



Groundwater Impacted System Management Plan

Chinnor, Cuttle Brook (River Thame)

March 2021



It's everyone's water

Version control

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1-d1	March 2021	Draft for EA	DJ	SE	APH
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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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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 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 Chinnor system

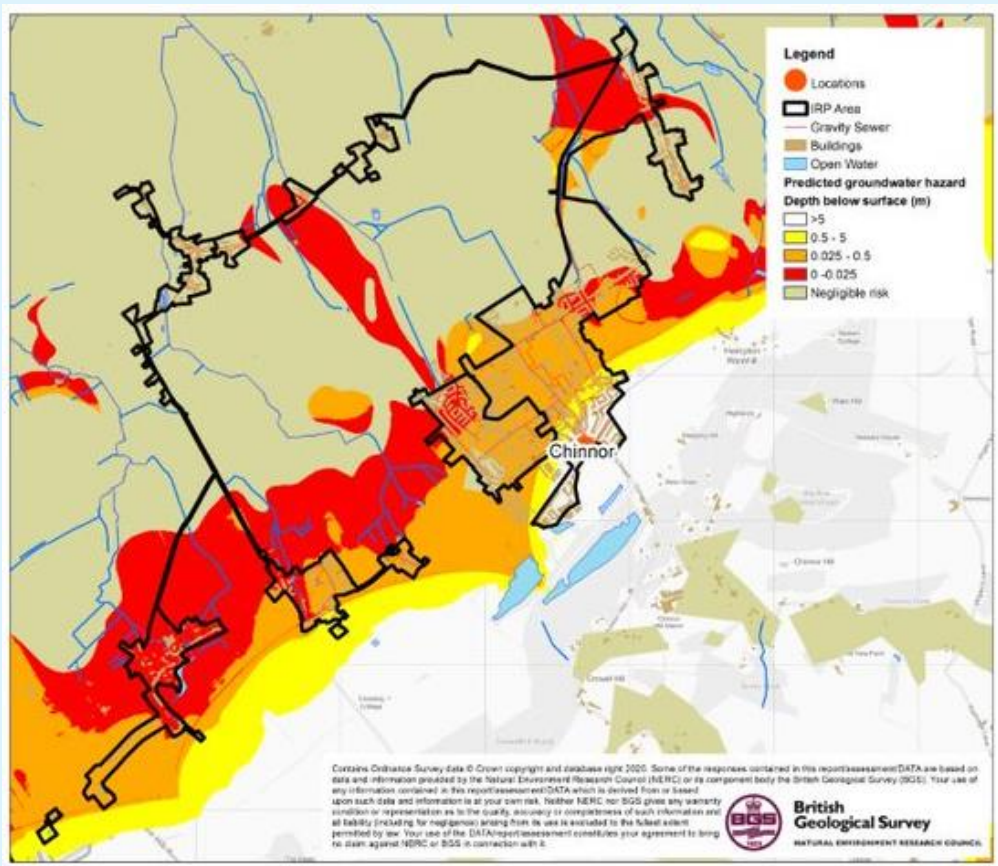


Figure 1.0 – Chinnor catchment

Chinnor lies on the Cuttle Brook, a tributary of the River Thames in South Oxfordshire, England, 20km east of Oxford. Chinnor serves a population equivalent³ of 8,926 with a predominantly separate sewerage network totaling some 56km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above and includes the villages of Crowell, Kingston Blount, Kingston Stert, Sydenham, Emmington, Henton and Ashton Rowant.

Problem characterisation

Groundwater has potential to enter our sewers when levels are high which reduces their capacity and increases their risk of becoming overwhelmed. A link is observed between the rising river levels that cause rising groundwater levels, and the drainage issues some of our customers have experienced, including sewer flooding and restricted use of their toilets and bathrooms. A number of watercourses run through the Chinnor catchment including the Upper Cuttle Brook and tributaries and Kingsey Cuttle Brook and tributaries at Thame.

