



Groundwater Impacted System Management Plan

Benson, River Thames

July 2021



It's everyone's water

Version control

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1-d1	19/06/2021	Draft for EA	AJ	SE	DJ
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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 being significant and likely to lead the sewerage system, on occasions, becoming 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 centred on a 'find and fix' basis which has involved monitoring and investigating the networks in periods of high groundwater to identify sources of ingress and fix as we find them. This approach is constrained for the reason that investigations are typically limited to periods of high groundwater and when high groundwater occurs there are limited windows of time in which investigations can be successfully undertaken before flows either subside or the system is fully surcharged meaning CCTV surveys are not 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 the medium to 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 Benson catchment

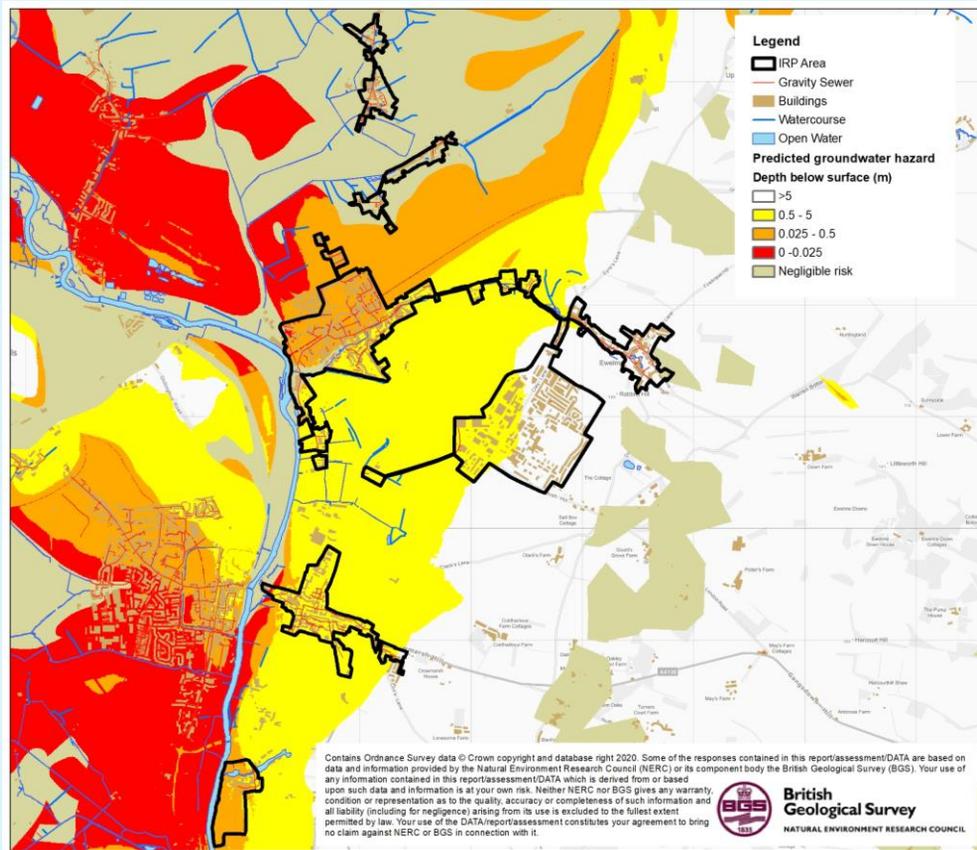


Figure 1.0 – Benson catchment

Benson is located in South Oxfordshire, England, approximately a mile and half north of Wallingford. Benson serves a population equivalent³ of 8269 with a partially separate sewerage network totaling some 48.95 km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above.

Problem characterisation

Groundwater has the potential to enter our sewers when groundwater levels are high and a positive head above the offset of the sewer is created. Significant groundwater ingress can impact sewer capacity and increase the risk the sewerage system becoming overwhelmed. There's a strong link between rising river levels and rising groundwater levels, particularly adjacent to the Crowmarsh Gifford, Roke, Ewelme and Berrick Salome streams, and the drainage issues some of our customers have experienced, including sewer flooding and restricted use of their toilets and bathrooms.

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 Benson system has on occasions become overwhelmed, following prolonged and heavy rainfall and raised groundwater levels. This resulted in operational problems at Roke Marsh pumping station, in addition to some properties experiencing sewer flooding and restricted toilet use.

The sewerage system is identified on the public sewer records as being a partially separate foul system, rather than a combined system. We believe that significant volumes of surface water runoff from surrounding saturated fields 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 into the foul sewer network when groundwater levels are high, and surfacewater inundation from highways, public spaces and properties and fluvial flooding from local watercourses. Surface water misconnections (i.e. downpipes 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.

The unwanted flows in the Benson system has contributed to the overloading of the gravity sewers in the local villages and the Sewage Treatment Works (STW). To maintain sewerage services, tankers were used extensively during the winter of 2012/13 at Roke Marsh pumping station to prevent foul water flooding of properties.

In addition to essential repairs to the pumps at Roke Marsh pumping station, there have been a number of upgrades to the Benson sewage treatment works to meet changing performance criteria. However, further investigations are needed to understand the full extent of problems in the catchment (and sources of unwanted flow) in order to be certain of the full range of solutions required.

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.

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

During the winter months, following prolonged heavy rainfall, we often experience increased rates of flow arriving at the STW which on occasions may impact the performance of the STW.

Our permit conditions for Benson 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 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 West Oxfordshire District Council as Lower Tier 1 and Oxfordshire County Council as Lead Local Flood Authority, County Council and 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).

Anticipated unavoidable discharges

Within recent years there have been unavoidable sewage escapes in the network as a result of surcharging man-holes.

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

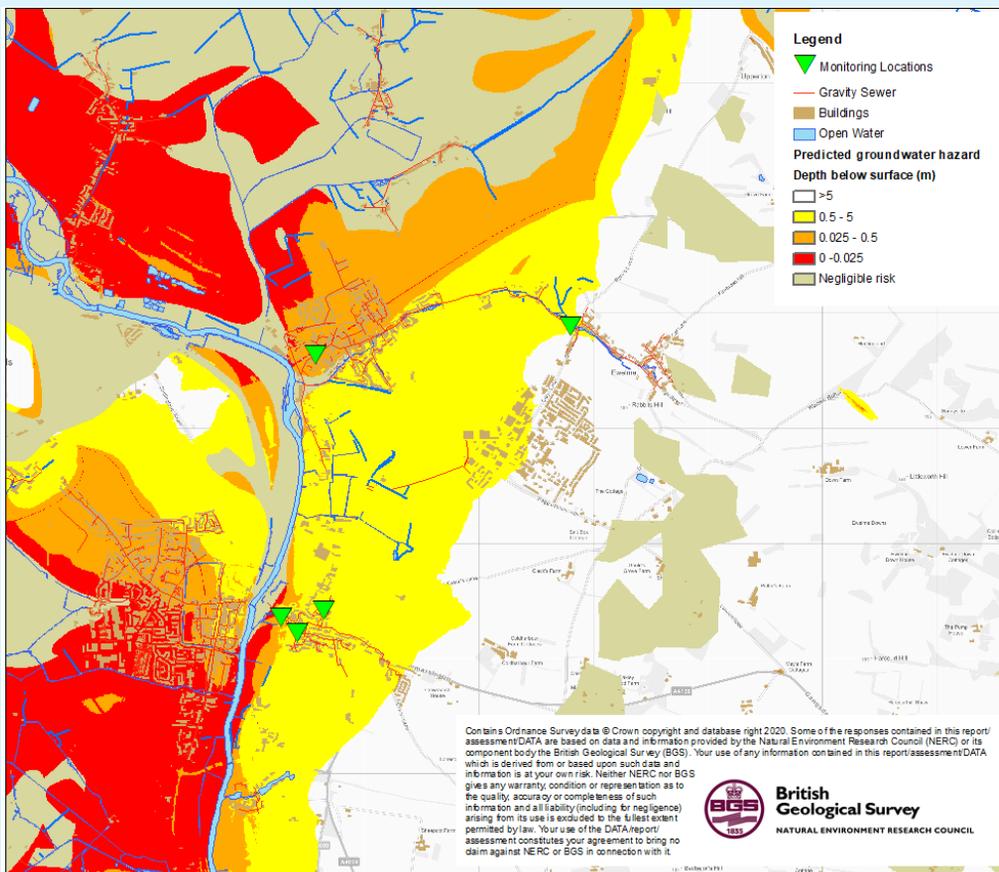


Figure 2.0 – Benson monitoring and infiltration zones

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 Benson system – see Figure 2.0.

