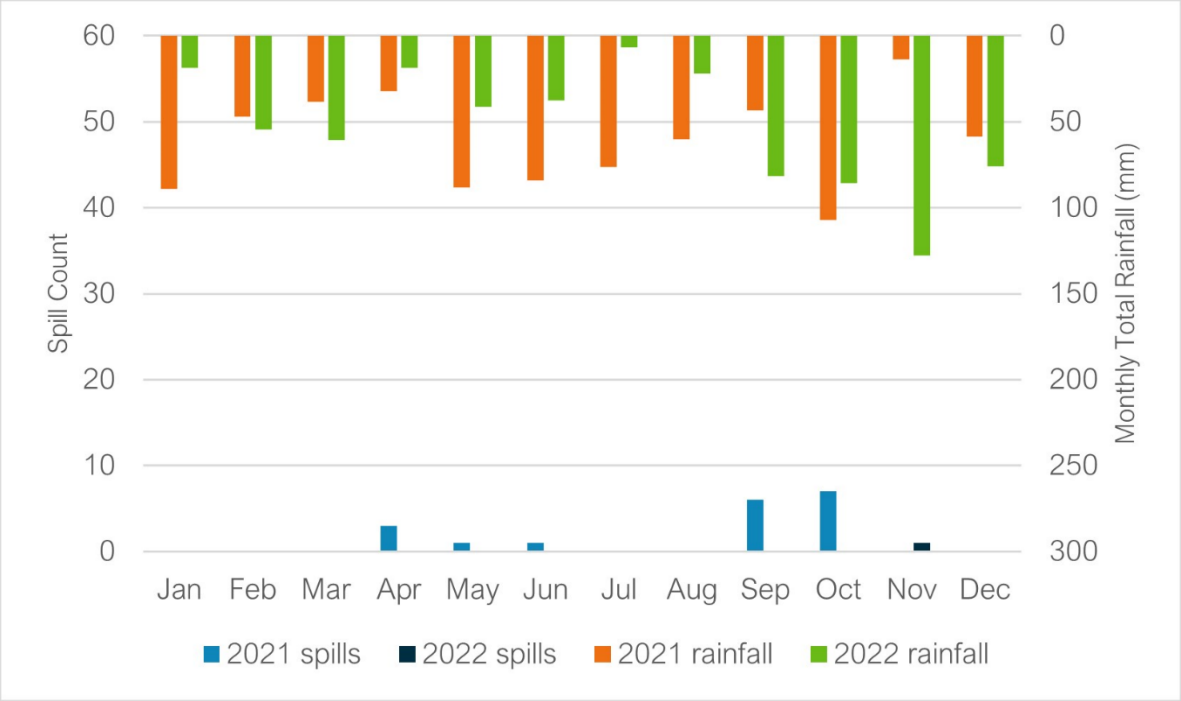
Table 9 below details the last 2 years performance of overflow 'Swains Road SPS'.

Table 9 – Event Duration Monitoring – Swains Road SPS

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Swains Road SPS	18	60.39	1	0.87

Figure 10 below presents the EDM performance trend and rainfall for recent years. Note that the EDM was only operational for 70% of the time in 2022, and 78% of the time in 2021, which may have impacted the recorded spill counts.

Figure 10 – EDM Monthly Performance – Swains Road SPS



Overall, the data for Swains Road SPS is not indicative of a wider relationship between rainfall, elevated groundwater levels and spill frequency at the overflow, with the occurrence of spills at the overflow not focussed on winter months with the most elevated groundwater levels. This suggests the occurrence of spills at the overflow, is primarily due to prolonged or intense rainfall events in the catchment. However, note the potential impact of the EDM operational issues on recorded spill counts at the overflow in 2021 and 2022.

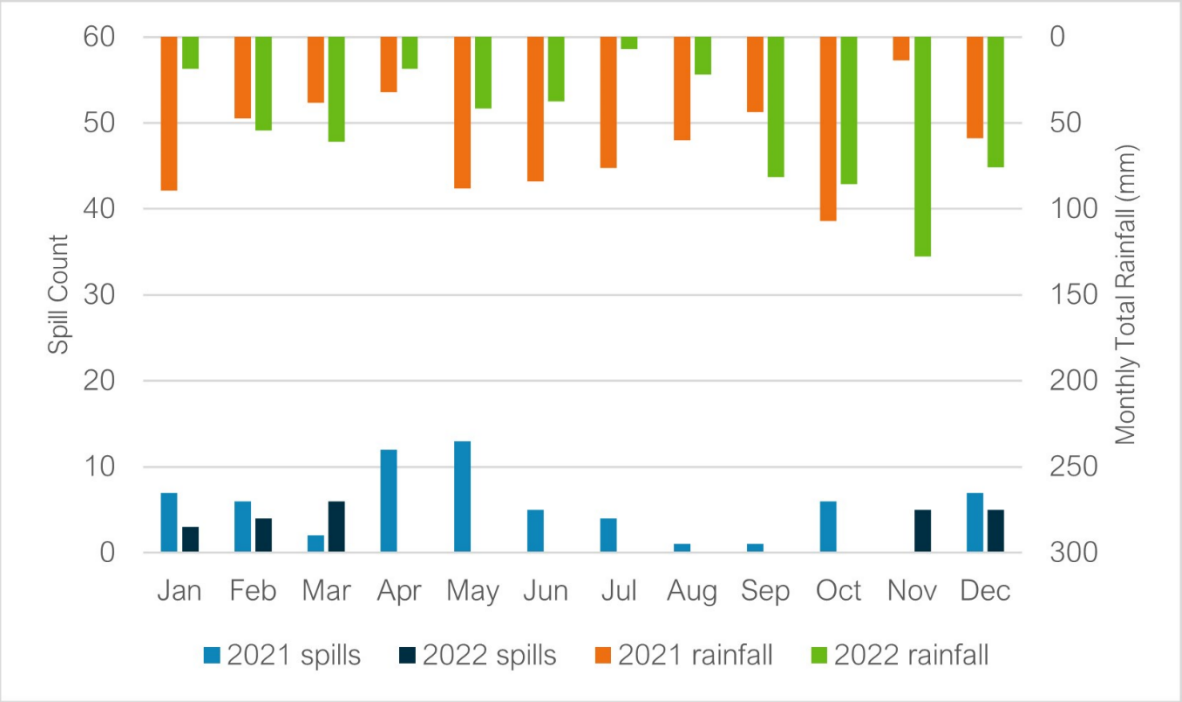
Table 11 below details the last 2 years performance of overflow 'Opp St Stephens Hall SPS'.