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 Chinnor catchment has become overwhelmed, following prolonged and heavy rainfall and raised groundwater levels. This has resulted in certain properties suffering from sewer flooding and restricted toilet use, as well as highway flooding. 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 the combination of foul and surface water, however, there are a limited number of public surface water sewers in the area.

We believe that significant volumes of surface water 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 to date also suggest that there is some evidence of unwanted flows in the foul sewerage network when groundwater levels are high and inundation from highways, public spaces and properties. Surface water misconnections (i.e. down pipes 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.

The catchment is generally made up of a chalk bedrock in the higher areas (Chinnor and Crowell) and gault in the lower areas (Kingston Stert and Emmington). The chalk also extends locally to Sydenham. 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 and springs leading to inundation potential from flows on the surface.

A project was completed in April 2015 to reduce the flood risk to properties in Sydenham and Emmington by constructing a new pumping station in Stert Road and transferring the flows from Kingston Blount and Ashton Rowant via a new pumping main direct to the network downstream of Chinnor, therefore bypassing Sydenham.

The impact of the groundwater infiltration and high flows in the Chinnor catchment has overloaded the gravity sewers, sewage pumping station and the STW, which on occasions may impact the performance of the STW.

Our permit conditions for Chinnor 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 snowmelt and shall be emptied and its contents returned to the continuation flow as soon as reasonably practicable”

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 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.

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 Oxfordshire County Council as Lead Local Flood Authority, County Council and South Oxfordshire District Council as 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 manholes causing pollution.

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

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

General outline plan & timescale

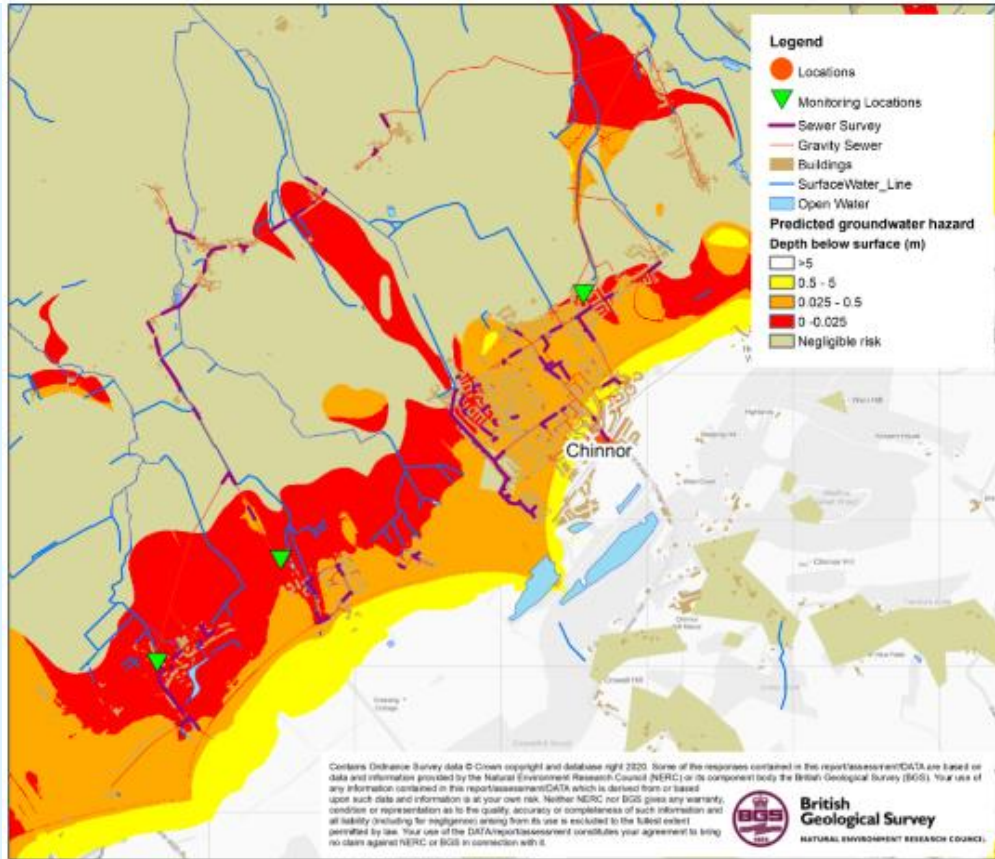


Figure 2.0 – Chinnor monitoring and infiltration zones

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 Chinnor 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 Chinnor 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 Chinnor.