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 Benson 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 systems 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 Benson.

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	2020	Monitors have now 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	2021-2023	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, results of monitoring and successful submission of our plans for future 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	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.

Benson Infiltration Management Plan

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

As part of our current investment plan, we have a project to increase the flow to full treatment at Benson STW. The main driver for the upgrade is growth, however the rate of maximum observed infiltration is considered as part of the calculation for the new treatment flow rates. This work is programmed to be completed by 31/03/2023.

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

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

High level approach statement

For Benson 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 (2020 to 2023). Each year we will assess the completeness of monitoring and if required add to or modify the current locations.

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

The purpose of these units is to act as alerts for high groundwater impact in the sewer, calibration of the zones of infiltration risk and to demonstrate benefit gained from work undertaken to reduce infiltration. 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 Benson we do not envisage needing to undertake further 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	7.96	33.3
Medium	Predicted groundwater extreme 0-1m above pipe invert	5.11	21.3
Low	Predicted groundwater extreme 0-1m below pipe invert	2.48	10.3
Very Low	Predicted groundwater extreme >1m below pipe invert	8.42	35.1
Total		23.97 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	108	15.3
Medium	Inundation risk in 1% AEP fluvial or pluvial event	80	11.3
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	132	18.6
Very Low	All other manholes	388	54.8
Total		708	100.0

⁶Total 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

Large scale Lift and Look and CCTV surveys have not yet commenced in the Benson system. A summary of findings will be provided in the next update of this report.

Our local operational teams have undertaken some localised Lift and Look and reactive remediation as outlined in the table below.

2020/21 Implementation Works

Activities	Value	Comment
Sewer Lining Length (m)	106	
Infiltration Points Targeted (no.)	0	
Manhole Sealing (no.)	3	

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

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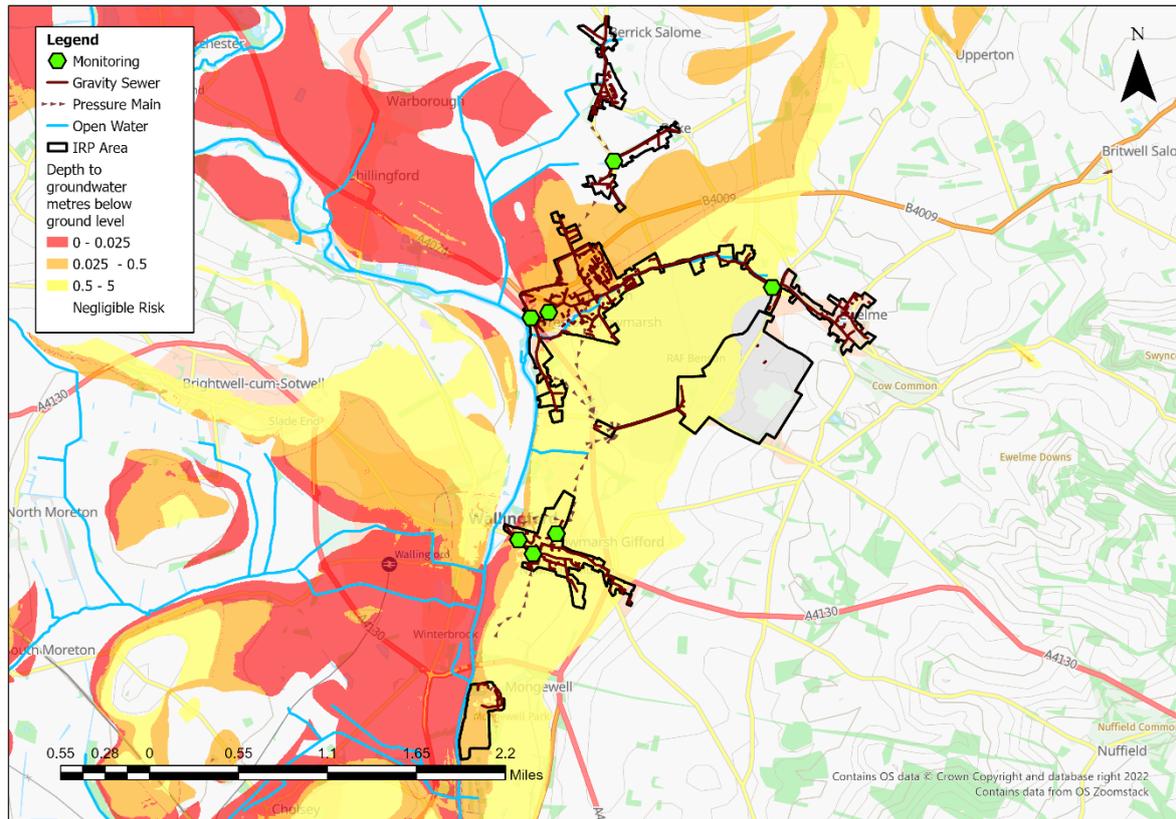
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Overview

This addendum to the Benson 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 – Benson Monitoring Plan



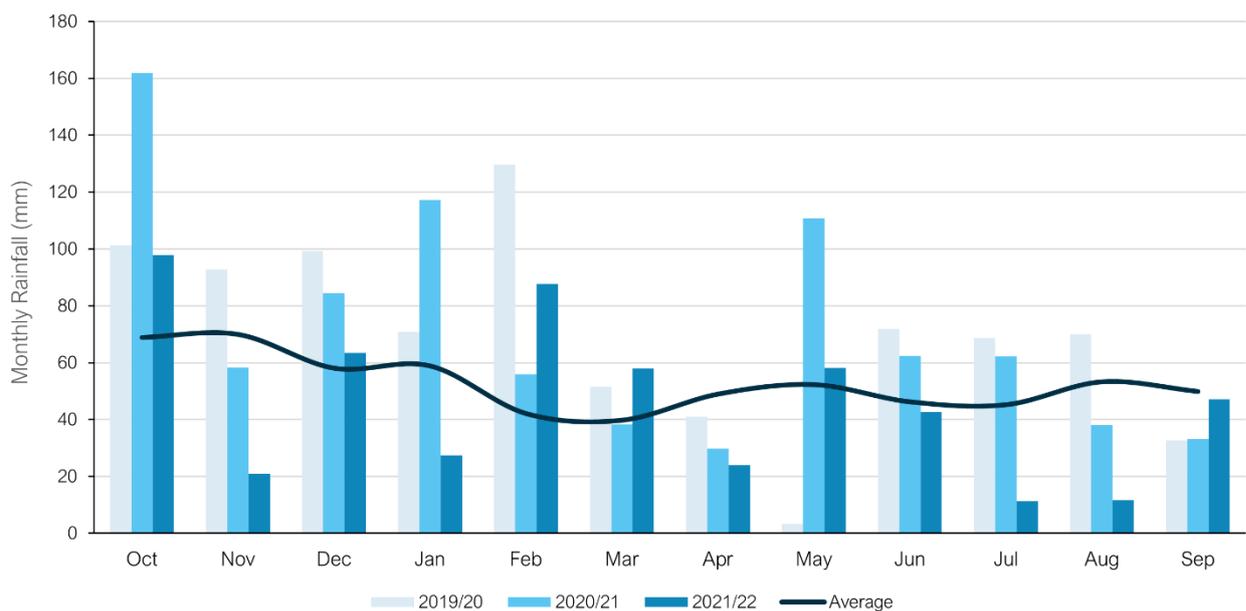
Hydrological Review – 2021-2022

This section summaries the hydrological conditions within the Benson 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 Benson based on the period 1991-2020

The total rainfall for the 2021/22 hydrological year is 11% 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)
634	833	853	562