Table 11 – Event Duration Monitoring – Opp St Stephens Hall SPS

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Opp St Stephens Hall SPS	64	560.31	23	77.36

Figure 12 below presents the EDM performance trend and rainfall for recent years. Note that the EDM was only operational for 85% of the time in 2022, which may have impacted the recorded spill count.

Figure 12 – EDM Monthly Performance – Opp St Stephens Hall SPS



The data does not strongly suggest a wider relationship between rainfall, elevated groundwater levels and spill frequency at the overflow, with the highest monthly spill counts observed in April and May 2021, when the River Enborne at Brimpton indicator site data shown in Figure 5 suggests groundwater levels in the catchment were subsiding. A significant number of spills were also recorded across the summer months in 2021. The data overall suggests that spills do occur at the overflow during prolonged or intense rainfall events outside of periods of significantly elevated groundwater levels, however infiltration may still be impacting spills at the overflow. For example, leading to spills occurring at the overflow during rainfall events, that wouldn't occur in the absence of groundwater infiltration, through elevating peak flows in the network.

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 11 monitors installed within the Silchester 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 13 below provides a summary of the investigations and remediation works undertaken or planned within the Silchester catchment in the 2022-23 Hydrological Year, as well as work undertaken in the 2021-22 Hydrological Year.

Table 13 – 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	N/A
Look and lift survey	N/A	N/A
Sewer lining	N/A	N/A
Patch lining	N/A	N/A
Manhole sealing	N/A	N/A
Manhole sealing plates	N/A	N/A
Manhole covers and frames replaced	N/A	N/A

No interventions/ investigations were carried out in the catchment in the 2022/23 Hydrological Year. However, the system will continue to be monitored and investigations/ interventions carried out as appropriate and when conditions allow.

We are aware that network issues are present in Tadley. Previous manhole flooding has been reported here, the root cause of this has been identified partly as infiltration. These network issues are mitigated by a tankering plan in the event of re-occurrence.

An upgrade is planned for Silchester STW. This will improve its ability to treat the volumes of incoming sewage, reducing the need for untreated discharges to the environment. The scheme, still in the design phase, is due to complete in 2026.

Summary

This hydrological year, indicator site data suggests that groundwater levels in the Silchester catchment have reached higher levels than the previous hydrological year, and the significant number of spills recorded at EDM sites in the catchment November – December 2022, is indicative of the role of groundwater infiltration on spills in the catchment. The EDM data for 2023 will be analysed once available to continue to examine the relationship between groundwater levels and overflow spills in the Silchester catchment.

Lift and look and CCTV surveys will be undertaken in remaining wet winter periods if conditions allow. The aim of this is to find 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

