



Groundwater Impacted System Management Plan

Princes Risborough, Horsenden Stream

April 2021



It's everyone's water

Version control

Version	Date	Amendment	Author	Checked	Reviewed
1-d1	March 2021	Draft for EA	DJ	SE	APH
1-V1	April 2021	Version 1	DJ	APH	JO
1-V2	July 2021	Update to introductory text and infiltration potential figures	DJ	APH	JO
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Annual Update 2022	October 2022	Addition of Annual Update 2022	MB/JH	DJ	DJ
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Annual Update 2024	October 2024	Addition of Annual Update 2024	CW/MW	DJ	DJ

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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 infiltration¹ 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 possible². 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

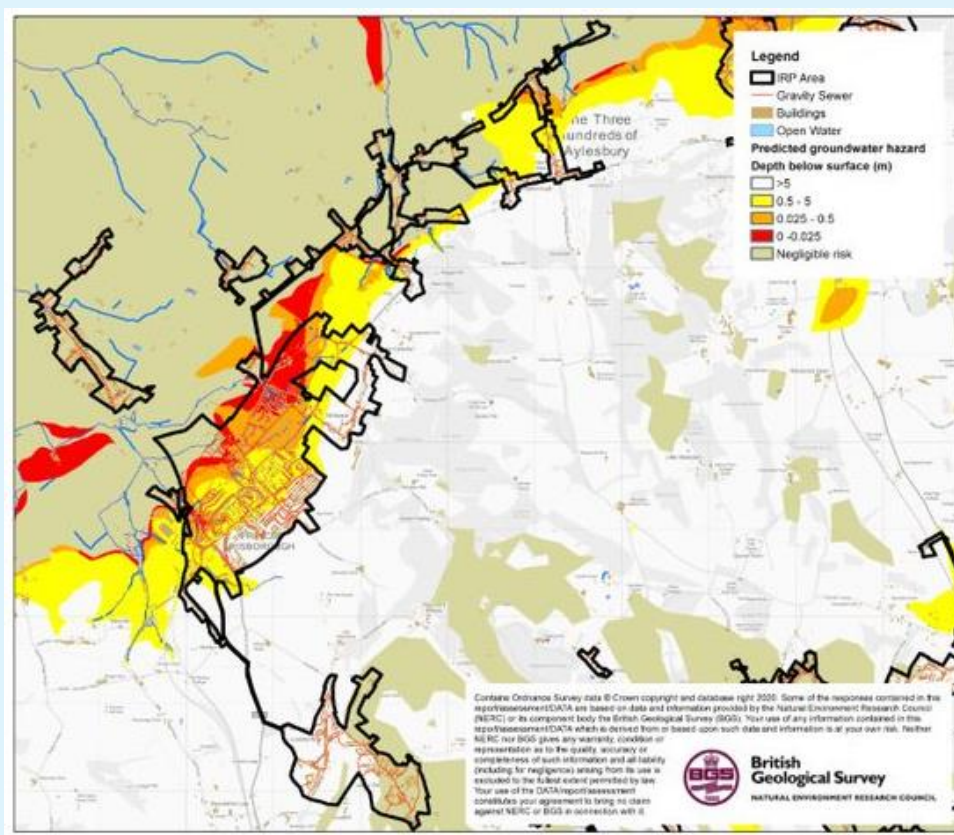
¹ Sewers for Adoption makes an allowance for 10% of peak wastewater flow to allow for unaccounted flows such as groundwater infiltration.

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 the Princes Risborough system



1.0 – Princes Risborough catchment

The Princes Risborough system lies on the Horsenden Stream, in Buckinghamshire, England, approximately 12km south of Aylesbury. The Princes Risborough system serves a population equivalent³ of 14,263 with a predominantly separate sewerage network totaling some 120km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above and includes Princes Risborough and the villages of the villages of Longwick, Monks Risborough, Great Kimble, Loosley Row and Lacey Green.

Problem characterisation

Groundwater has potential to enter our sewers when levels are high which reduces their capacity and increases their risk of becoming overwhelmed. There's a strong link between the rising river levels that cause rising groundwater levels, and the drainage issues some of our customers have experienced.

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.

In recent years the foul sewerage system in the Princes Risborough catchment has become overwhelmed, following prolonged and heavy rainfall and high groundwater levels. This has resulted in certain properties suffering from sewer flooding and restricted toilet use. The sewerage system is identified on the public sewer records as being a separate foul system, rather than a combined system. It should therefore, in theory, only be accepting foul drainage rather than a combination of foul and surface water, however, there are almost no areas in the system with public surface water sewers.

We believe that significant volumes of surface water run-off from the surrounding saturated fields entered the foul sewerage network during the wet winters of 2012/13 and 2013/14, causing the network to surcharge. The surveys we have carried out in previous years also suggest that there is some evidence of unwanted flows in the foul sewerage network and inundation from highways, public spaces and properties. Surface water misconnections (i.e. downpipes from roofs), into the foul sewerage network may also be a contributing factor, however further analysis is required to determine the extent to which this has contributed to sewer flooding. We therefore have a perceived understanding of the possible root causes, which we are in the process of investigating, monitoring, and verifying over the forthcoming winter periods.

The catchment is at the foot of the Chiltern Hills and is generally made up of chalk bedrock in the south and mudstone, sandstone and limestone in the north. This is predominantly overlaid with well drained permeable soils and clayey, or loamy over clayey soils with an impermeable layer at shallow depth. This catchment is situated in an area that is

prone to significant seasonal fluctuations in groundwater levels, with the added likelihood of rainfall induced infiltration owing to its permeable soils. There are a number of springs within the catchment that feed a network of small watercourses. These are generally designated as Ordinary Watercourses. The Kingsey Cuttle Brook starts near the centre of Princes Risborough and flows in a north-westerly direction past Longwick.

The root causes of sewer surcharges and STW performance are therefore numerous and resolution of issues complex, requiring all stakeholders responsible for drainage in the catchment to work together to resolve them.

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 as Lead Local Flood Authority and as the planning authority, 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).

A number of our sewerage systems include for permitted 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 impact of the groundwater infiltration and high surface water flows in the catchment has overloaded the gravity sewers, sewage pumping stations in the system and the STW; which has also impacted the performance of the STW.

Our permit conditions for Princes Risborough 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.”

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

Anticipated unavoidable discharges

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

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

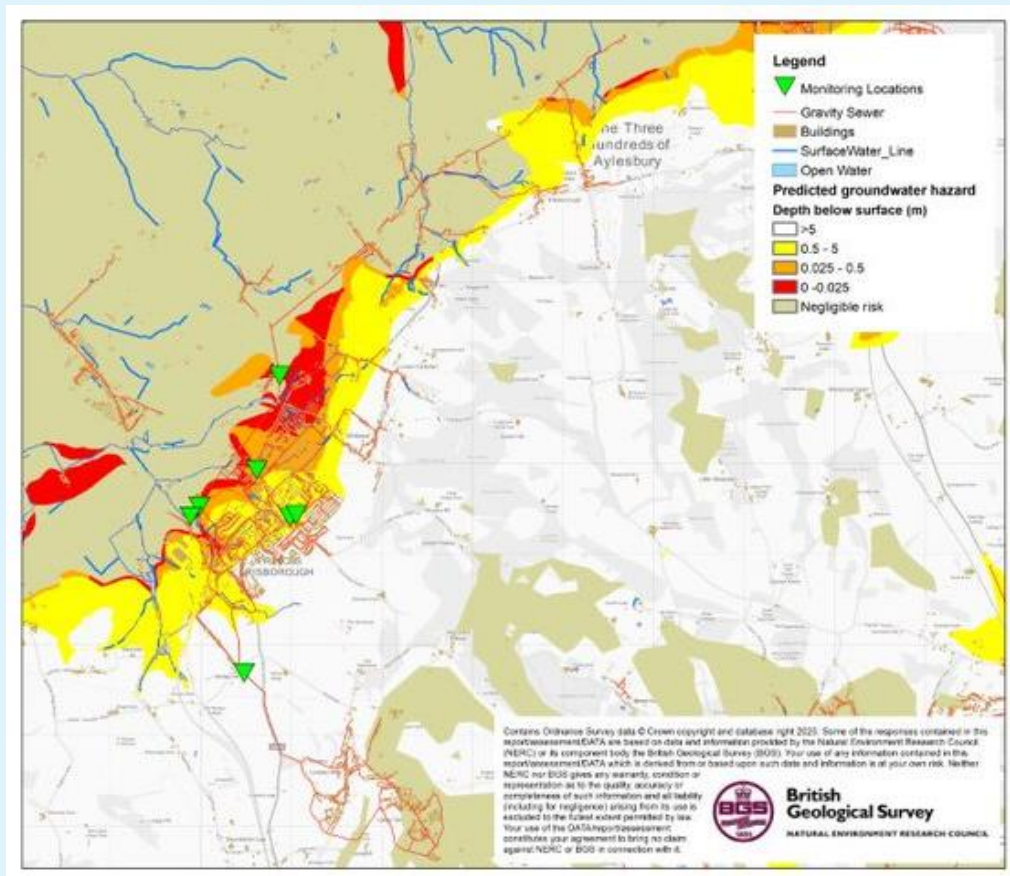


Figure 2.0 –Princes Risborough monitoring and infiltration zones

Key to bringing the impact of groundwater infiltration under control is an enhanced monitoring regime. We have identified and have installed several telemetered depth monitor locations around the Princes Risborough 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 Princes Risborough 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 have been 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 wholly⁴ 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 Princes Risborough.

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

⁴ 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.

Princes Risborough 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 sewerage system is outlined below.

High level approach statement

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

1. We will investigate the network with a view to identifying sources of ingress of infiltration that are cost effective⁵ to address. To investigate the network, we have:
 - Undertaken a desktop analysis to determine infiltration high to low risk zones (October 2020);
 - Installed additional monitoring to back up the analysis and to aid focusing of locations for identification of infiltration (to 2023). Each year we will assess the completeness of monitoring and if required add to or modify the current locations.

To further investigate the network, we will:

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

We will also review any results of Winter 2019/20 and 2020/21 with historic data to build up evidence to support interventions in the network (Summer/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 planning cycles.

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, to be 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 any work undertaken is included in the appendix to this report.

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.

Monitoring

Further Sewer Depth Monitors will be installed in the catchment in 2021 (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.

These units 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.

We do not envisage needing to undertake further mitigation work within the network (e.g. over pumping) at this stage apart from ongoing tinkering where required.

Updates

Work on the Groundwater infiltration management plan will continue, and we will provide updates in October 2022 and annually in October thereafter.

Appendix

Groundwater infiltration potential analysis

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

Sewer Length by Groundwater Infiltration Risk Zones

Risk category	Description	Length (km)	Percentage
High	Predicted groundwater extreme >1m above pipe invert	14.22	20.1
Medium	Predicted groundwater extreme 0-1m above pipe invert	4.90	6.9
Low	Predicted groundwater extreme 0-1m below pipe invert	4.94	7.0
Very Low	Predicted groundwater extreme >1m below pipe invert	46.66	66.0
Total		70.70 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	69	3.9
Medium	Inundation risk in 1% AEP fluvial or pluvial event	99	5.6
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	277	15.7
Very Low	All other manholes	1324	74.8
Total		1769	100.0

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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 Princes Risborough System. Our next update to the plan will include information on our progress in these areas.