Groundwater / Local River Level

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

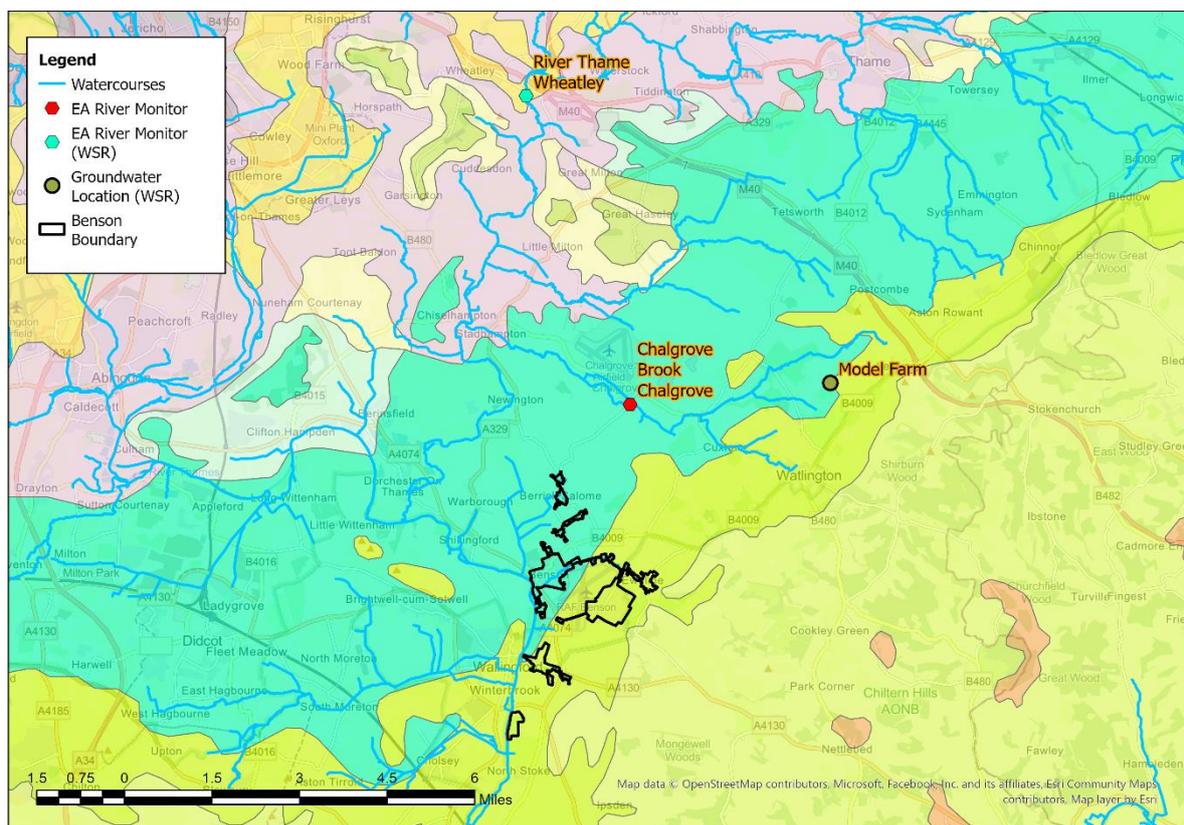
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

From previous investigations we have identified the following site is a good indicator of groundwater levels within the catchment.

- Chalgrove Brook, Chalgrove

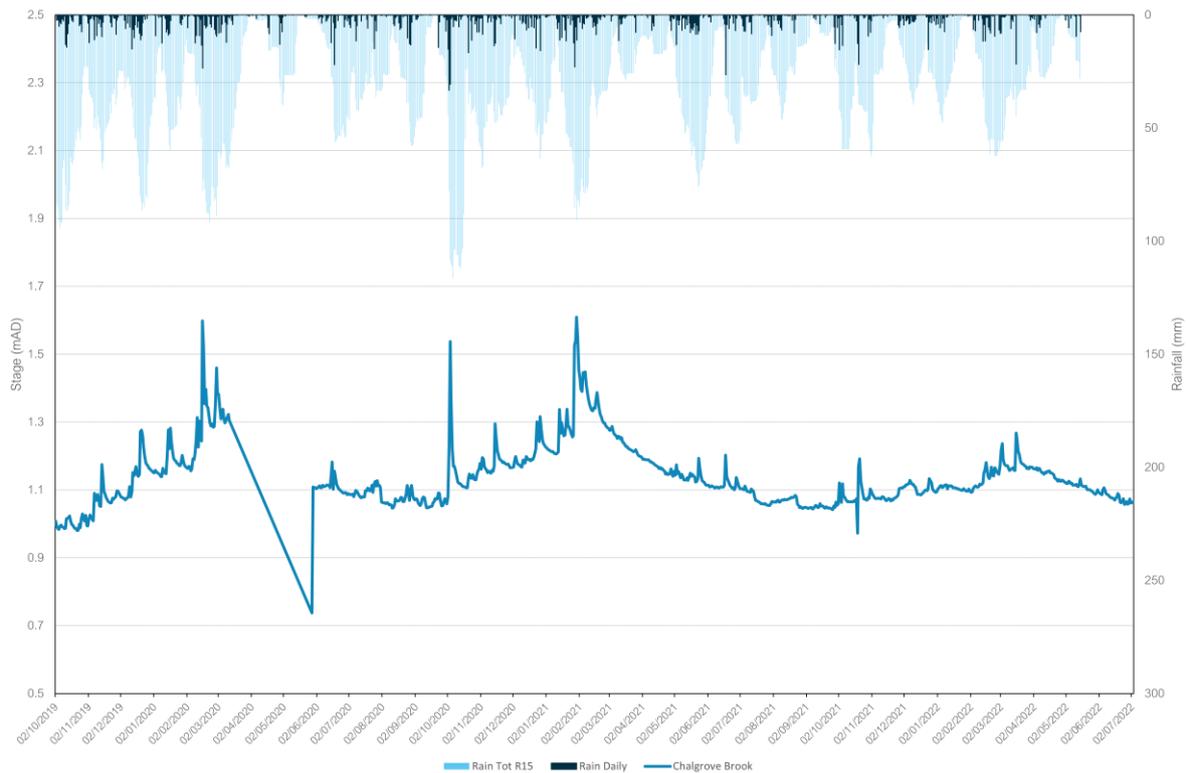
This site is illustrated in the figure below, alongside the closest groundwater reference station and closest gauging station from the Water Situation Report.

Figure 4 – Local Monitoring Stations



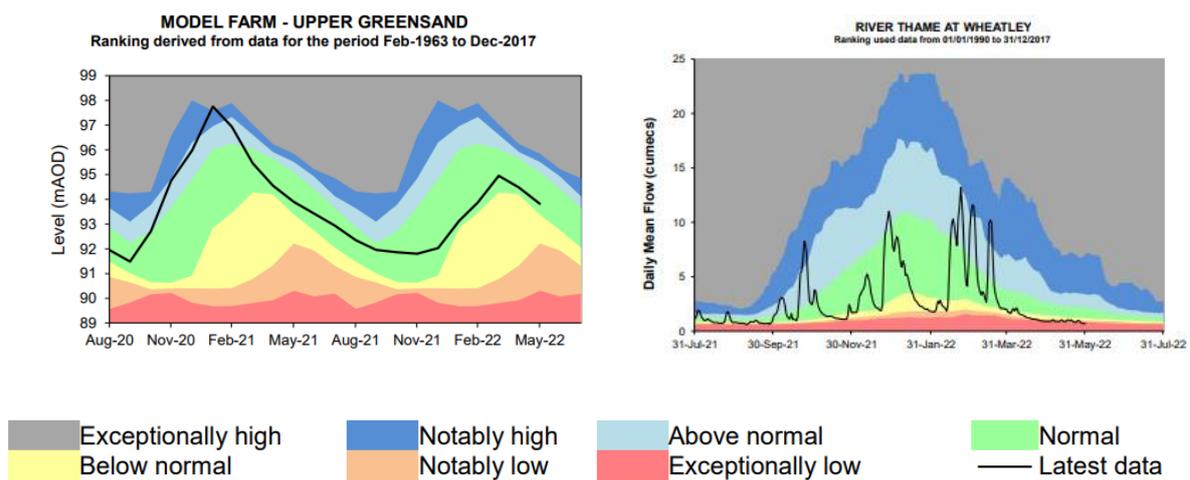
The following figures represent the last three hydrological years of level information at the indicator sites to build a picture of the relative conditions prevalent in the current year. It is presented against both the daily total rainfall values for the catchment and a rolling 15 day total rainfall.