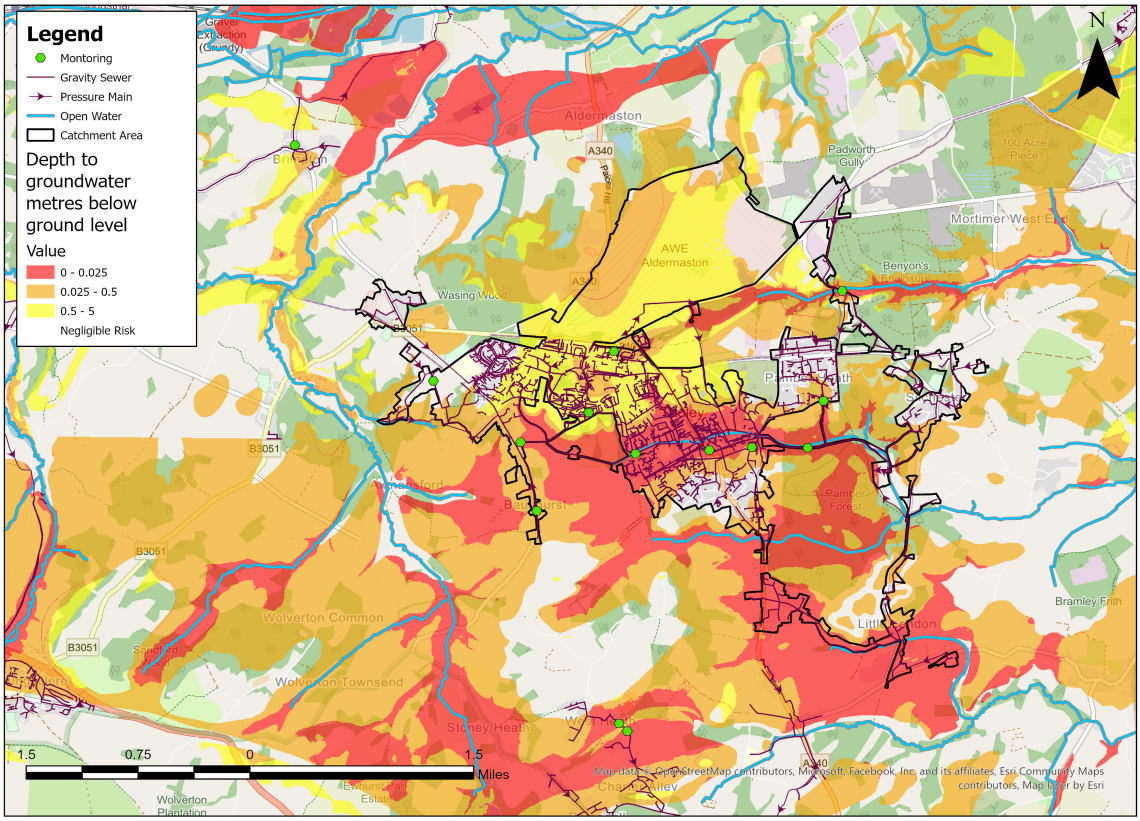
Table of contents

Overview

This addendum to the Silchester 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 2023/24.

Figure 1 – Silchester Monitoring Plan



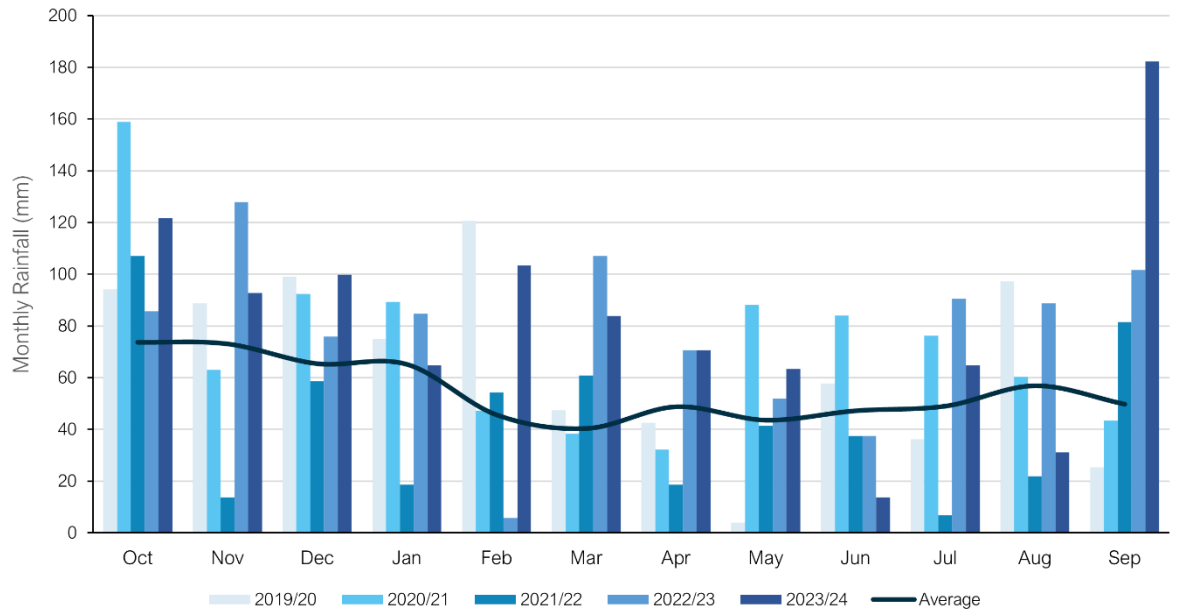
Hydrological Review – 2023-2024

This section summarises the hydrological conditions across the Silchester 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 Reading University based on the period 1991-2020

The total rainfall for the 2023/24 hydrological year is 51% 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)
658	788	873	521	928	992

Groundwater / Local River Level

The Silchester catchment is situated in the Enborne and Loddon water resources areas. It sits in the sedimentary bedrock of the London Clay formation of sand, the London Clay formation of clay, silt, and sand; and the Windlesham formation of sand, silt and clay. The Silchester catchment is not part of a designated principal aquifer within the UK.