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

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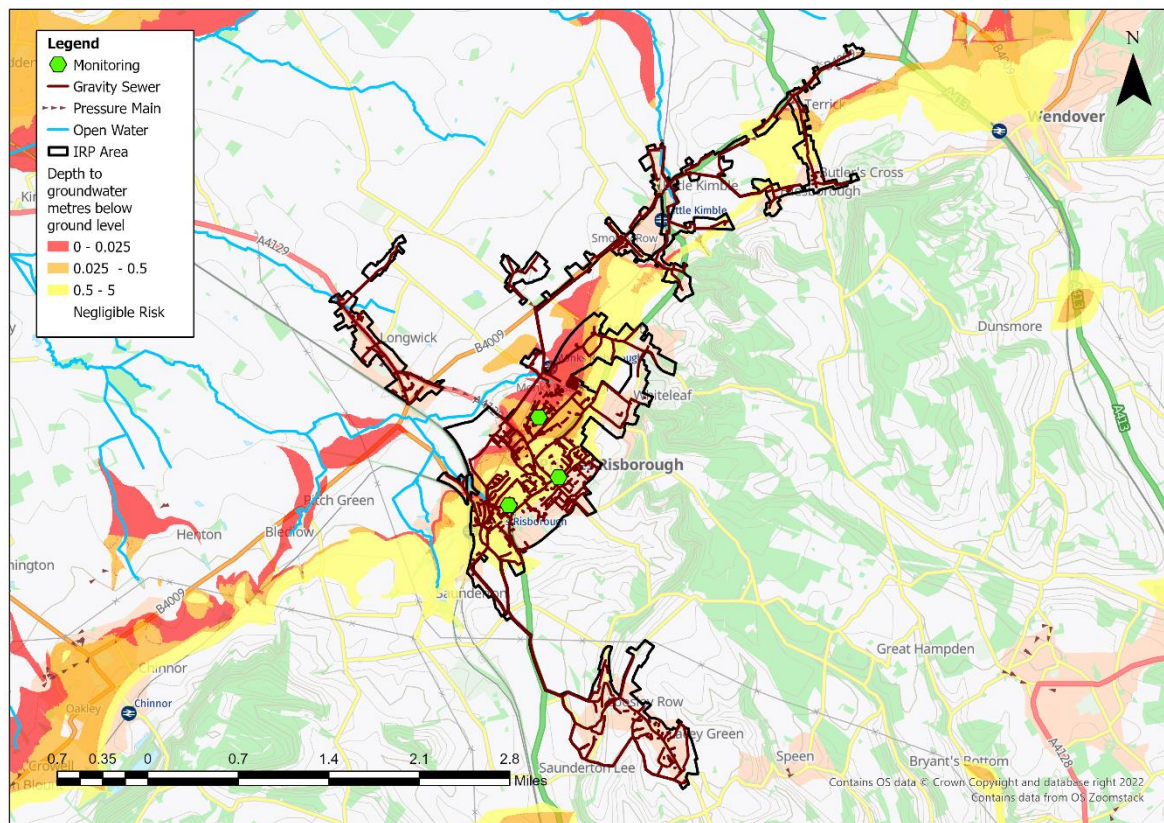
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Overview

This addendum to the Princes Risborough 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 – Princes Risborough Monitoring Plan



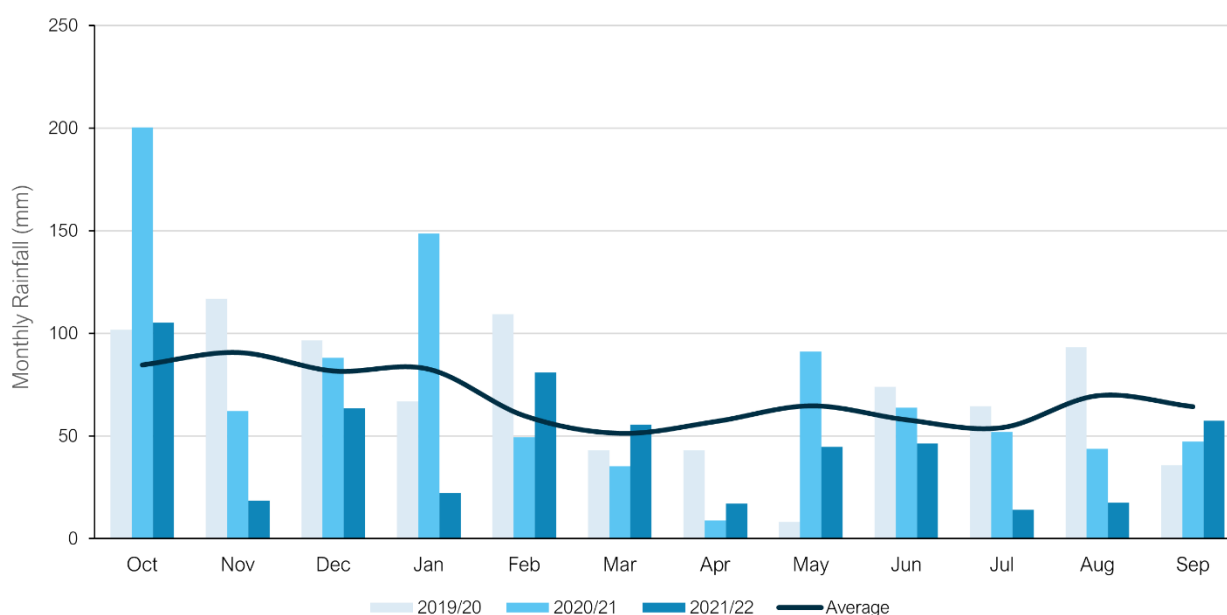
Hydrological Review – 2021-2022

This section summaries the hydrological conditions within the Princes Risborough 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 33% 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	853	891	551

Groundwater / Local River Level

The Princes Risborough catchment is situated in the Thames and Chilterns West water resource areas. It primarily sits in West Melbury Marly Chalk Formation of carbonate material forming distinctive beds of chalk, the Gault Formation of coarse to fine grained sediments and the Upper Greensand Formation of coarse to fine grained sediments. The West Melbury Marly Chalk Formation and the Upper Greensand Formation are designated principal aquifers within the UK.

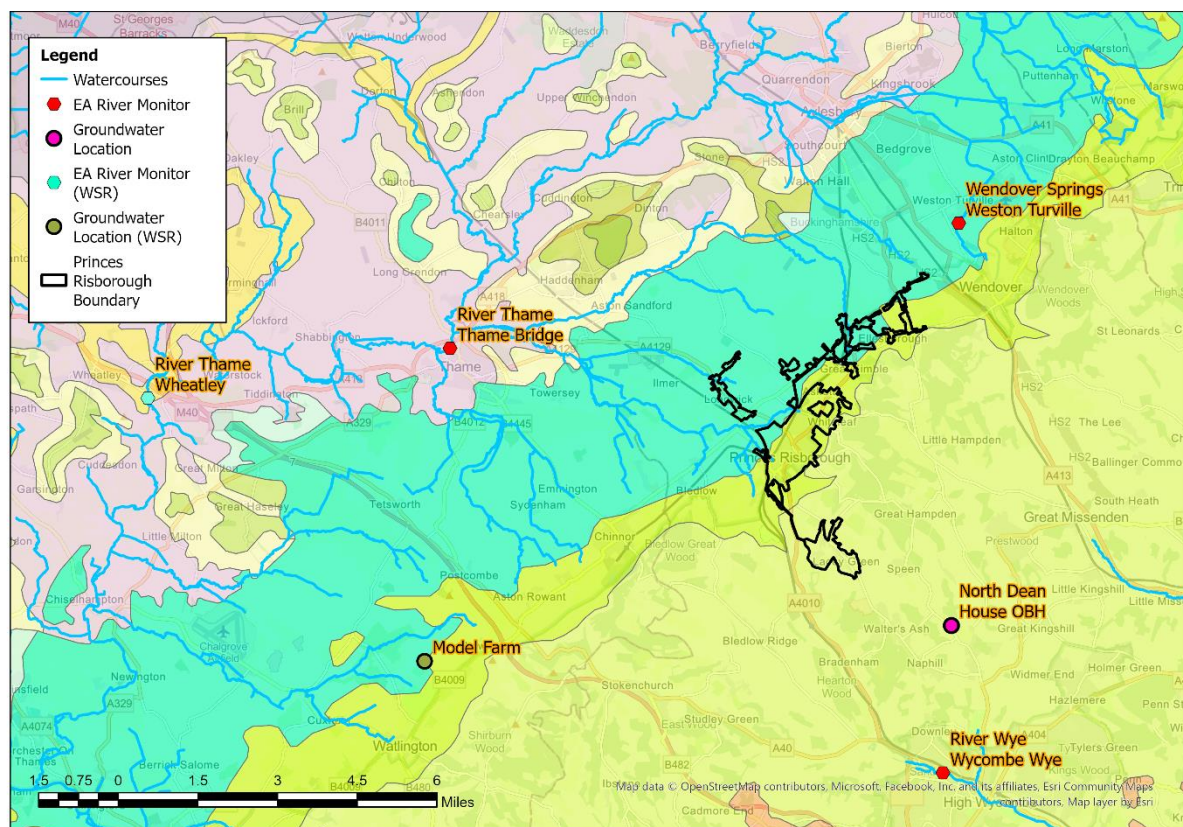
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

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

- River Thames, Thame Bridge.
- Wendover Springs, Weston Turville.
- River Wye, Wycombe Wye.
- North Dean House OBH.