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 Decision of extent of sealing will be based on outcomes of works undertaken to date, result of monitoring and successful submission of our plans for investment.

Activity	When	Description
Minor works	2020-2023	As mentioned, if we detect minor works being required, we 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.

Chinnor 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 Chinnor 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 STW.

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

High level approach statement

For Chinnor 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.
- Undertaken 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 (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 there will be include in our AMP9 (2030-35) programme of investment. Significant investment needs may need to be included in our future investment cycles

⁵ Assessment of cost effectiveness is based on assessment of the ratio of the cost of a solution to the monetised benefit gained from implementing the solution i.e. reduction in flood/pollution risk and/or reduced operating costs.

Investigations

As mentioned above JBA Consulting have been supporting by undertaking an exercise involving assessing groundwater elevation data to determine which areas of the network are potentially below the groundwater table during high groundwater periods.

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

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

Monitoring

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

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

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.

With regard to the Chinnor system we will continue to tanker where required.

Updates

Work on the Groundwater infiltration management plan will continue, and we will aim to 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	14.8	52.1
Medium	Predicted groundwater extreme 0-1m above pipe invert	0.98	3.5
Low	Predicted groundwater extreme 0-1m below pipe invert	0.67	2.4
Very Low	Predicted groundwater extreme >1m below pipe invert	11.90	42.0
Total		28.35 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	46	7.2
Medium	Inundation risk in 1% AEP fluvial or pluvial event	50	7.7
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	130	20.0
Very Low	All other manholes	422	65.1
Total		648	100.0

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

At the time of writing we are currently on site undertaking lift and look and CCTV surveys in the Chinnor system. A summary of findings will be provided in the next update of this report.

Glossary of terms

AEP – Annual Exceedance Potential

AMP – Asset Management Plan

CCTV – Closed Circuit Television

EA - Environment Agency

IRP – Infiltration Reduction Plans

MH – Manhole

STW – Sewage Treatment Works

WINEP – Water Industry National Environment Programme

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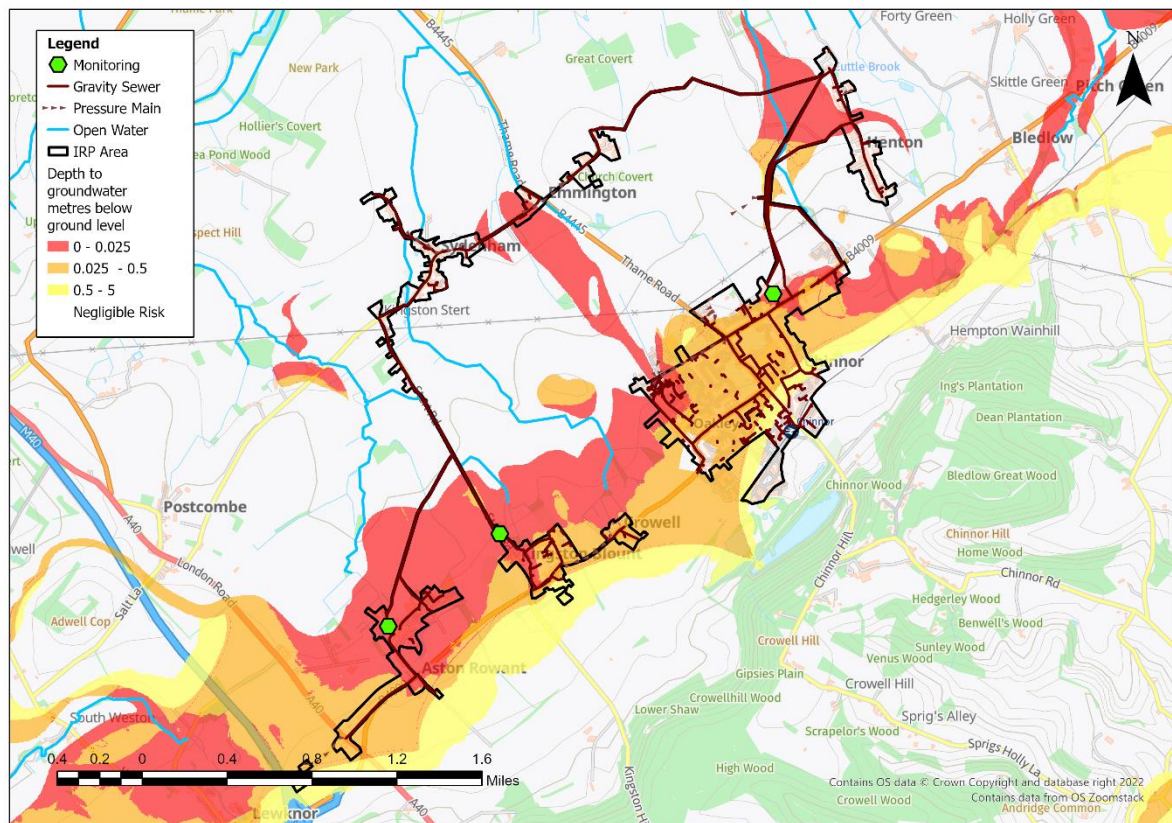
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Overview