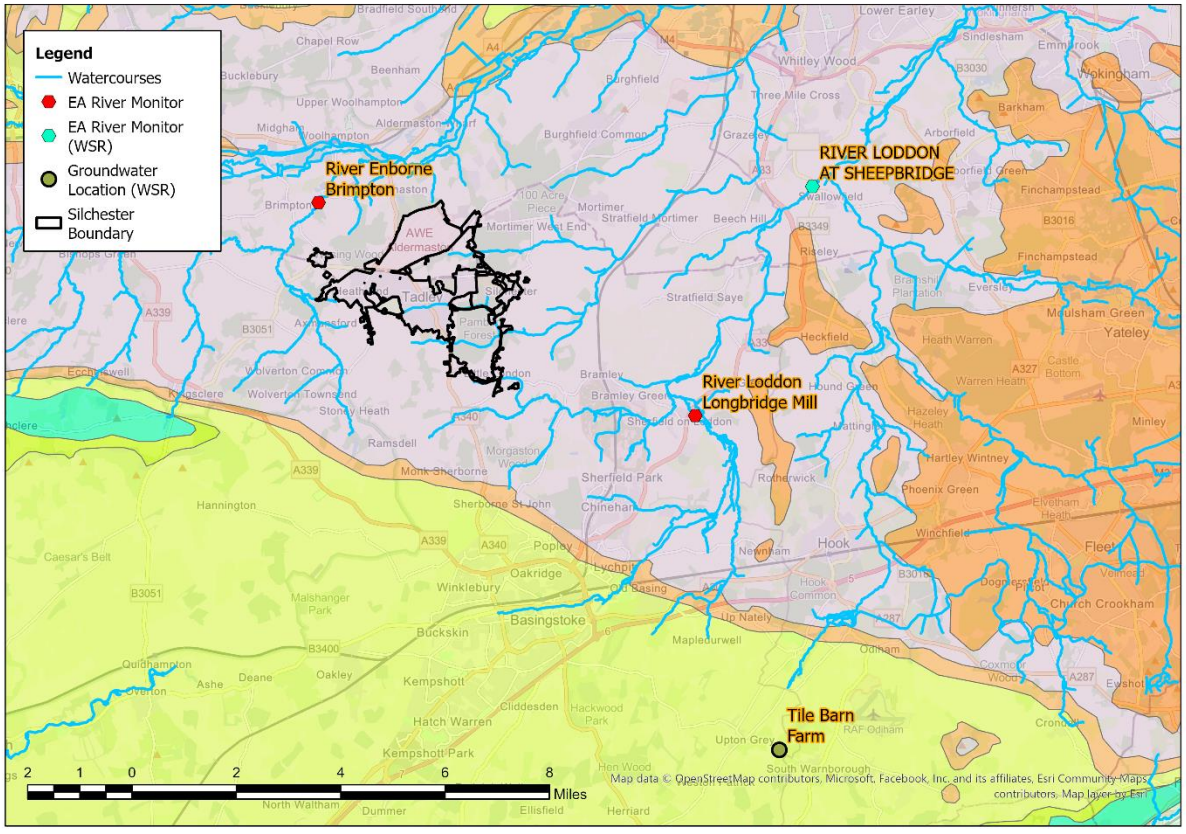
The Environment Agency has gauging stations on local watercourses measuring stage, and observation boreholes (OBH) measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

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

- River Enborne, Brimpton.
- River Loddon, Longbridge Mill.

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. Note that data quality for the River Loddon at Longbridge Mill site is variable.