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 – Thame, Thame Bridge

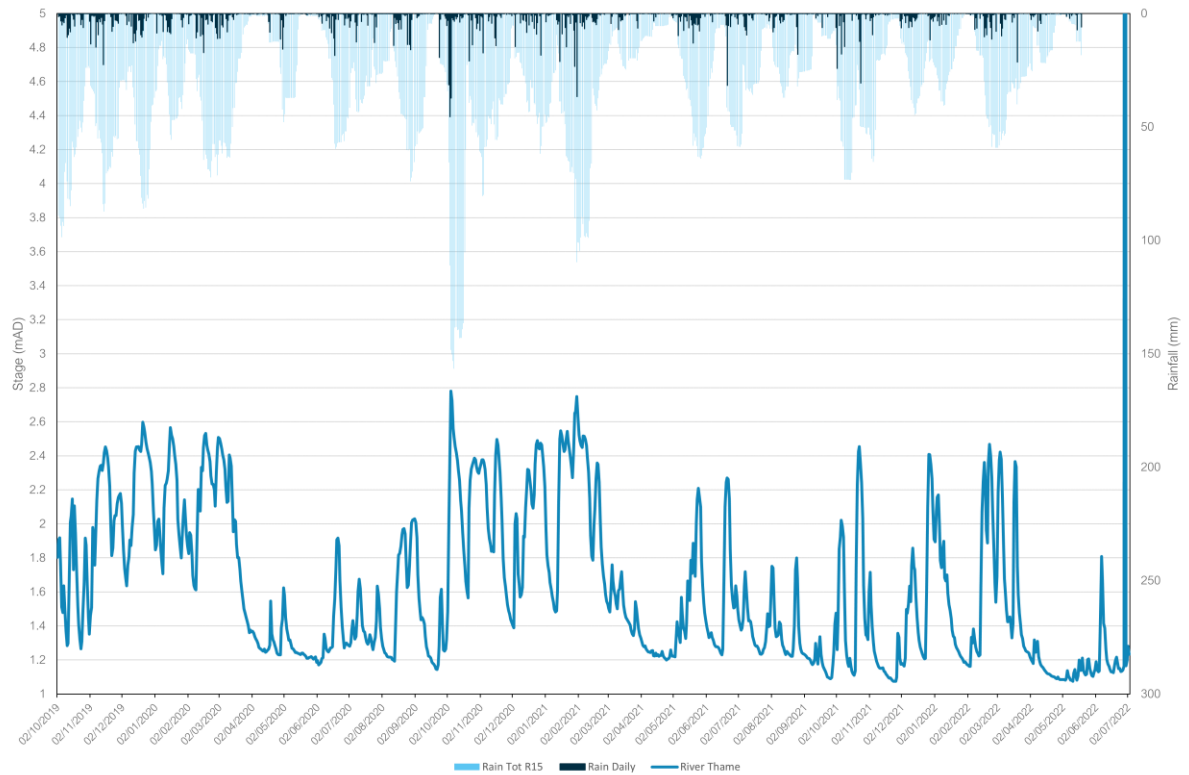


Figure 5B – Wendover Springs, Weston Turville

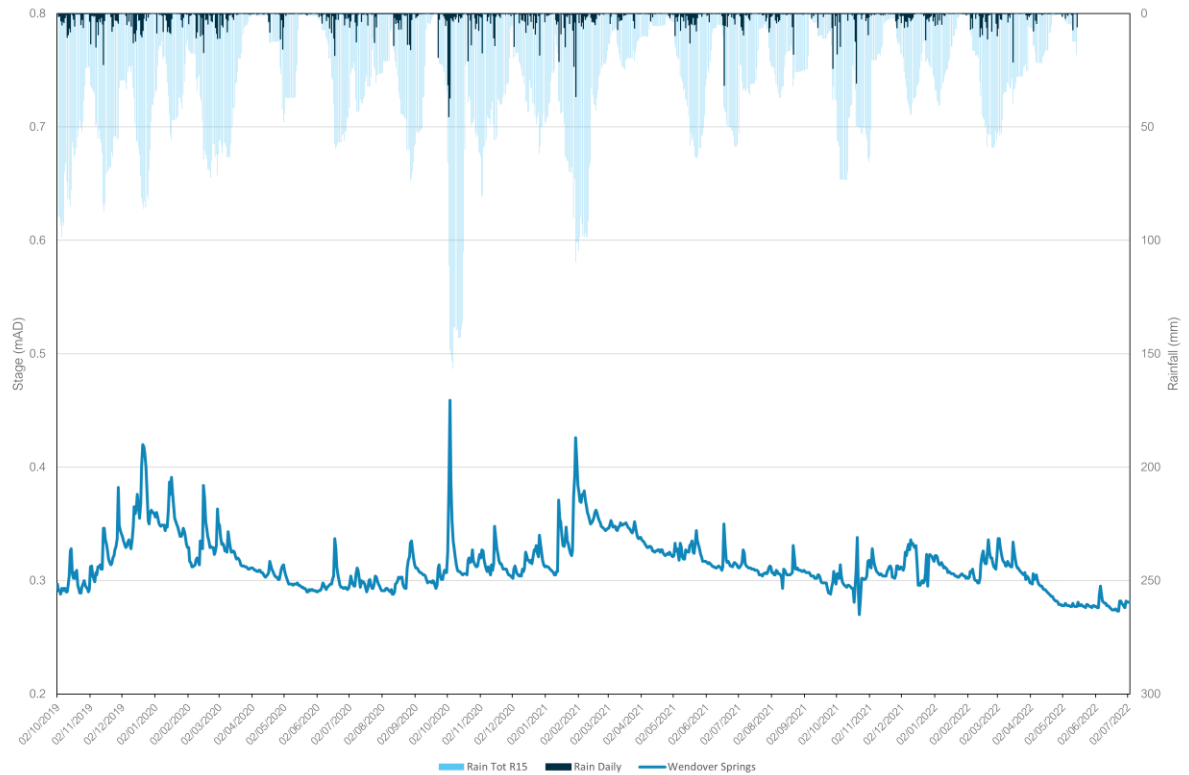


Figure 5C – River Wye, Wycombe Wye

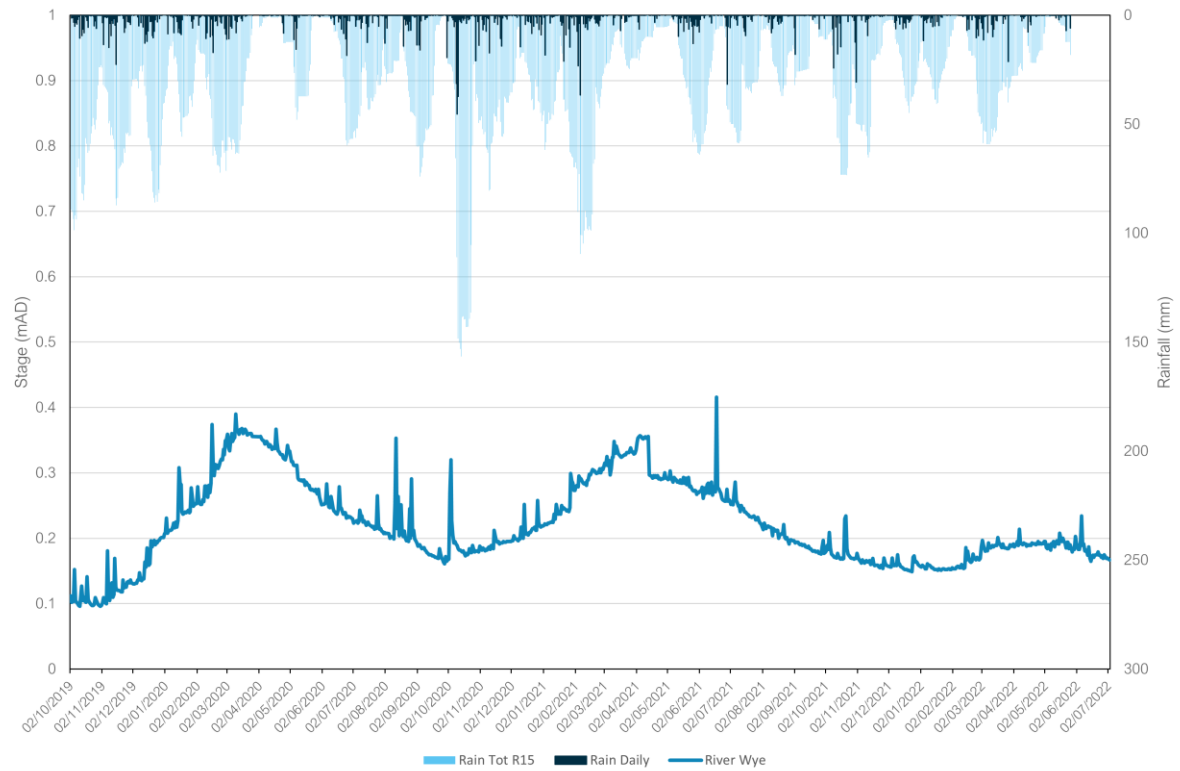
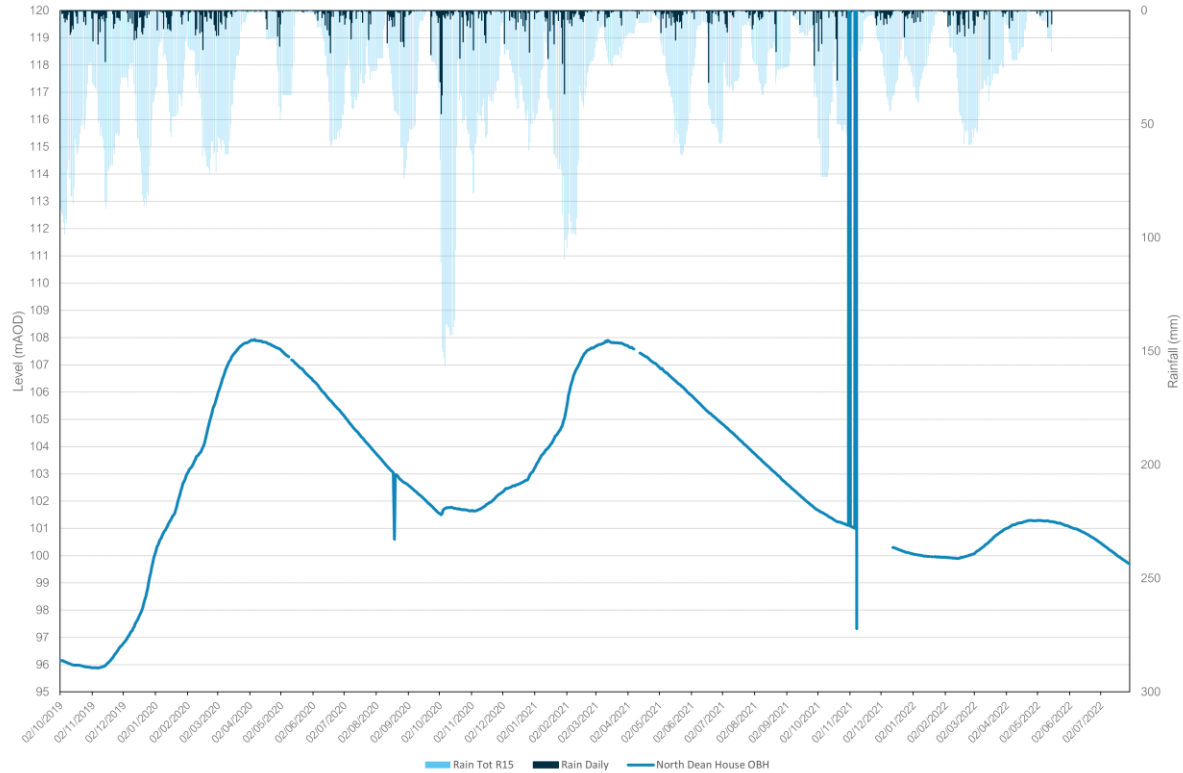
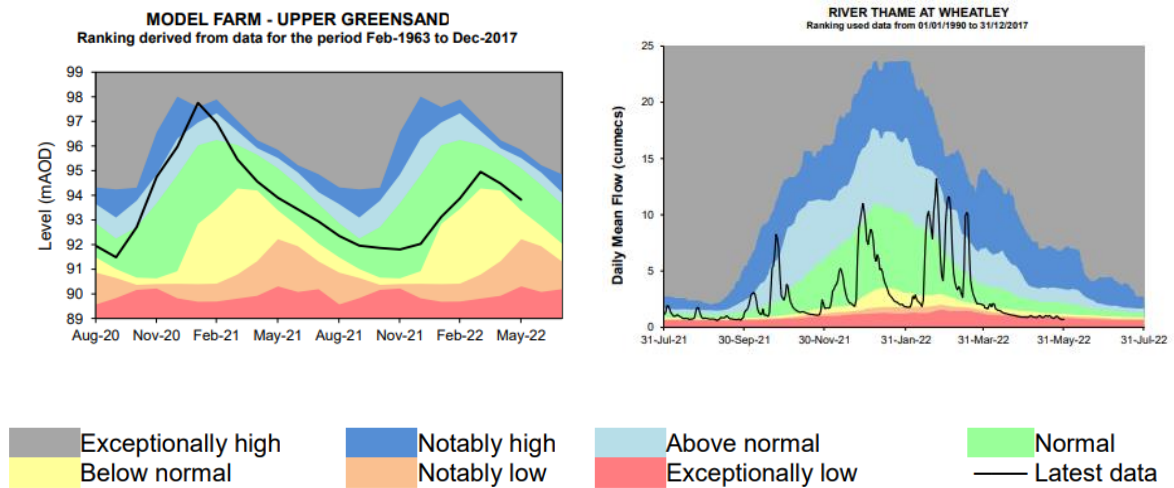


Figure 5D – North Dean House OBH



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for the Thame. The nearest groundwater reference station is Model Farm. This site shows significantly lower overall groundwater than the previous year. This can be seen in the figure below alongside the river indicator location at Wheatley on the River Thame.