Figure 5A – Chalgrove Brook, Chalgrove



In addition to this specific station, the wider groundwater context is illustrated in the Water Situation Report for the Ock. 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 Thames.

Figure 6 – Water Situation Report



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

Network Performance

Within the Benson 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.

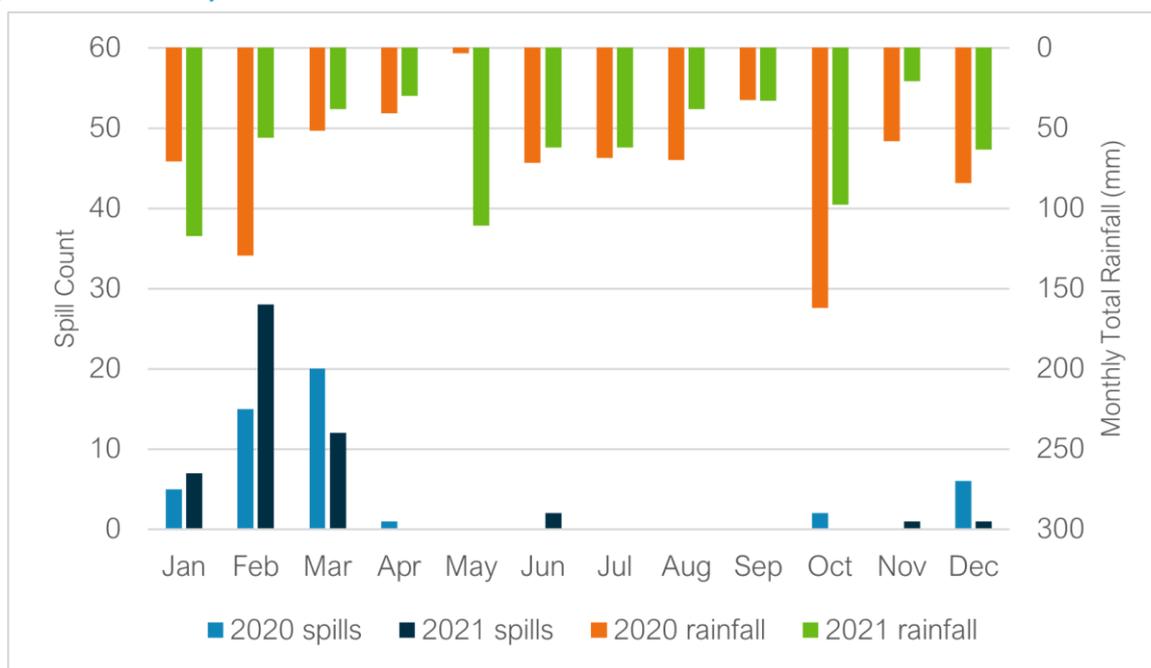
Table 7 – Event Duration Monitoring

Overflow	2020		2021	
	Spills	Duration (hours)	Spills	Duration (hours)
Benson STW	49	992.67	51	869.98

Note that a spill count of 49 is stated for 2020, which is lower than the published figure of 56. The spill count data has been revalidated/corrected and the revised figure of 49 will be included in the 2020 re-submission.

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, with a slower tail off in spills evident within the first half of 2020, when the Chalgrove Brook indicator site suggests groundwater levels in the catchment were higher than within the first half of 2021. The higher spill frequency in December 2020, which had broadly similar rainfall to December 2021, is also indicative of the role of elevated groundwater levels, as the indicator sites suggest groundwater levels 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 7 monitors installed within the Benson catchment. There are no further monitor installs currently 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 Benson 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

With the seasonal trends in groundwater having been low in comparison with previous years and the SDM installations generally not showing significant groundwater presence, the larger scale identification, survey and remediation of the sewerage system has not been possible within this hydrological year.

Summary

Rainfall in the Benson catchment over the 2021/22 hydrological year has been below average, with groundwater levels in the aquifer beneath Benson 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 spills recorded at Benson 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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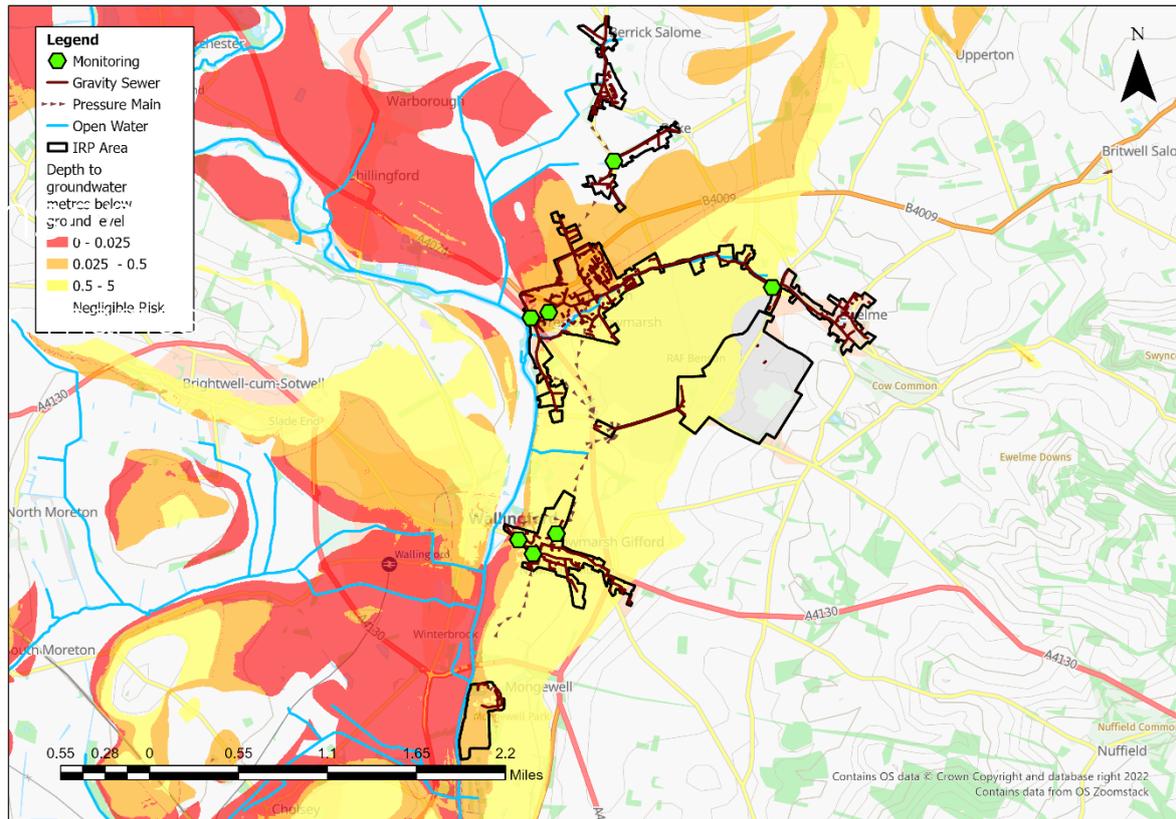
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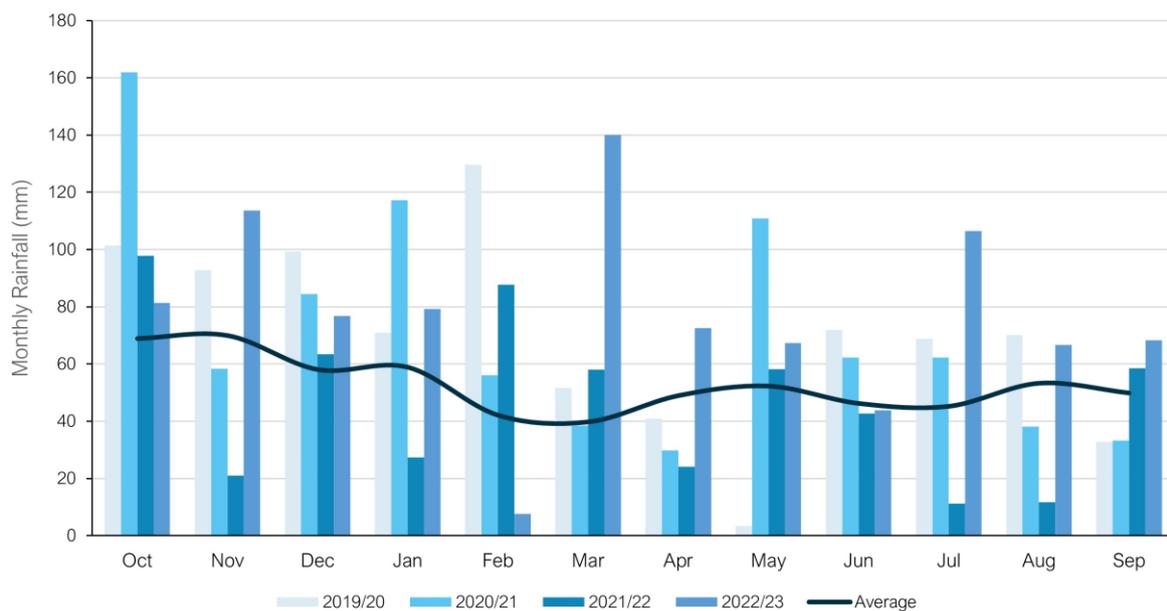
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Catchment Rainfall