Figure 5A – River Enborne, Brimpton

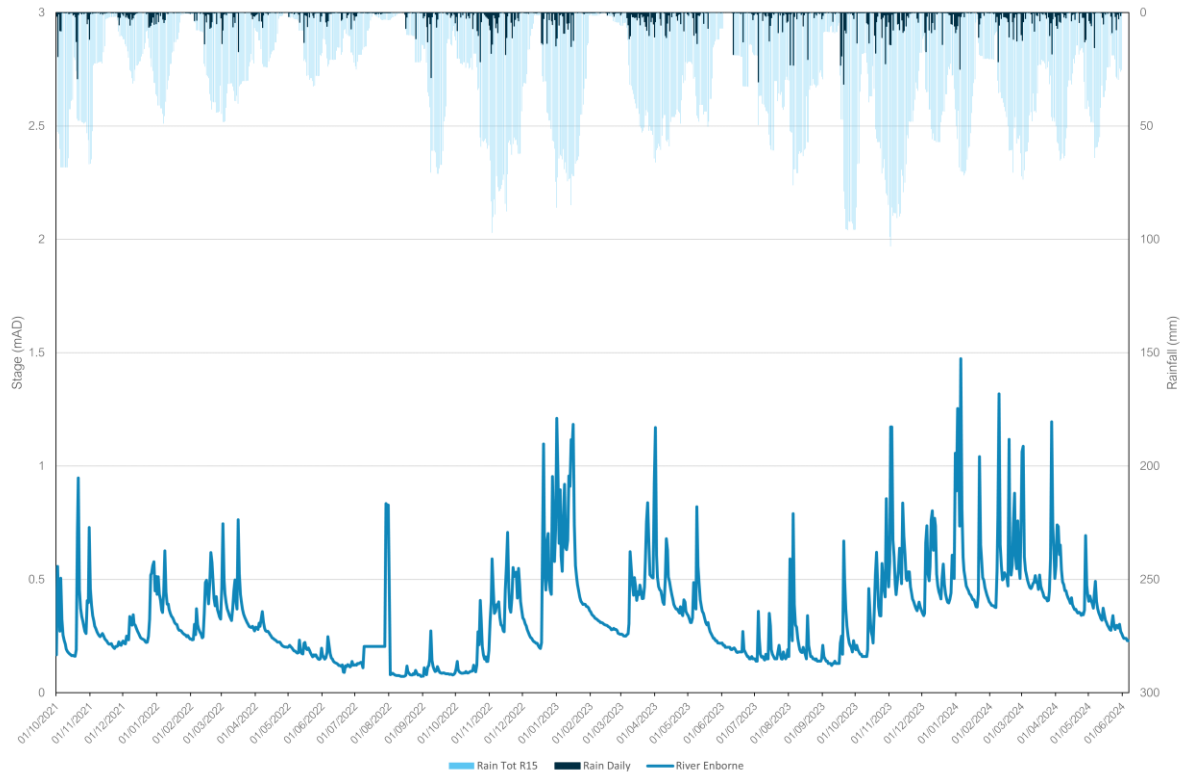
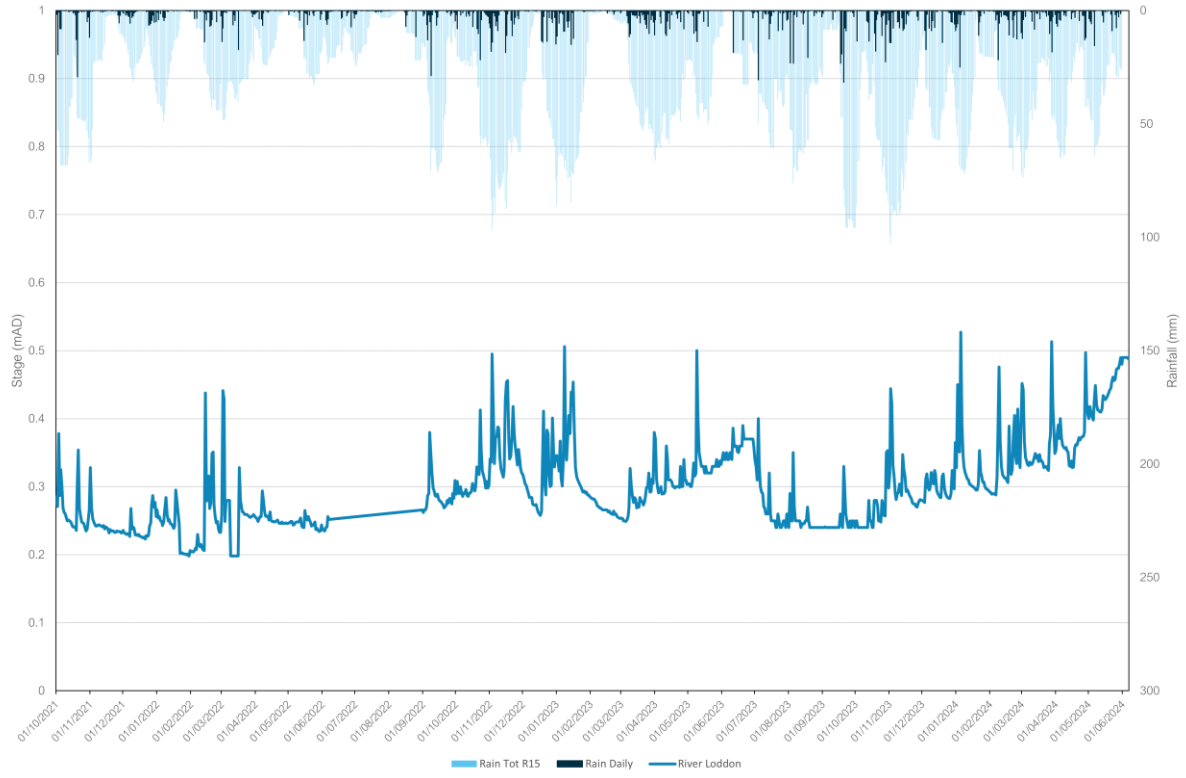
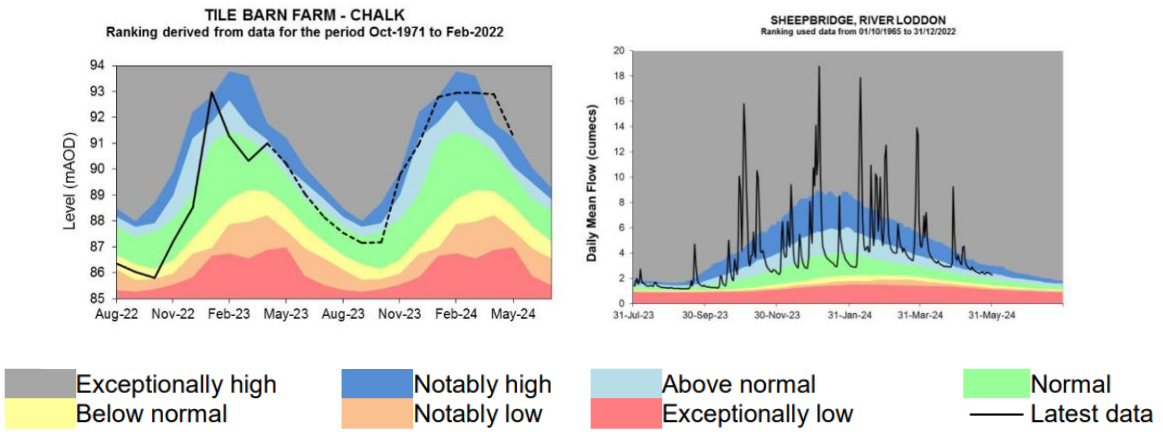


Figure 5B – River Loddon, Longbridge Mill.