This addendum to the Chinnor 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 – Chinnor Monitoring Plan



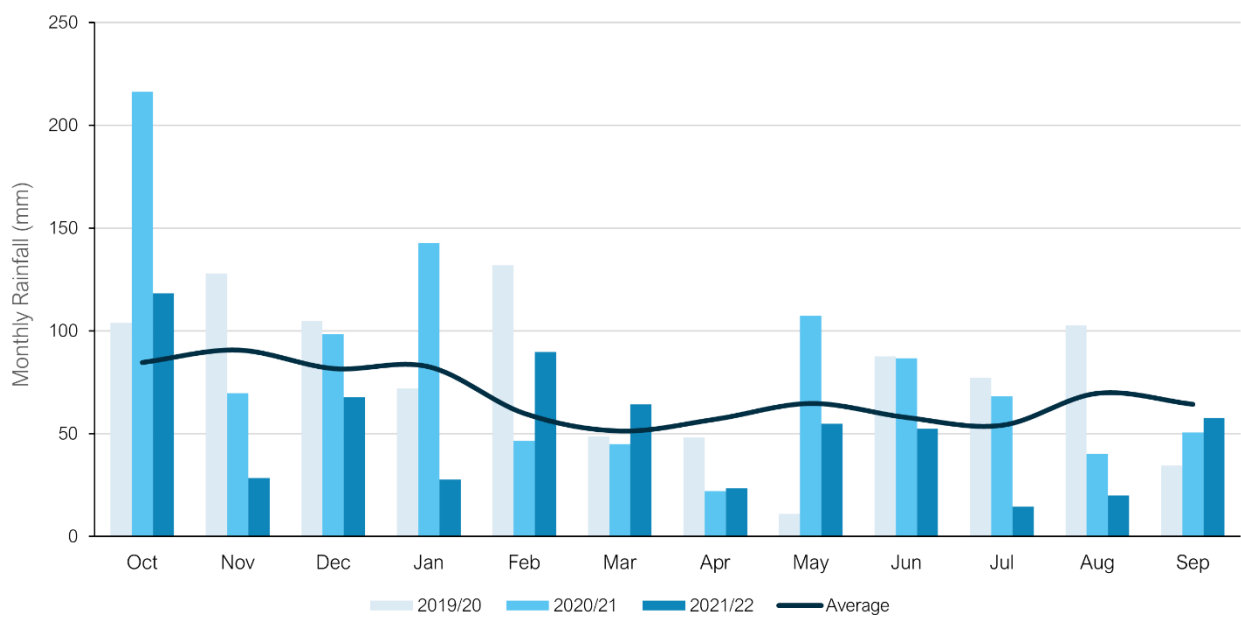
Hydrological Review – 2021-2022

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

Catchment Rainfall

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

Figure 2 – Monthly Rainfall Performance



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

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

Table 3 – Total Rainfall Based on Hydrological Year

Average (mm)	2019/20 (mm)	2020/21 (mm)	2021/22 (mm)
817	951	994	627

Groundwater / Local River Level