Figure 6 – Water Situation Report



Extract from - [Water Situation Report \(publishing.service.gov.uk\)](https://publishing.service.gov.uk)

Network Performance

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

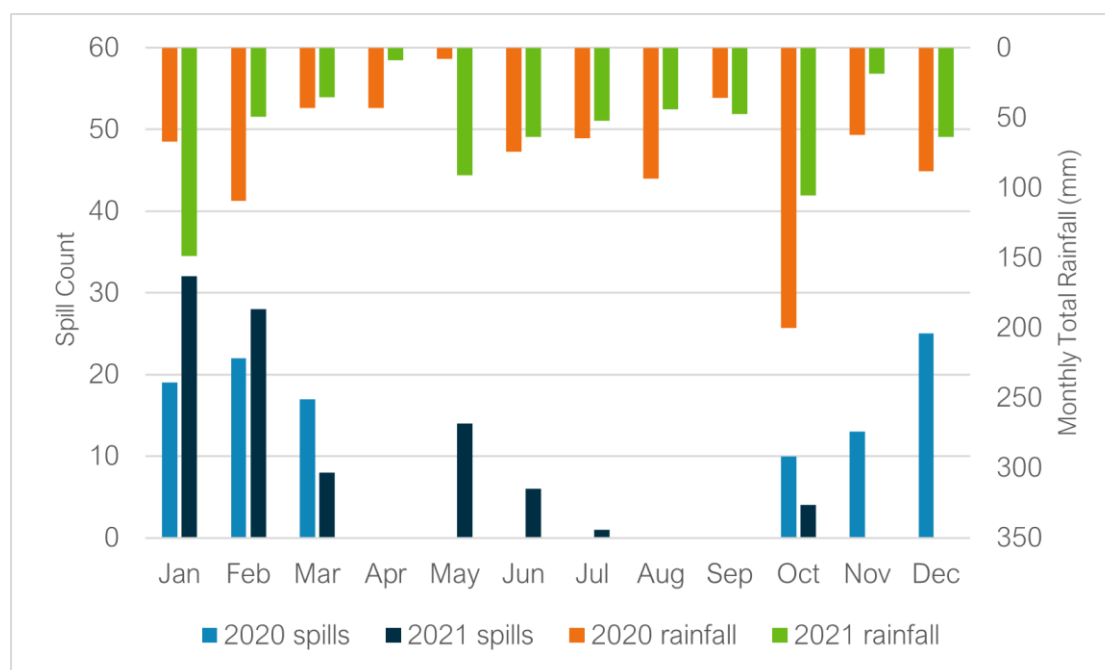
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2020		2021	
	Spills	Duration (hours)	Spills	Duration (hours)
Princes Risborough STW	106	1706.84	93	1685.68

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. 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 a focus on spills during the autumn and winter months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency, particularly evident at the start of the hydrological years (October – December). Despite broadly similar rainfall, no EDM spills were recorded at Princes Risborough STW in December 2021, compared to 25 spills in December 2020. The indicator sites shown in Figures 5 and 6 suggest groundwater levels in the catchment were higher in October – December 2020, compared to October – December 2021, whilst being broadly similar across other months when comparing 2020 and 2021.

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 3 monitors installed within the Princes Risborough 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 Princes Risborough 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, 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 Princes Risborough catchment over the 2021/22 hydrological year has been below average, with groundwater levels in the aquifer beneath Princes Risborough 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 Princes Risborough 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 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.

Addendum - Annual Update 2023

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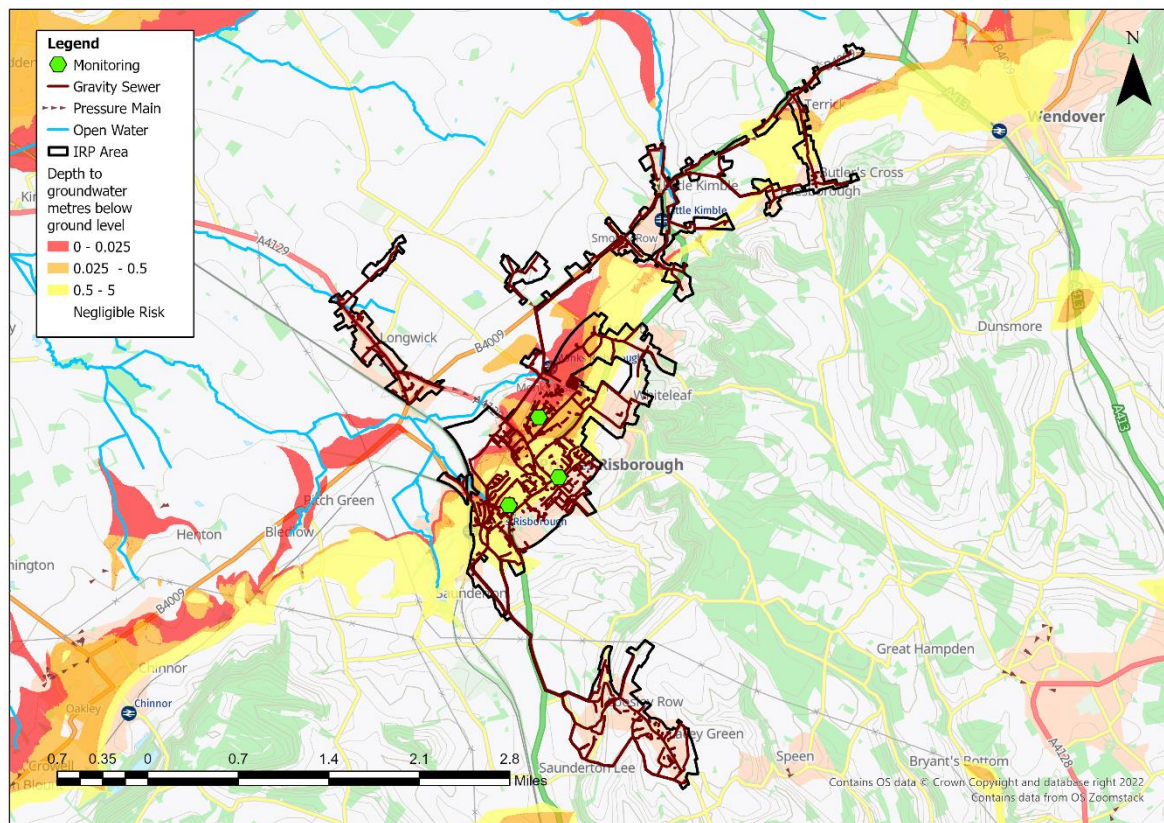
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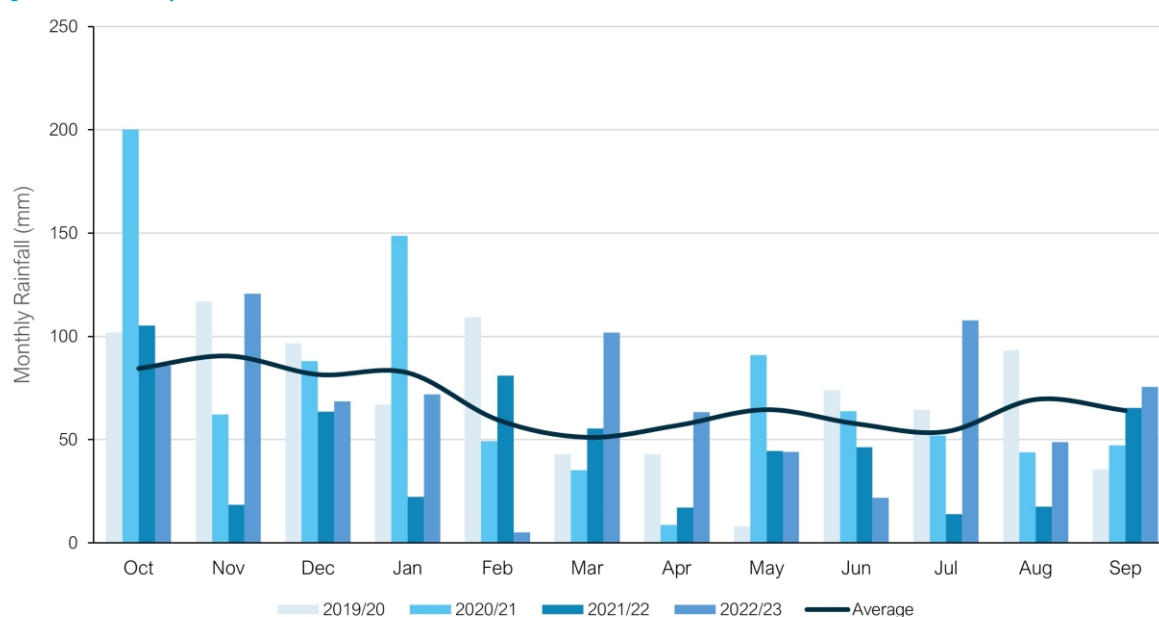
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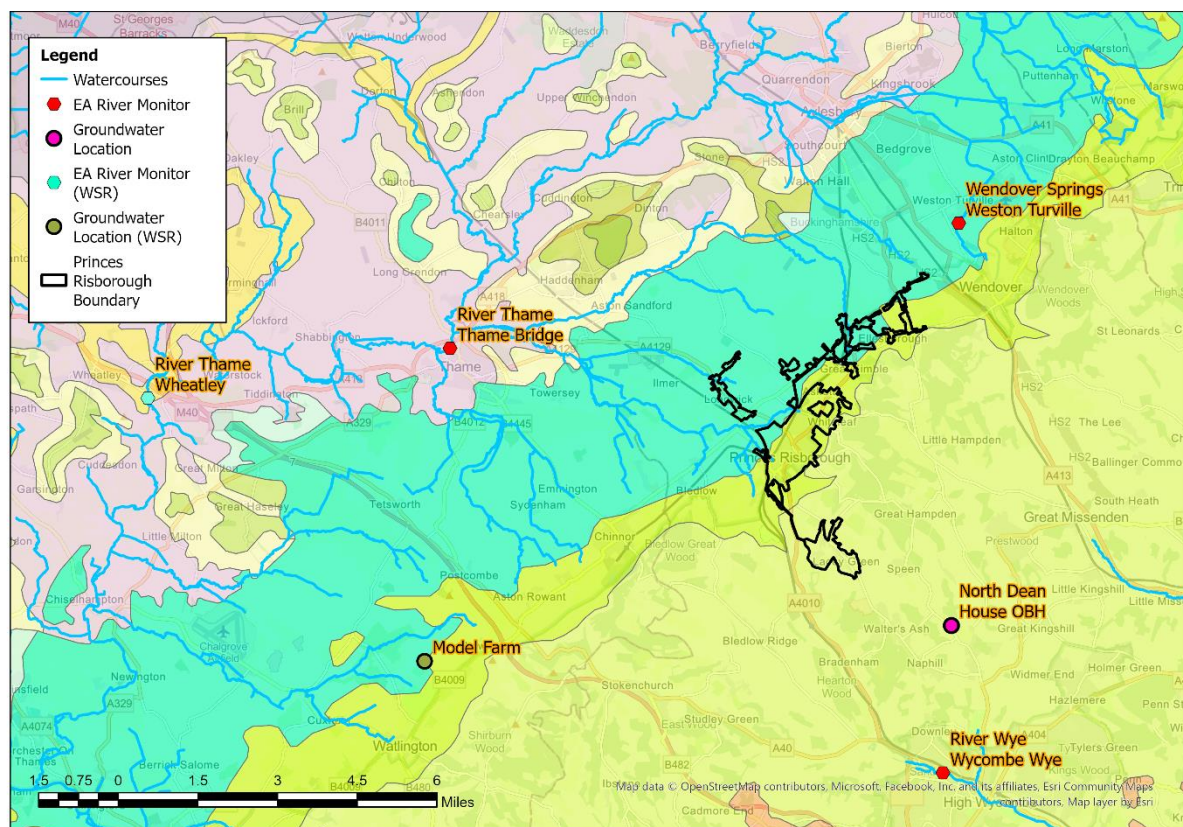
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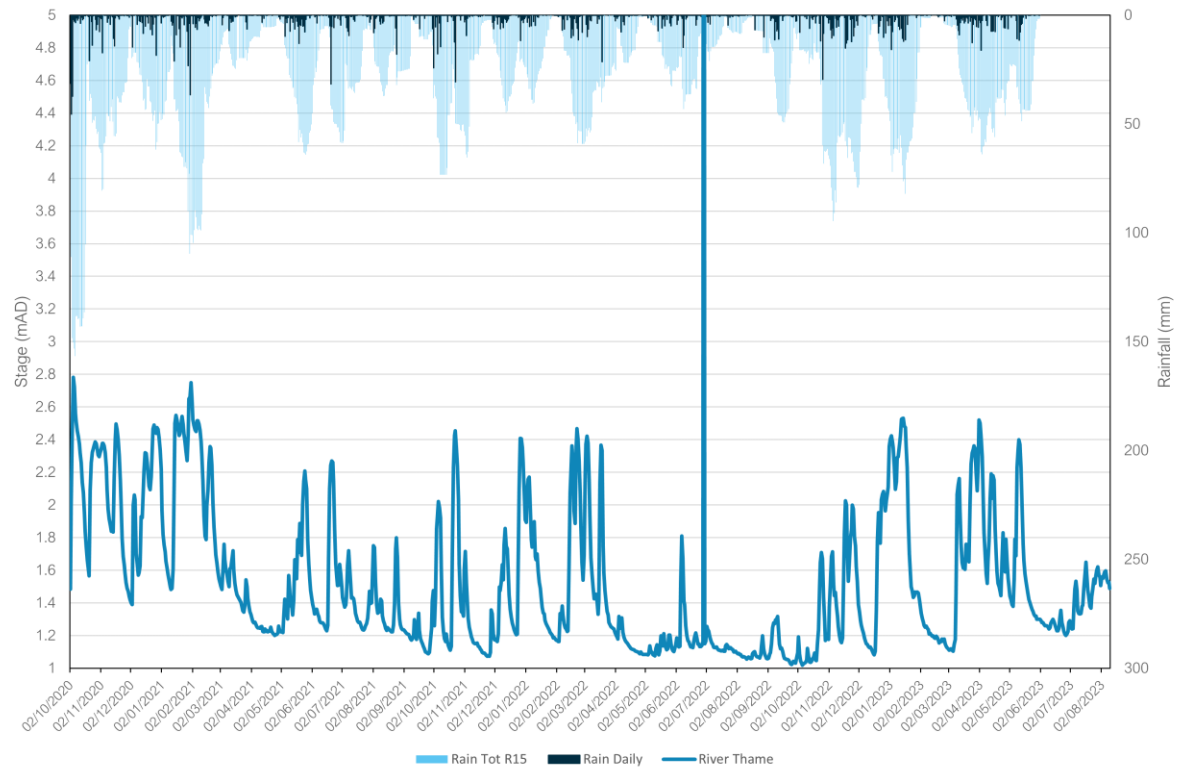