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for Enborne and Loddon. The nearest groundwater reference station is Tile Barn Farm. This site shows groundwater levels in 2024 to reach similar levels to those observed in 2023. However, groundwater levels remained at notably high levels for a more prolonged period in 2024 and were observed at exceptionally high levels in spring 2024. This can be seen in Figure 6 alongside the river indicator Sheepbridge on the River Loddon. Note recent groundwater levels at Tile Barn Farm have been estimated based on nearby boreholes due to site monitoring issues.

Figure 6 – Water Situation Report



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

Network Performance

Within the Silchester catchment there are three sites detailed within the Environment Agency Consents Database which have an Event Duration Monitor (EDM) fitted.

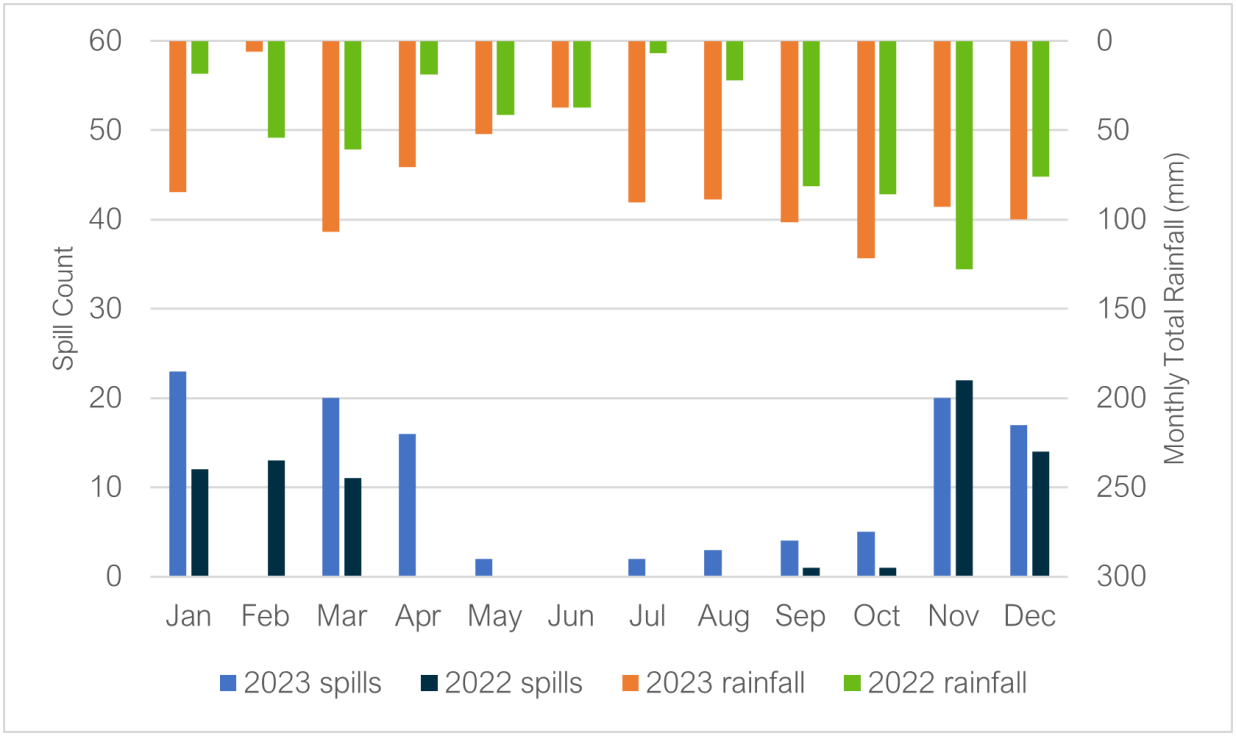
Table 7 below details the last 2 years performance of overflow 'Silchester STW'.

Table 7 – Event Duration Monitoring – Silchester STW

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Silchester STW	74	1239.36	112	2067

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 – Silchester STW



The trend in spill performance across the two recorded years does show variation in spills, with an overall focus on spills during the winter, spring and autumn months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. For example, January, March and April in 2023 recorded spikes in spill readings, the indicator site data shown in Figure 5A suggests that groundwater levels in the catchment were elevated during these periods. Summer in 2023 recorded numerous spills during periods of lower groundwater levels (see Figure 5), this suggests spills also occurring as a direct response to prolonged or intense rainfall events in the catchment, outside of periods of elevated groundwater levels.