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

Figure 2 – Monthly Rainfall Performance



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

The total rainfall for the 2022/23 hydrological year is 46% 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)
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Groundwater / Local River Level

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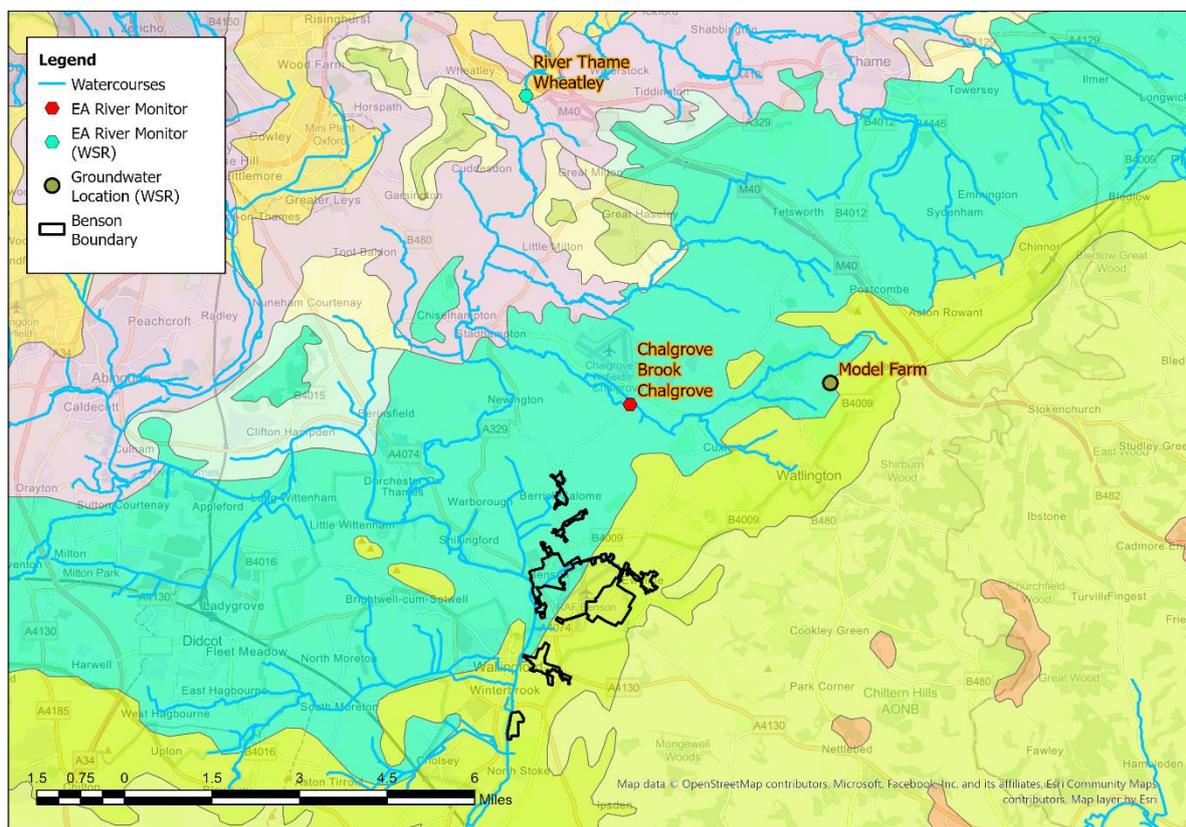
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes (OBH) measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

From previous investigations we have identified the following site is a good indicator of groundwater levels within the catchment.

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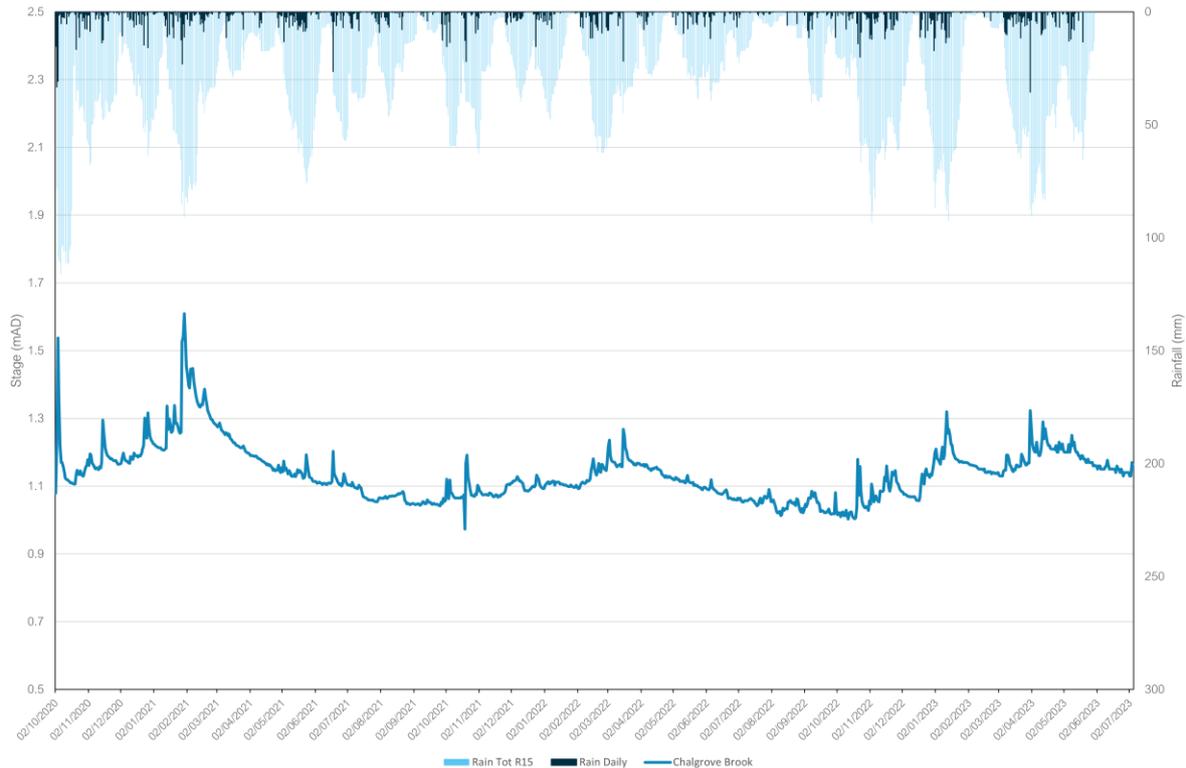
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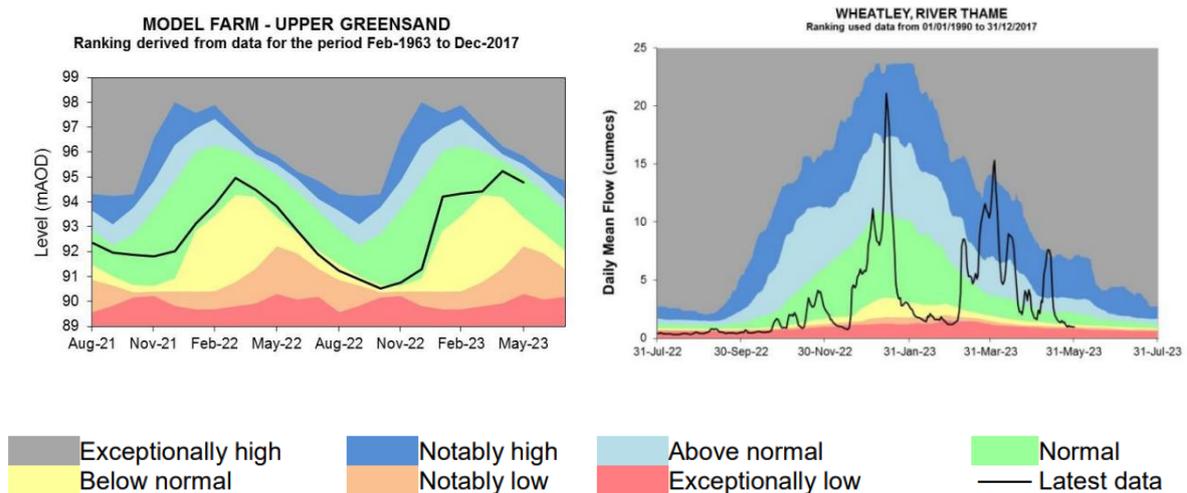
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Figure 5A – Chalgrove Brook, Chalgrove