Figure 5B – Wendover Springs, Weston Turville

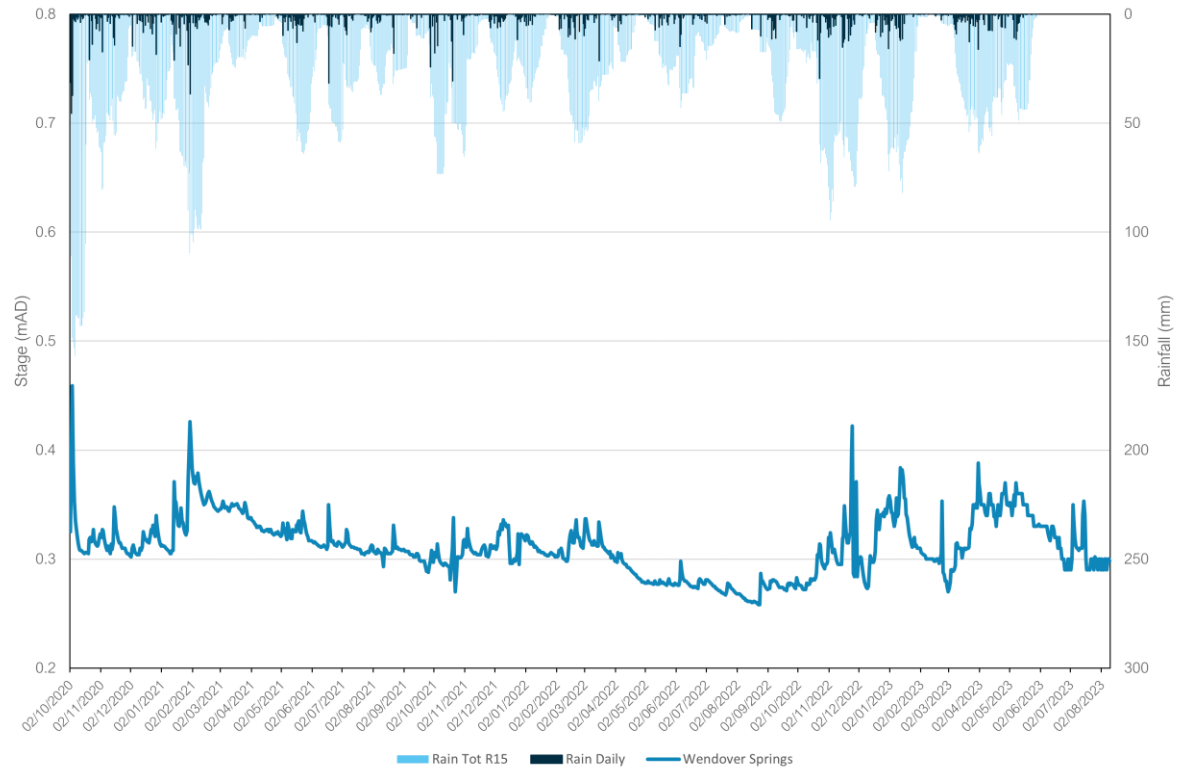


Figure 5C – River Wye, Wycombe Wye

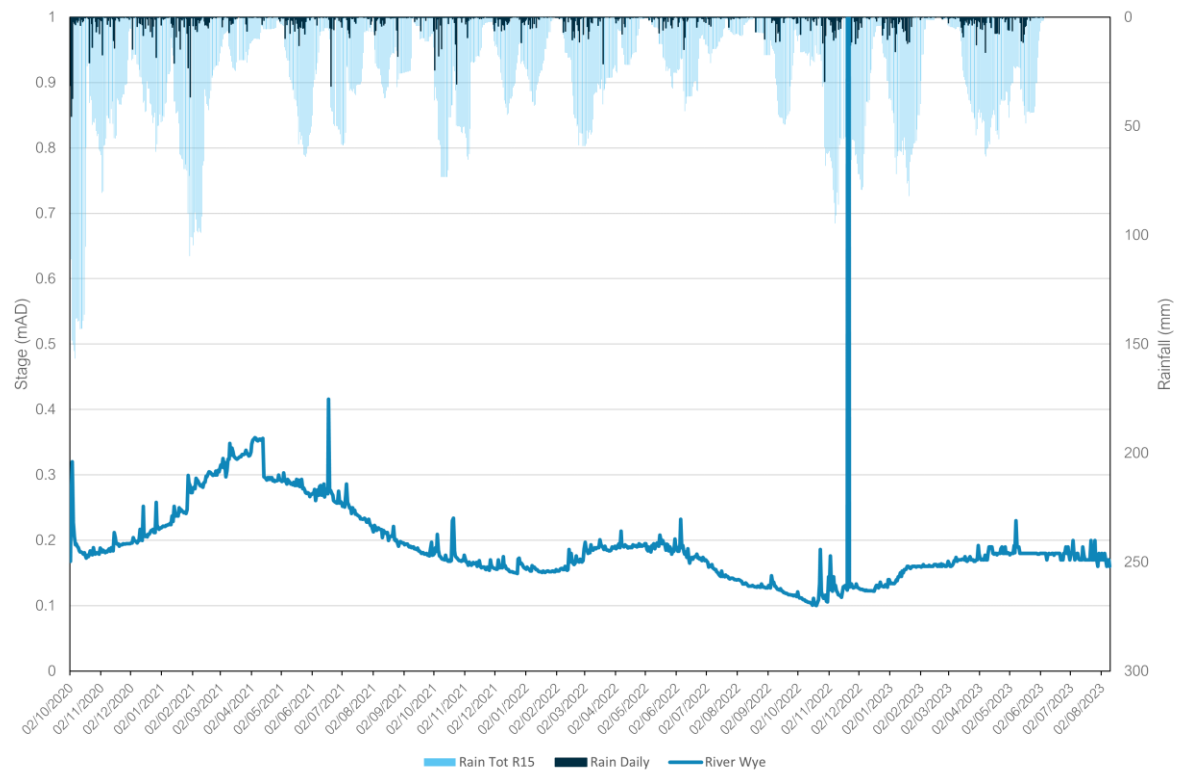
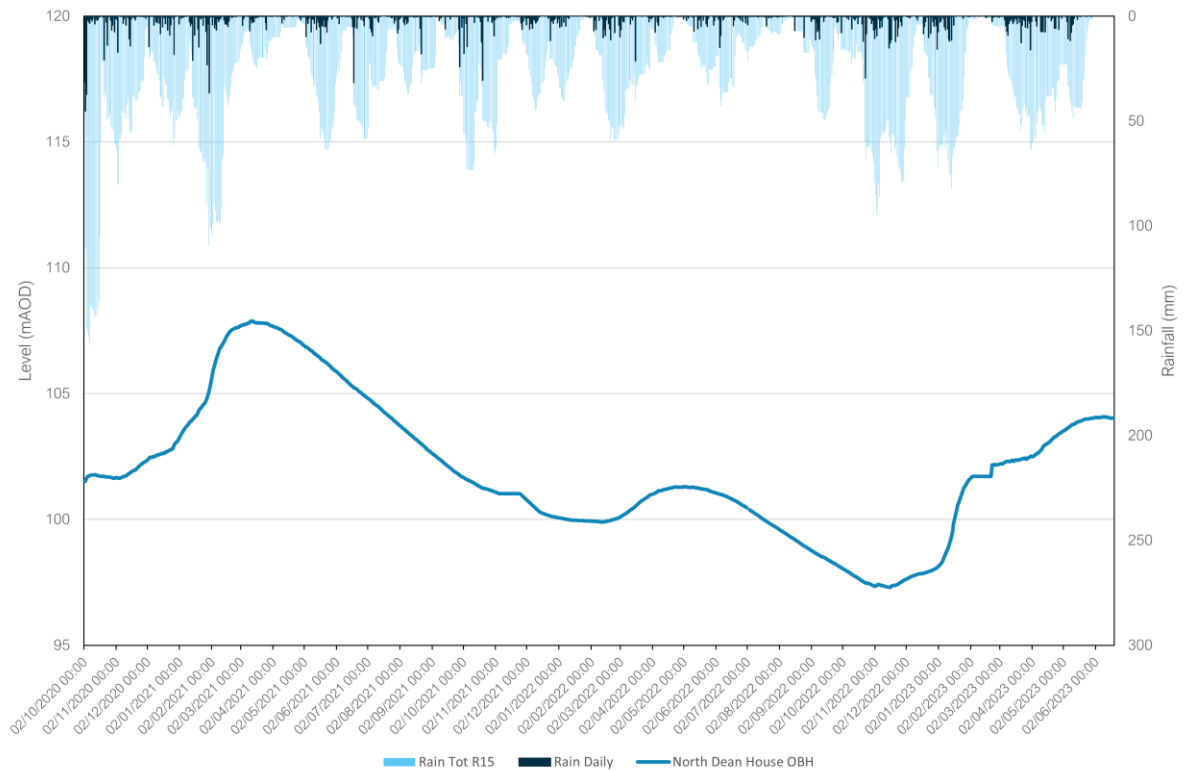
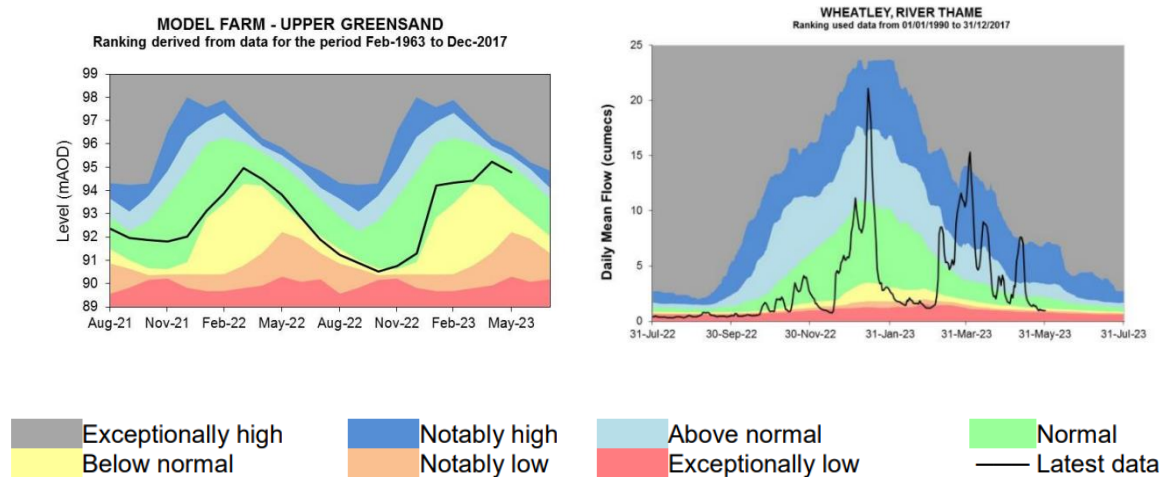