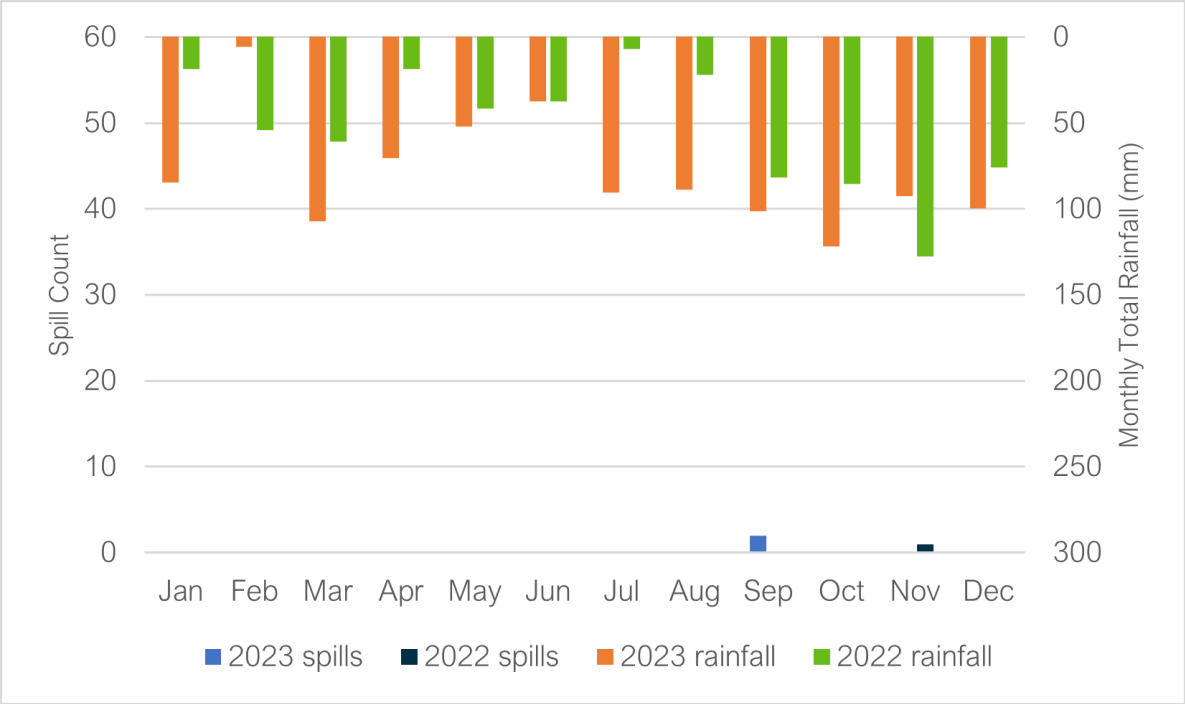
Table 9 below details the last 2 years performance of overflow 'Swains Road SPS'.

Table 9 – Event Duration Monitoring – Swains Road SPS

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Swains Road SPS	1	0.87	2	3.50

Figure 10 below presents the EDM performance trend and rainfall for recent years. Note that the EDM was only operational for 70% of the time in 2022 which may have impacted the recorded spill count.

Figure 10 – EDM Monthly Performance – Swains Road SPS



A low number of spills were recorded at Swains Road SPS in 2022 and 2023, the data is therefore not indicative of a wider relationship between rainfall, elevated groundwater levels and spill frequency at this in catchment overflow. As the overflow is located upstream in the catchment, the amount of groundwater infiltration occurring in the network upstream of it, will be less in comparison to that occurring upstream of the STW. See the 2022 Addendum Report, included in this PDF document, for further discussion regarding the limited evidence for groundwater infiltration impacting spills at Swains Road SPS.

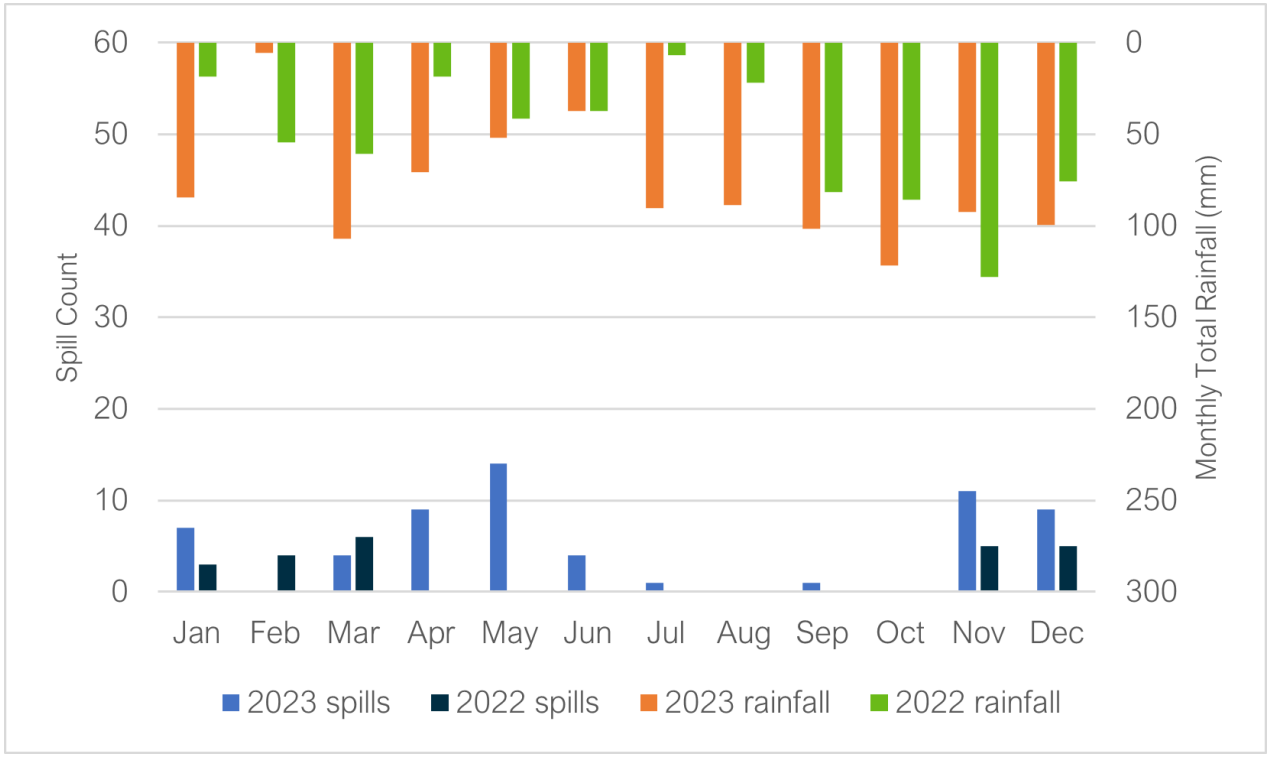
Table 11 below details the last 2 years performance of overflow 'Opp St Stephens Hall SPS'.