In addition to this specific station, the wider groundwater context is illustrated in the Water Situation Report for the Ock. The nearest groundwater reference station is Model Farm. This site shows groundwater levels were mainly in the normal range during 2022, with periods when groundwater levels were below normal. Groundwater levels are observed at normal level during 2023. This can be seen in the figure below alongside the river indicator location at Wheatley on the River Thames.

Figure 6 – Water Situation Report



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

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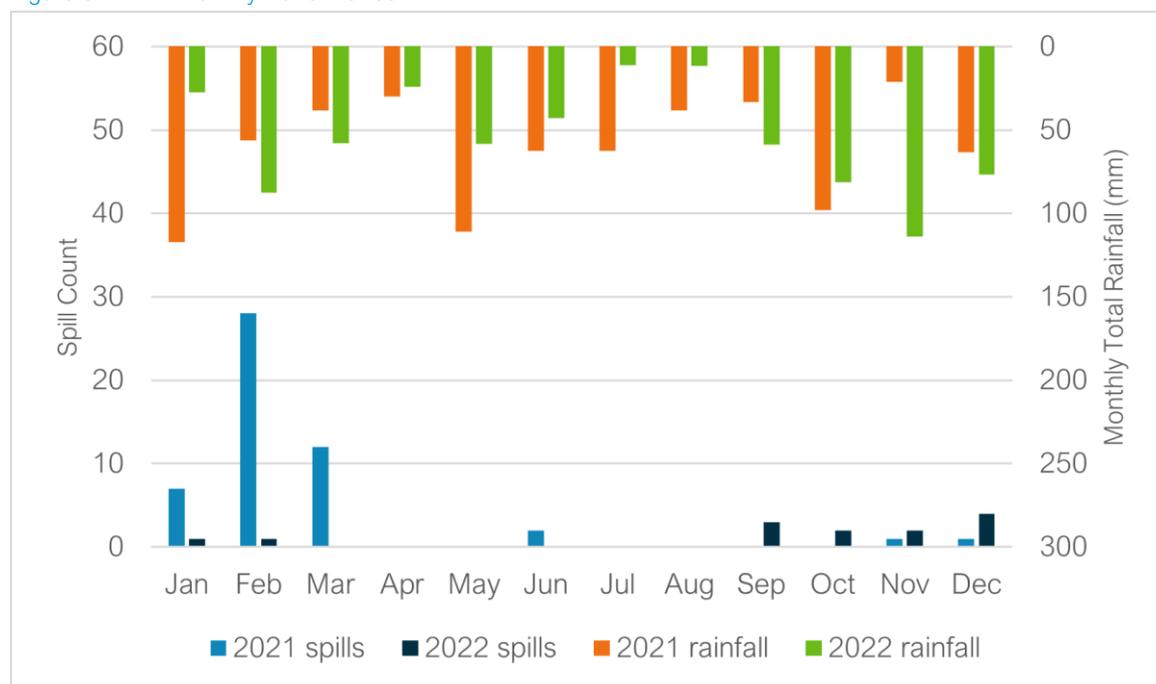
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Benson STW	51	869.98	13	2.14

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 during 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 compared to February 2021, only one spill was recorded at Benson STW in February 2022, compared to twenty-eight in February 2021. The Chalgrove Brook indicator site shown in Figure 5, suggests groundwater levels in the catchment were higher in February 2021 compared to February 2022. A similar comparison can be made between March 2022 and March 2021.

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 7 monitors installed within the Benson catchment. There are no further monitor installs currently 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 Benson 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 2021/22	Number/ length undertaken 2022/23
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

No interventions/ investigations have been carried out in the Benson catchment in the 22/23 Hydrological Year. Based on indicator site data, groundwater levels in the catchment only exceeded high threshold level (assigned as 1.22 mAD at the Chalgrove Brook indicator site), for brief periods in January, April, and May 2023, which provided less time for investigations to be carried out. However, the system will continue to be monitored and future investigations/ interventions carried out as appropriate and as conditions allow.

Benson STW is also being upgraded at a cost of more than £9 million. The upgrade will provide a major increase in treatment capacity, reducing the need for untreated discharges to the environment. This work is currently expected to complete in 2023.

Summary

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

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

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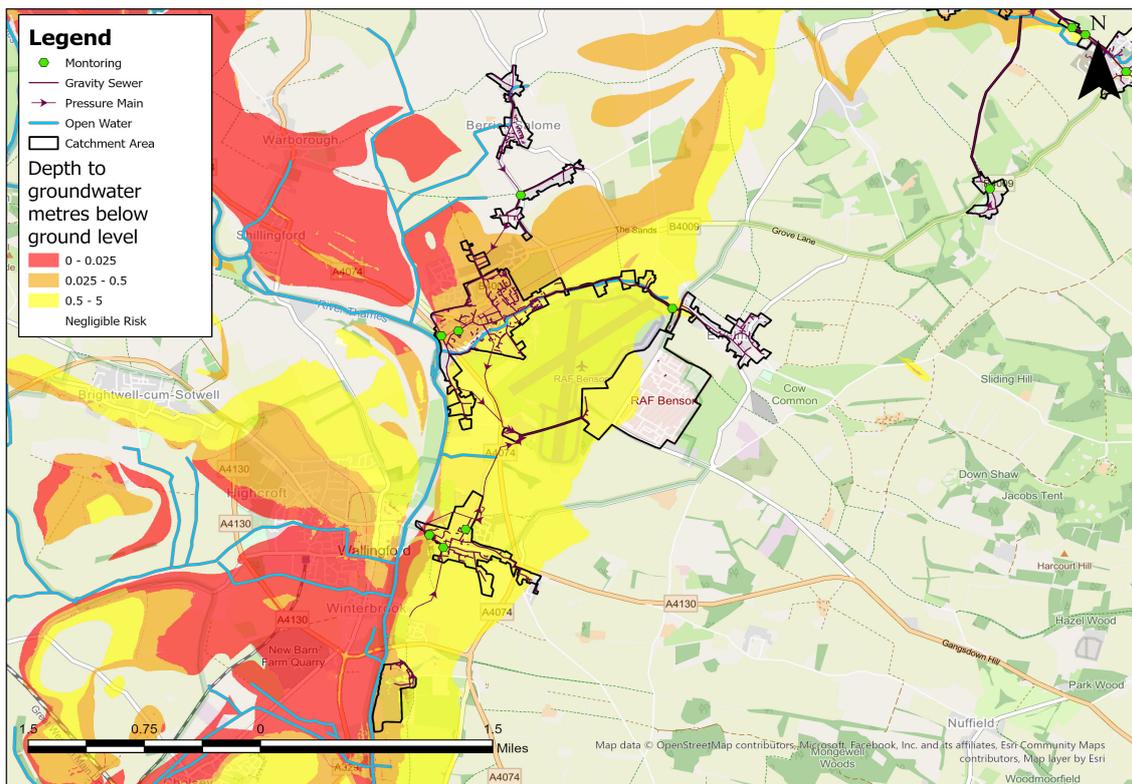
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Overview