Figure 5D – North Dean House OBH



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for the Thame. The nearest groundwater reference station is Model Farm. This site shows groundwater levels generally at just above below normal levels in 2022, and at normal levels in 2023. This can be seen in the figure below alongside the river indicator location at Wheatley on the River Thame.

Figure 6 – Water Situation Report



Extract from - [Water Situation Report \(publishing.service.gov.uk\)](https://publishing.service.gov.uk)

Network Performance

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

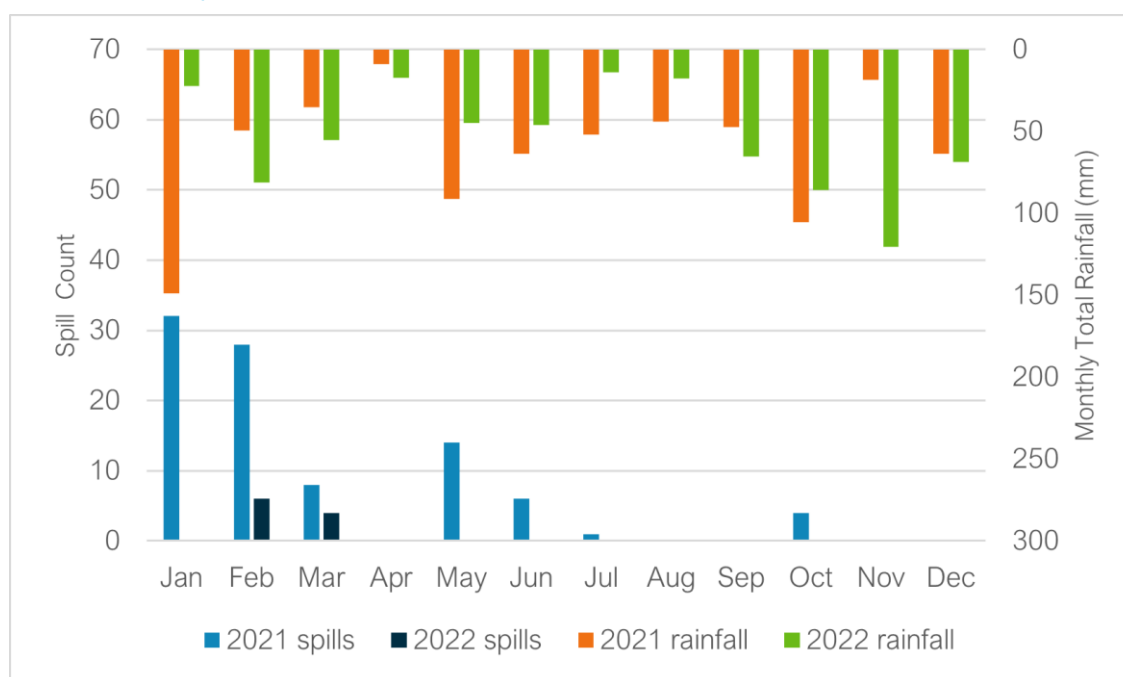
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Princes Risborough STW	93	1685.68	10	58.24

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 trend in spill performance across the two recorded years does show variation in spills, with a focus on spills in the winter months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. Despite a higher rainfall total in February 2022, significantly more spills were recorded at Princes Risborough STW in February 2021. The indicator site data shown in Figure 5, suggests groundwater levels in the catchment were significantly higher in February 2021, with Figure 6 suggesting they were just above below normal levels in February 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 3 monitors installed within the Princes Risborough 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 Princes Risborough 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	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.

An upgrade is also planned for Princes Risborough STW. This will improve its ability to treat the volumes of incoming sewage, reducing the need for untreated discharges to the environment. The scheme is due to be completed in 2027.

Summary

Indicator site data suggests groundwater levels in the Princes Risborough 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, some of the indicator site data available, 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 spills in the 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.

Addendum - Annual Update 2024

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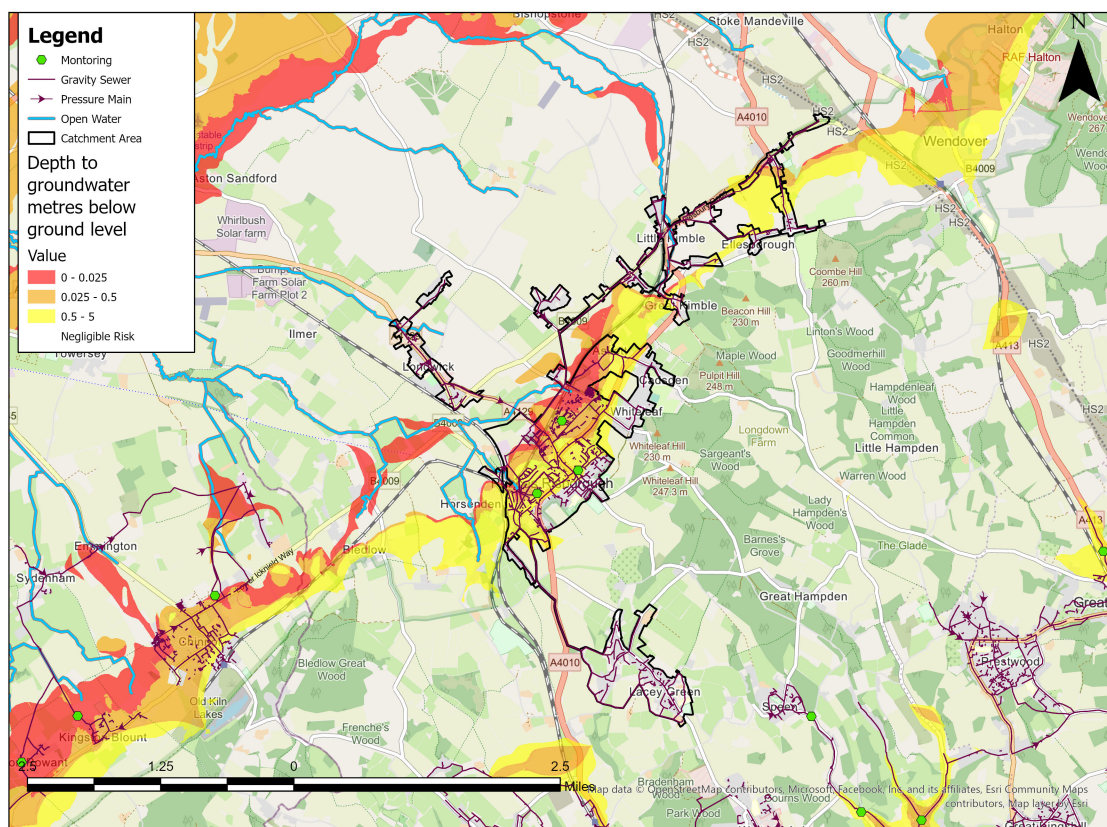
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Overview

This addendum to the Princes Risborough Groundwater Impacted System Management Plan 2021 (GISMP) provides an update on performance/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 being planned
- Summary and plan for 2024/25

Figure 1 – Princes Risborough Monitoring Plan



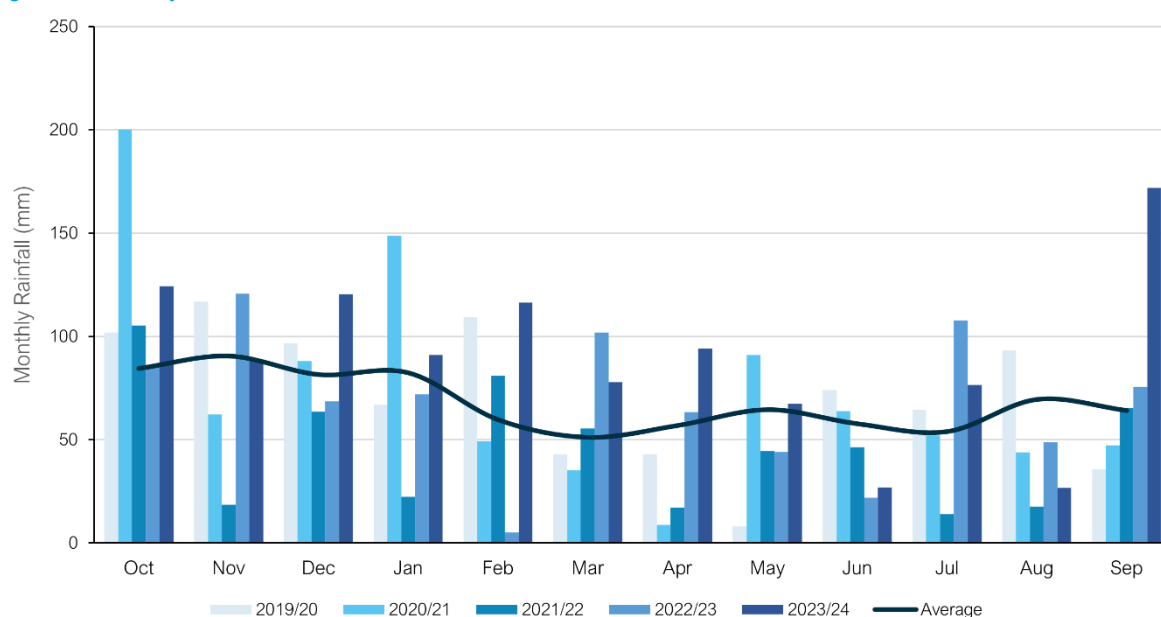
Hydrological Review – 2023-2024

This section summaries the hydrological conditions within the Princes Risborough 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 32% 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	853	891	551	816	1082

Groundwater / Local River Level

The Princes Risborough catchment is situated in the Thame and Chilterns West water resource areas. It primarily sits in West Melbury Marly Chalk Formation of carbonate material forming distinctive beds of chalk, the Gault Formation of coarse to fine grained sediments and the Upper Greensand Formation of coarse to fine grained sediments. The West Melbury Marly Chalk Formation and the Upper Greensand Formation are designated principal aquifers within the UK.