Table 11 – Event Duration Monitoring – Opp St Stephens Hall SPS

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Opp St Stephens Hall SPS	23	77.36	60	62.77

Figure 12 below presents the EDM performance trend and rainfall for recent years. Note that the EDM was only operational for 85% of the time in 2022 and 78% of the time in 2023, which may have impacted the recorded spill count.

Figure 12 – EDM Monthly Performance – Opp St Stephens Hall SPS



This data suggests a potential wider relationship between rainfall, elevated groundwater levels and spill frequency at the overflow. For example, despite broadly similar rainfall in November and December 2023 compared to November and December 2022, significantly more spills were recorded across these months in 2023. Figure 6 suggests that groundwater levels in the catchment were at notably high levels in 2023, compared to at normal levels in November and December 2022. The occurrence of summer spills at the overflow in 2023, is also indicative of spills occurring as a direct response to prolonged or intense rainfall events, outside of periods of elevated groundwater levels.

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 11 monitors installed within the Silchester 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 13 below provides a summary of the investigations and remediation works undertaken or planned within the Silchester catchment in the 2023-24 Hydrological Year, as well as work undertaken in the previous two hydrological years.

Table 13 – Works Undertaken in the 2023/2024 Hydrological Year, 2022/23 Hydrological Year & in the 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	N/A	4.74 Kilometres*
Look and lift survey	N/A	N/A	N/A
Sewer lining	N/A	N/A	N/A
Patch lining	N/A	N/A	N/A
Manhole sealing	N/A	N/A	N/A
Manhole sealing plates	N/A	N/A	N/A
Manhole covers and frames replaced	N/A	N/A	N/A

*Total length of network scoped for survey across sewers predicted to be at high/ medium and low risk of groundwater infiltration. The purpose of the surveys was to identify priority locations for remediation and to help verify the sewer risk zones.

Summary of CCTV surveys

Tables 14 and 15 below summarise the CCTV work undertaken for Silchester in the 2023-24 Hydrological Year and gives details on the infiltration identified.

Table 14 – Total length of sewerage network surveyed by CCTV in the 2023-24 Hydrological Year

Investigation/ remediation type	Length (m)
Planned CCTV Survey	4740
Survey Completed	3462
Total surveyed with clear flow	1107

Table 15 - Number of points of infiltration found and assessed severity from CCTV surveys

Infiltration severity	No. of sections of pipework
Gushing	0
Running	5
Dripping	3
Seeping	6
Total	14

We are aware that network issues are present in Tadley. Previous manhole flooding has been reported here, the root cause of this has been identified partly as infiltration. These network issues are mitigated by a tankering plan in the event of re-occurrence. No tankering was undertaken in the catchment during the 2023/24 Hydrological Year.

An upgrade is planned for Silchester STW. This will improve its ability to treat the volumes of incoming sewage, reducing the need for untreated discharges to the environment. The scheme, still in the design phase, is due to complete in 2027. Note, delivery dates are being managed at a programme level, delivery dates stated are based upon current views and are subject to change.

It is expected Silchester STW will meet all government targets for storm overflows by 2030-2035.

Swains Road SPS and Opposite St Stephens Hall SPS are expected to meet all government targets for storm overflows by 2040-2045.

Summary

This hydrological year (October 2023 – September 2024), indicator site data suggests that groundwater levels in the Silchester catchment have generally been higher than the previous hydrological year. EDM data is indicative of the role of groundwater infiltration on overflow spills in the catchment. The EDM data for 2024 will be analysed once available to continue to examine the relationship between groundwater levels and overflow spills in the Silchester catchment.

Lift and look and CCTV surveys will be undertaken in remaining wet winter periods if conditions allow and subject to funding and available capacity. The aim of this is to find 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.

It's everyone's water