This addendum to the Benson 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 – Benson Monitoring Plan



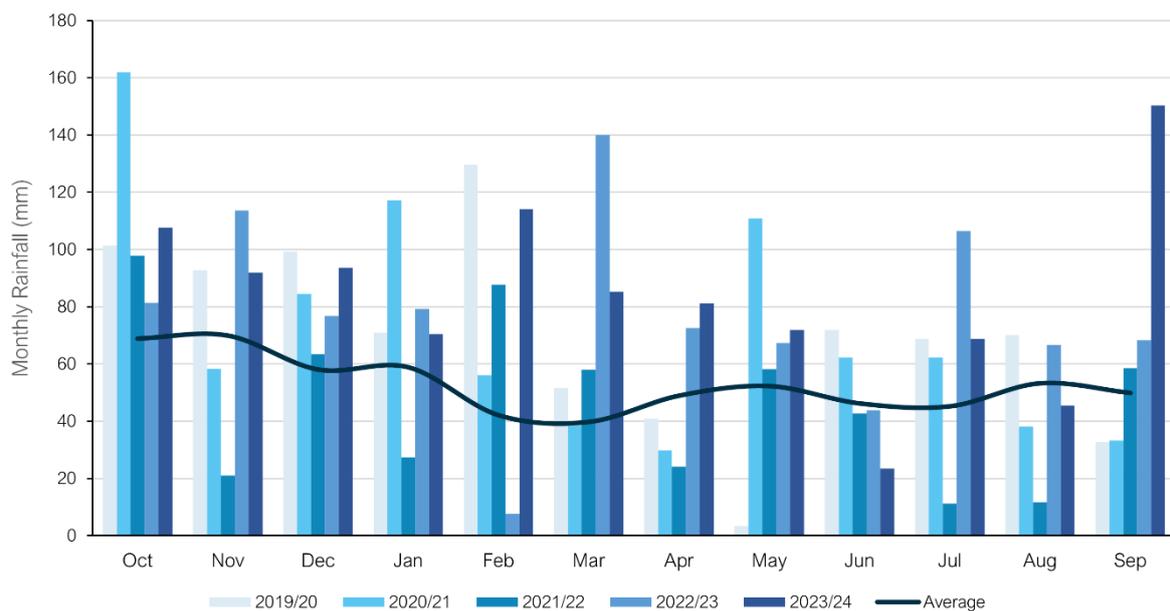
Hydrological Review – 2023-2024

This section summarises the hydrological conditions within the Benson 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 Benson based on the period 1991-2020

The total rainfall for the 2023/24 hydrological year is 58% 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)
634	833	853	562	924	1003

Groundwater / Local River Level

The Benson catchment is situated in the Ock and Chilterns West water resource areas. It primarily sits in the Upper Greensand Formation of coarse to fine grained sediments forming interbedded sequences and the West Melbury Marly Chalk Formation of carbonate material forming distinctive beds of chalk. These 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 site is a good indicator of groundwater levels within the catchment.

- Chalgrove Brook, Chalgrove

This site is illustrated in Figure 4, alongside the closest groundwater reference station and closest gauging station from the Water Situation Report.

Figure 4 – Local Monitoring Stations

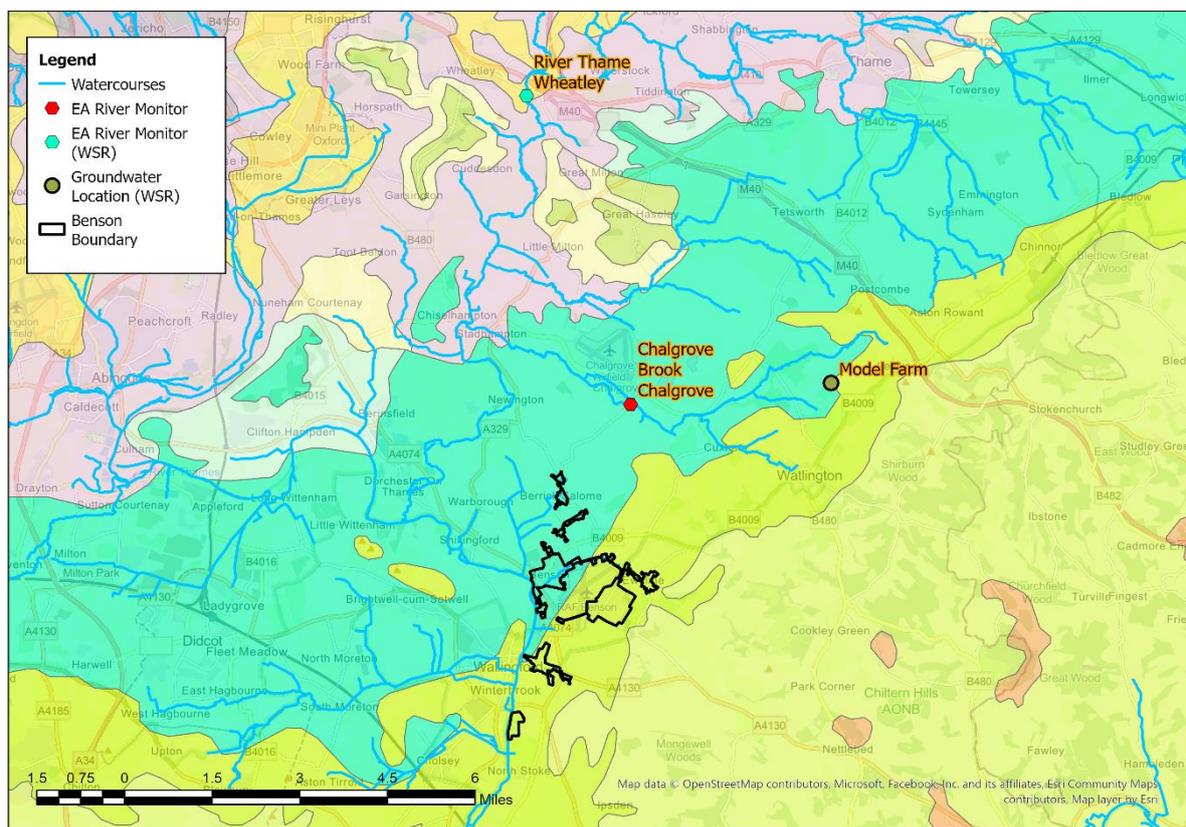
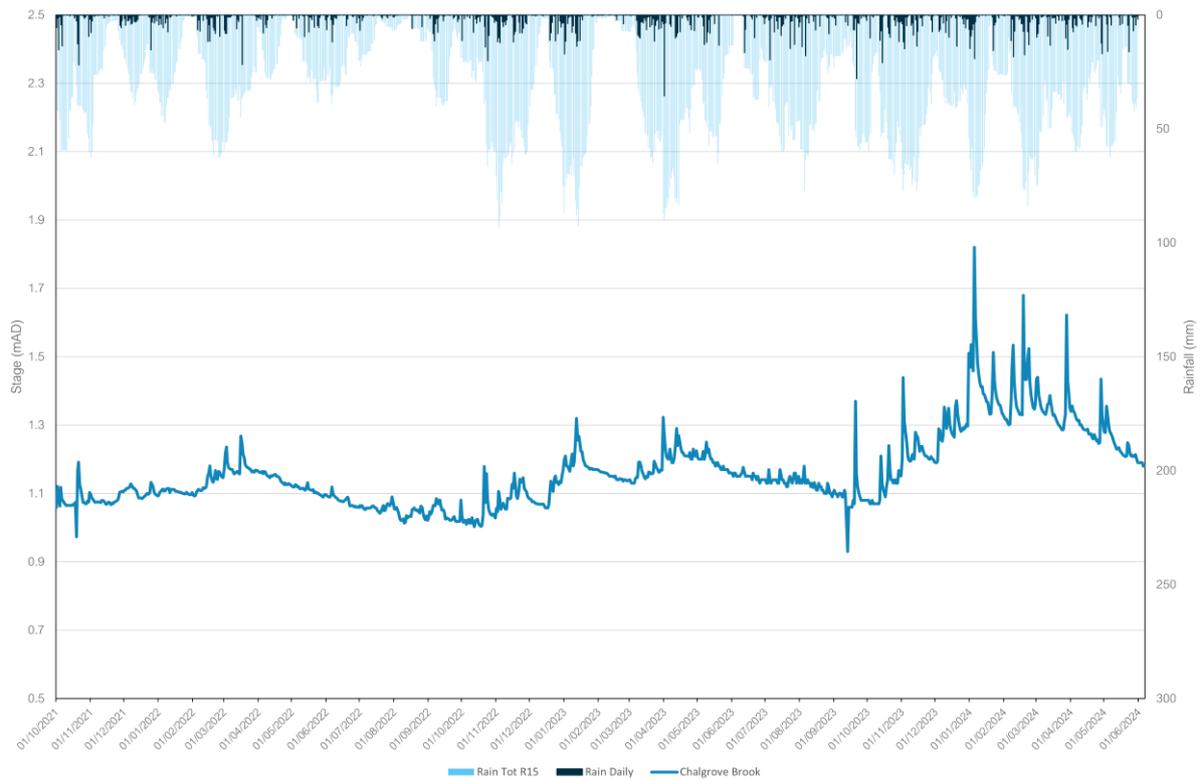