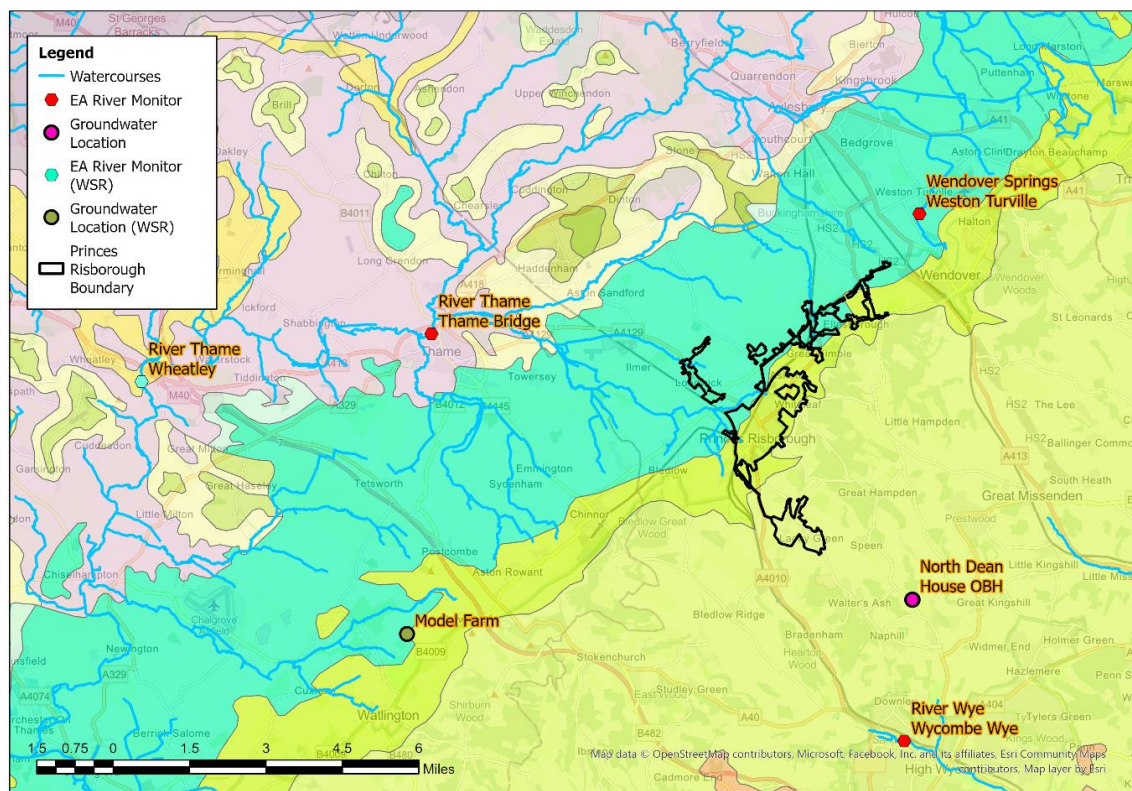
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes (OBH) measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

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

- River Thame, Thame Bridge.
- Wendover Springs, Weston Turville.
- River Wye, Wycombe Wye.
- North Dean House OBH.

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-5D 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 there is a gap in the data for North Dean House OBH between February 2024 and April 2024 due to site monitoring issues.