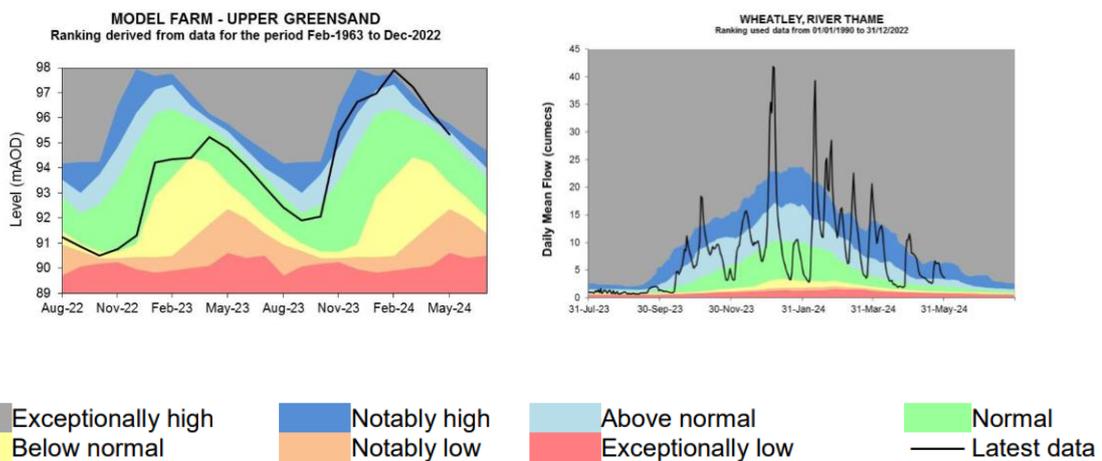
Figure 5A represents the last three hydrological years of level information at the indicator site to build a picture of the relative conditions prevalent in the current year. It is presented against both the daily total rainfall values for the catchment and a rolling 15 day total rainfall.

Figure 5A – Chalgrove Brook, Chalgrove



In addition to this specific station, the wider groundwater context is illustrated in the Water Situation Report for the Ock. The nearest groundwater reference station is Model Farm. This site shows groundwater levels in 2023 to be at normal levels until November/December when notably high levels are observed. Groundwater levels in 2024 are mostly at above normal / notably high levels, peaking at exceptionally high levels. This can be seen in Figure 6 alongside the river indicator location at Wheatley on the River Thames.

Figure 6 – Water Situation Report



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

Network Performance

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

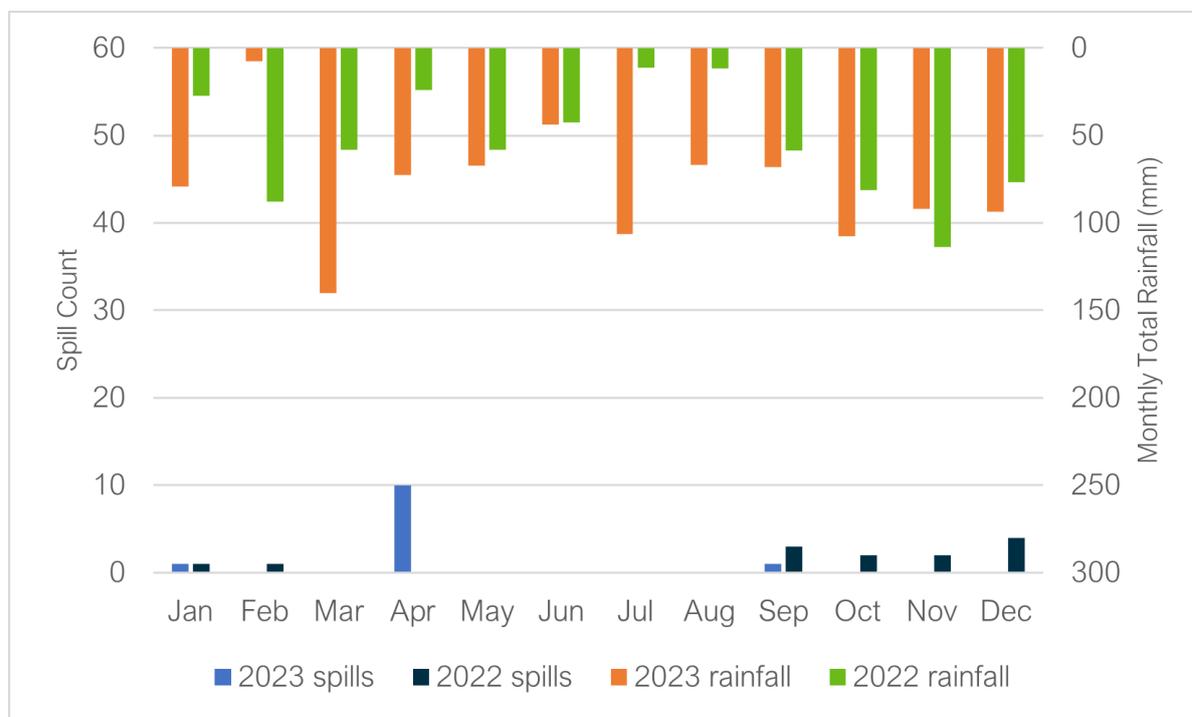
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Benson STW	13	2.14	12	164

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. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. The majority of the spills that occurred at Benson STW in 2023, were in April, despite higher rainfall totals being observed in other months. The indicator site data shown in Figure 6, suggests that groundwater levels in the catchment peaked during this period. This is a strong indicator of groundwater impacting spills at Benson STW. Of note also, is that despite very similar spill counts in 2022 and 2023, the total spill duration recorded in 2023 is much higher than 2022. This is also indicative of the role of groundwater infiltration on spills in the catchment, as groundwater infiltration often results in longer duration spills, compared to spills that occur only in response to rainfall events.

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 7 monitors installed within the Benson catchment. There are no further monitor installs currently 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 Benson catchment in the 2023-24 Hydrological Year, as well as works undertaken in the previous two hydrological years.

Table 9 – Works Undertaken in the 2023/2024 Hydrological Year, 2022/23 Hydrological Year & in the 2021/22 Hydrological Year

Investigation/ remediation type	Number/ length undertaken 2021/22	Number/ length undertaken 2022/23	Number/ length undertaken 2023/24
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

No interventions/ investigations have been carried out in the Benson catchment in the 2023/24 Hydrological Year. Based on indicator site data, groundwater levels in the catchment only exceeded high threshold level (assigned as 1.22 mAD at the Chalgrove Brook indicator site), for brief periods in January, April, and May 2023, which provided less time for investigations to be carried out. However, the system will continue to be monitored and future investigations/ interventions carried out as appropriate and as conditions allow.

Benson STW is also being upgraded at a cost of more than £9 million. The upgrade will provide a major increase in treatment capacity, reducing the need for untreated discharges to the environment. This work is currently expected to complete in 2024; however, 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 all government targets for storm overflows by 2040-45.

Summary

Indicator site data suggests groundwater levels in the Benson catchment have been significantly higher this hydrological year (October 2023 – September 2024) compared to the previous hydrological year. EDM data is indicative of the role of groundwater infiltration on 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.

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.



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