Figure 5A – Thame, Thame Bridge

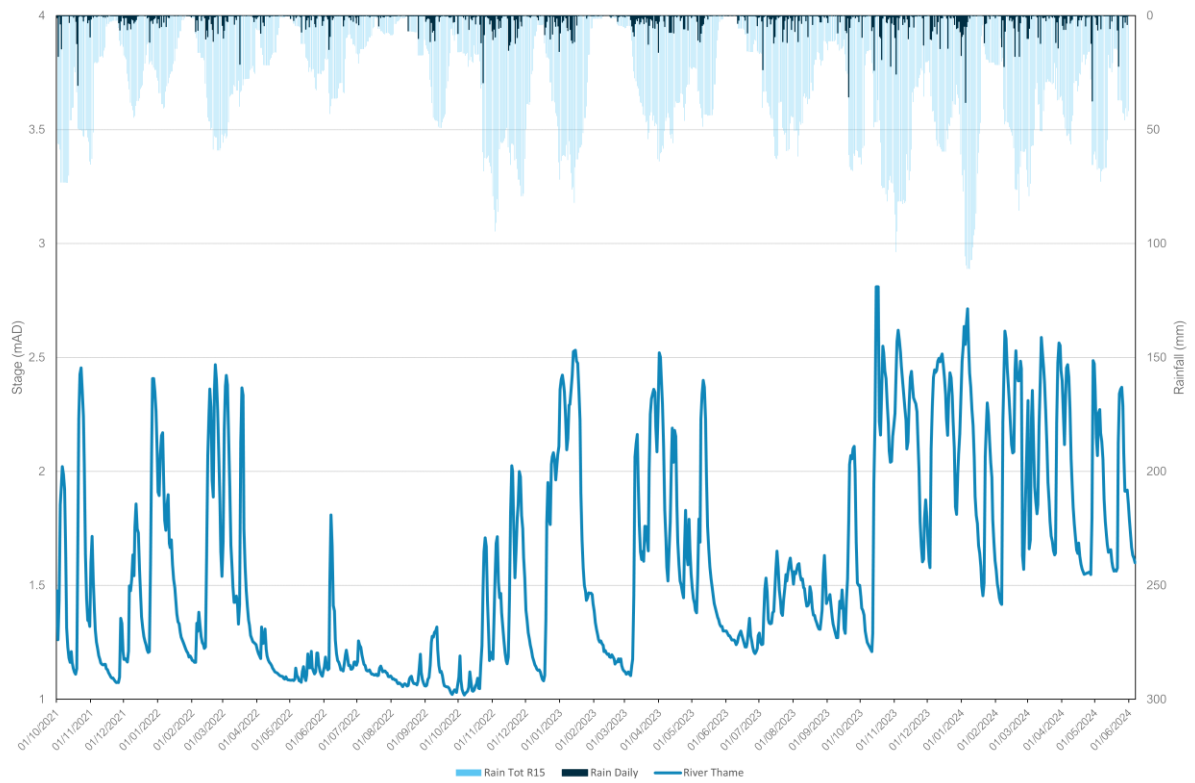


Figure 5B – Wendover Springs, Weston Turville

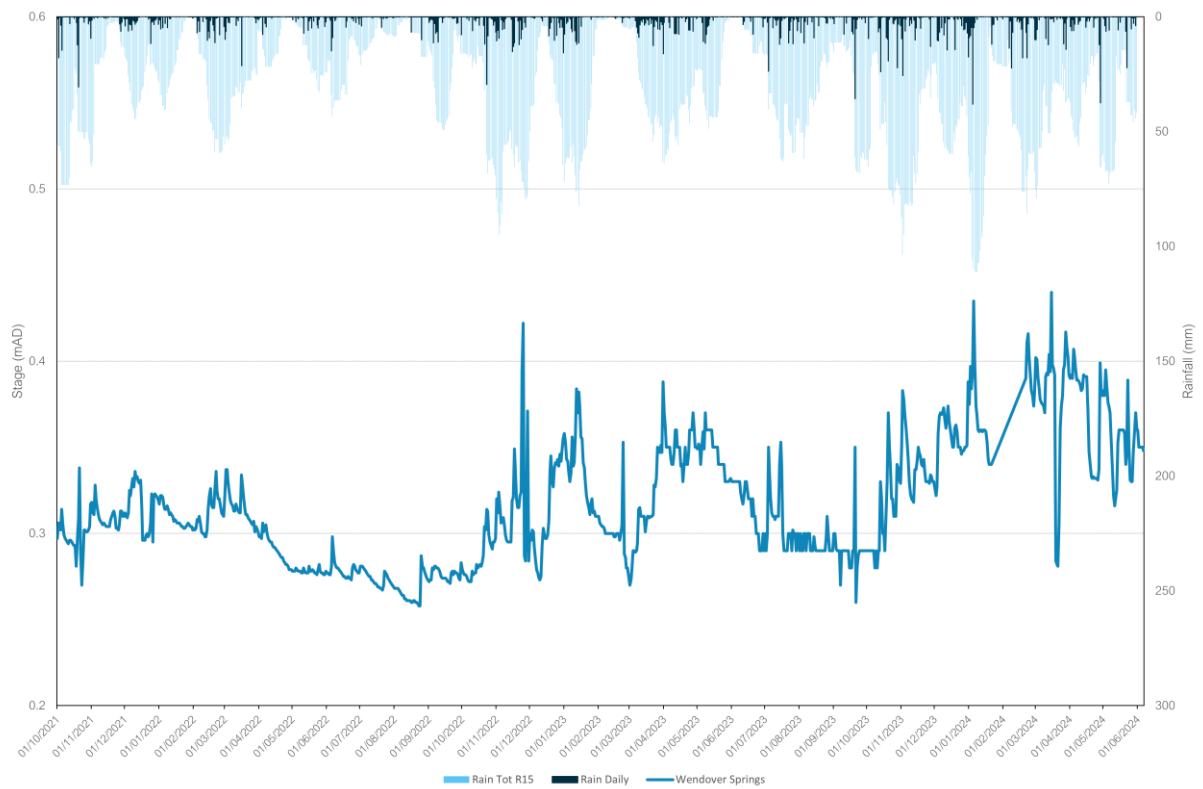


Figure 5C – River Wye, Wycombe Wye

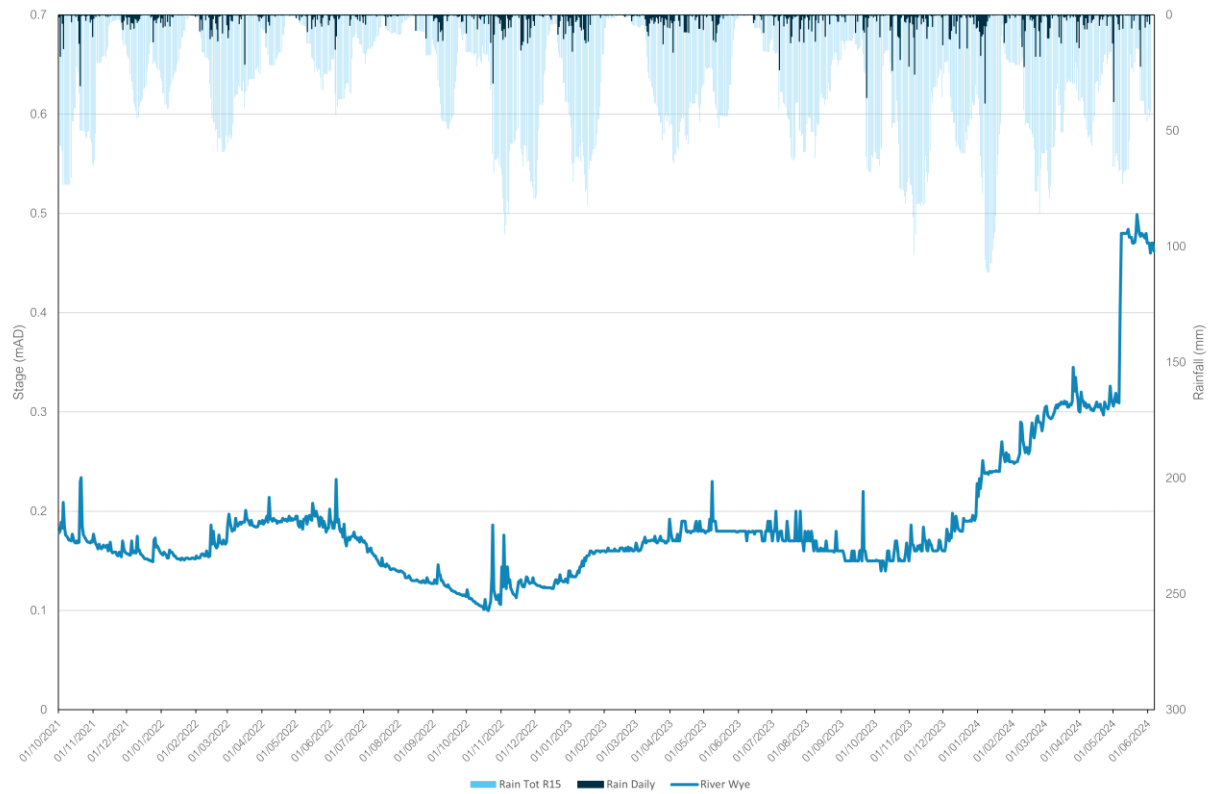
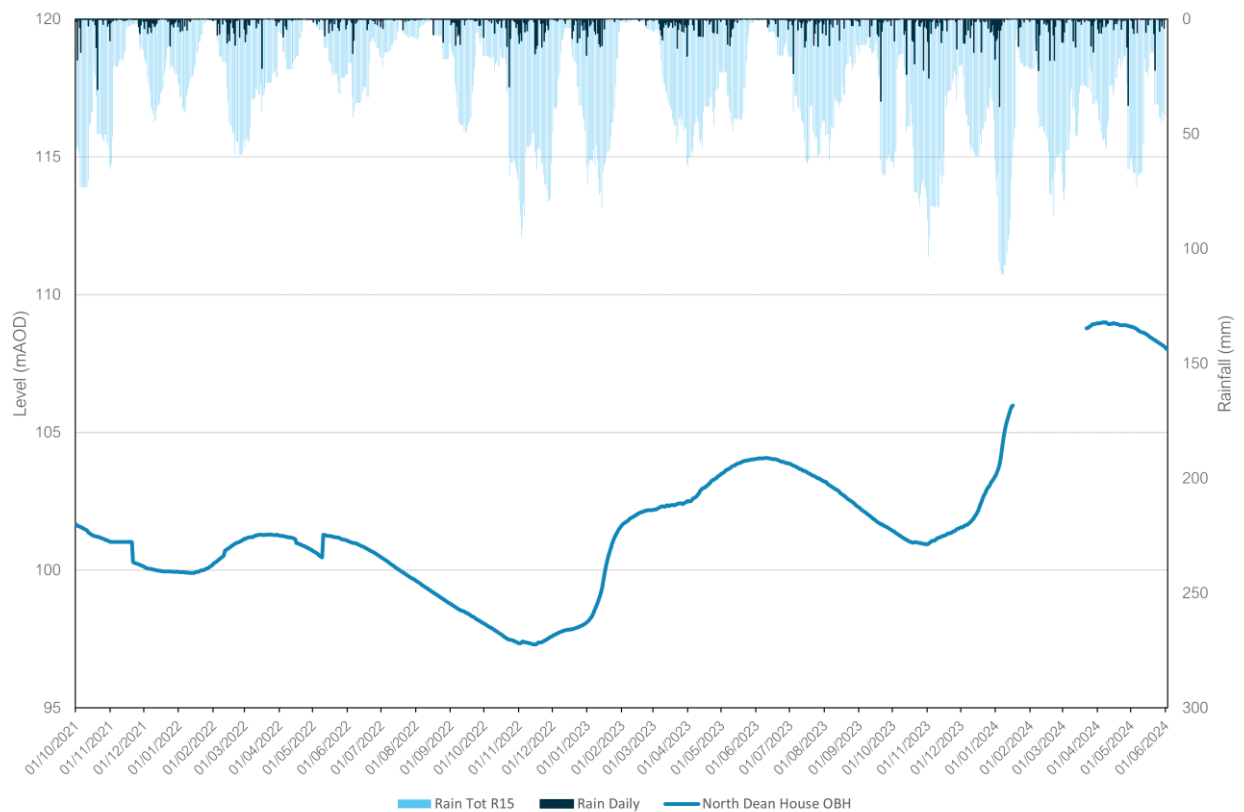
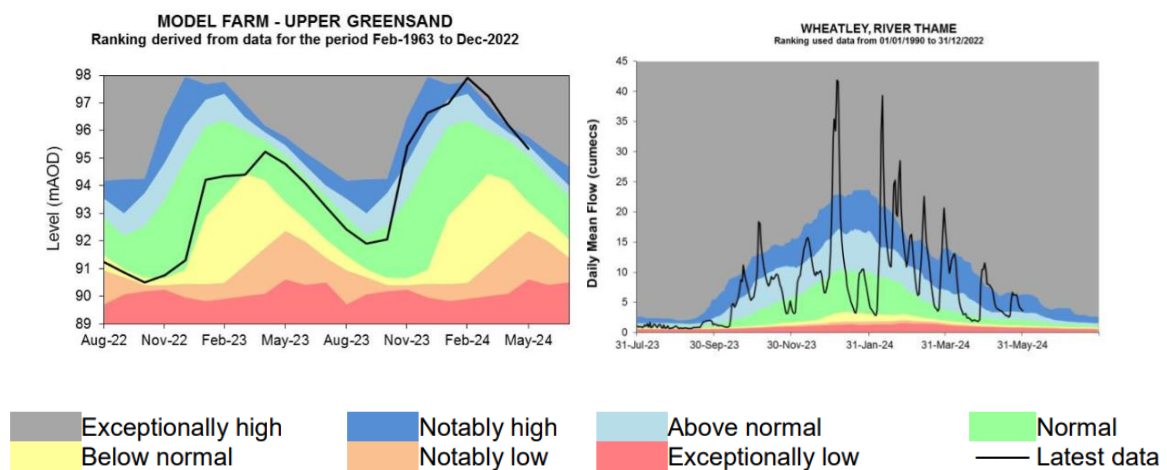


Figure 5D – North Dean House OBH



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for the Thame. The nearest groundwater reference station is Model Farm. This site shows groundwater levels were in the normal range until late 2023, before rising to above normal/ notably high levels. Groundwater levels have remained high in 2024 and were observed at exceptionally high levels in February 2024. This can be seen in Figure 6 alongside the river indicator location at Wheatley on the River Thame.

Figure 6 – Water Situation Report



Extract from - [Water Situation Report \(publishing.service.gov.uk\)](https://publishing.service.gov.uk)

Network Performance

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

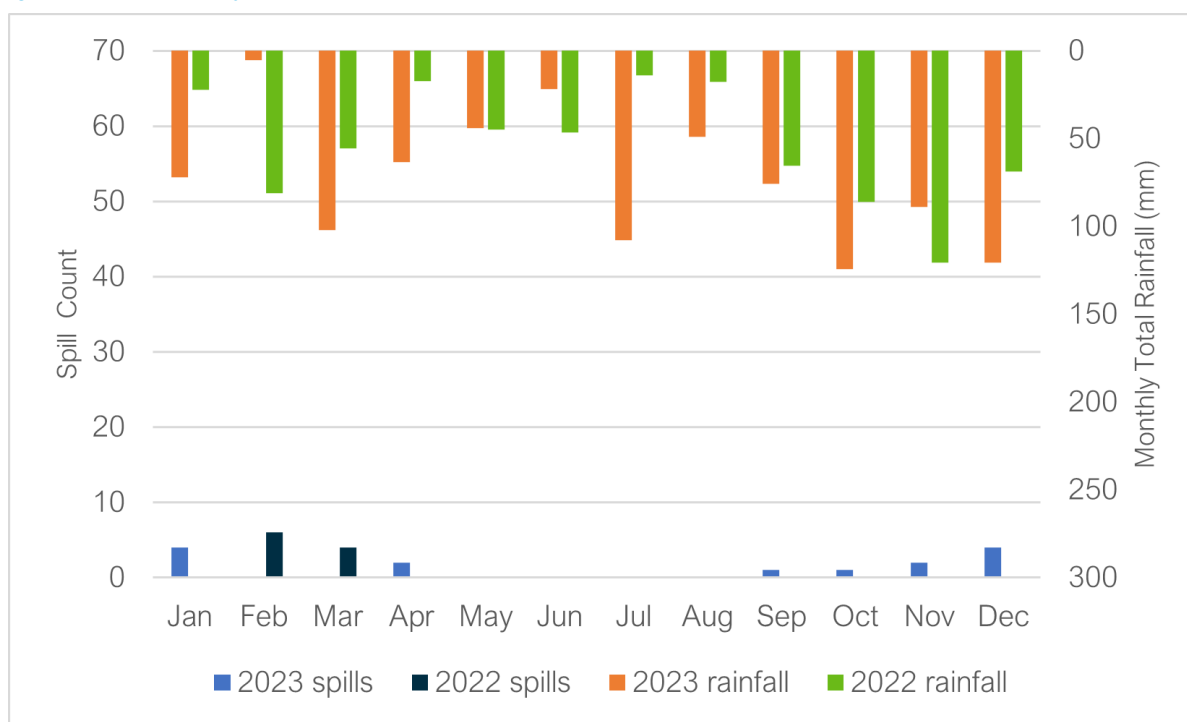
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Princes Risborough STW	10	58.24	14	119.75

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. A relatively high number of spills occurred in the catchment in November and December 2023, when the indicator site data shown in Figures 5 and 6 suggests that groundwater levels in the catchment began to rise. Based on the Model Farm indicator site data shown in Figure 6, groundwater levels in the catchment reached notably high levels during this period.

For further discussion regarding the relationship between rainfall, elevated groundwater levels and spill frequency in the catchment, see the 2023 Addendum Report included in this PDF document.

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 3 monitors installed within the Princes Risborough 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 Princes Risborough 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 Hydrological Year, 2022/23 Hydrological Year & 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	N/A
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

Tankering was required within the catchment during the 2023/24 Hydrological Year. Three days of flow management was undertaken at Terrick SPS from 31st December 2023 – 2nd January 2024.

No interventions/ investigations were carried out in the catchment in the 2023/24 Hydrological Year. However, the system will continue to be monitored and investigations/ interventions carried out as appropriate and when conditions allow.

An upgrade is also planned for Princes Risborough STW. This will improve its ability to treat the volumes of incoming sewage, reducing the need for untreated discharges to the environment. The scheme is due to be completed in 2027, though 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 that this catchment will meet government storm overflow targets by 2030 – 2035.

Summary

Indicator site data suggests groundwater levels in the Princes Risborough catchment have been significantly higher in the 2023/24 Hydrological Year than in the previous hydrological year. The EDM data for 2023, is indicative of a wider relationship between rainfall, elevated groundwater levels and spill frequency in the catchment. The impact of higher groundwater levels in 2024 will be assessed using the EDM data for 2024, once this is available, to further improve understanding of the relationship between groundwater levels and spills in the 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