The Chinnor catchment is situated in the Thames water resources area. It sits in the West Melbury Marly Chalk Formation of sedimentary bedrock, the Upper Greensand Formation of siltstone and sandstone and the Gault Formation of mudstone. The West Melbury Marly Chalk Formation and Upper Greensand Formation are designated principal aquifers within the UK.

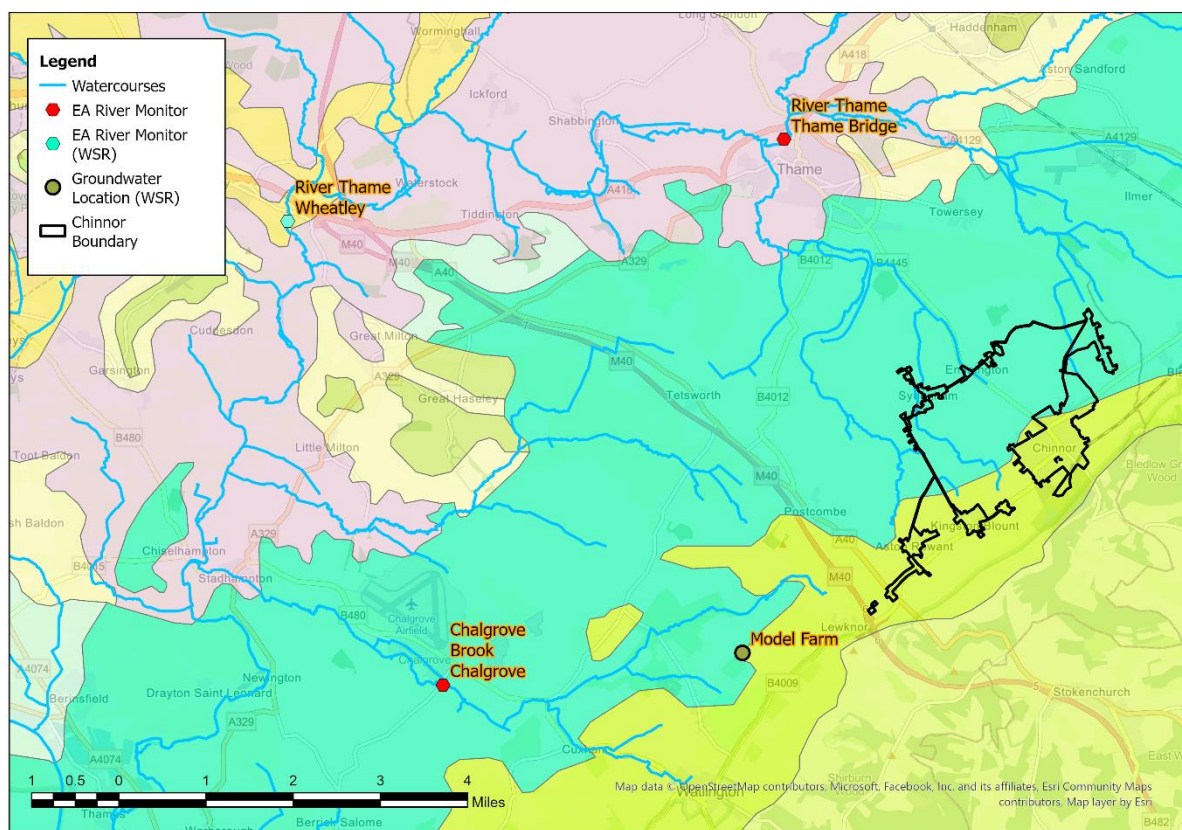
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

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

- Chalgrove Brook, Chalgrove.
- River Thames, Thames Bridge.

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 – Chalgrove Brook, Chalgrove

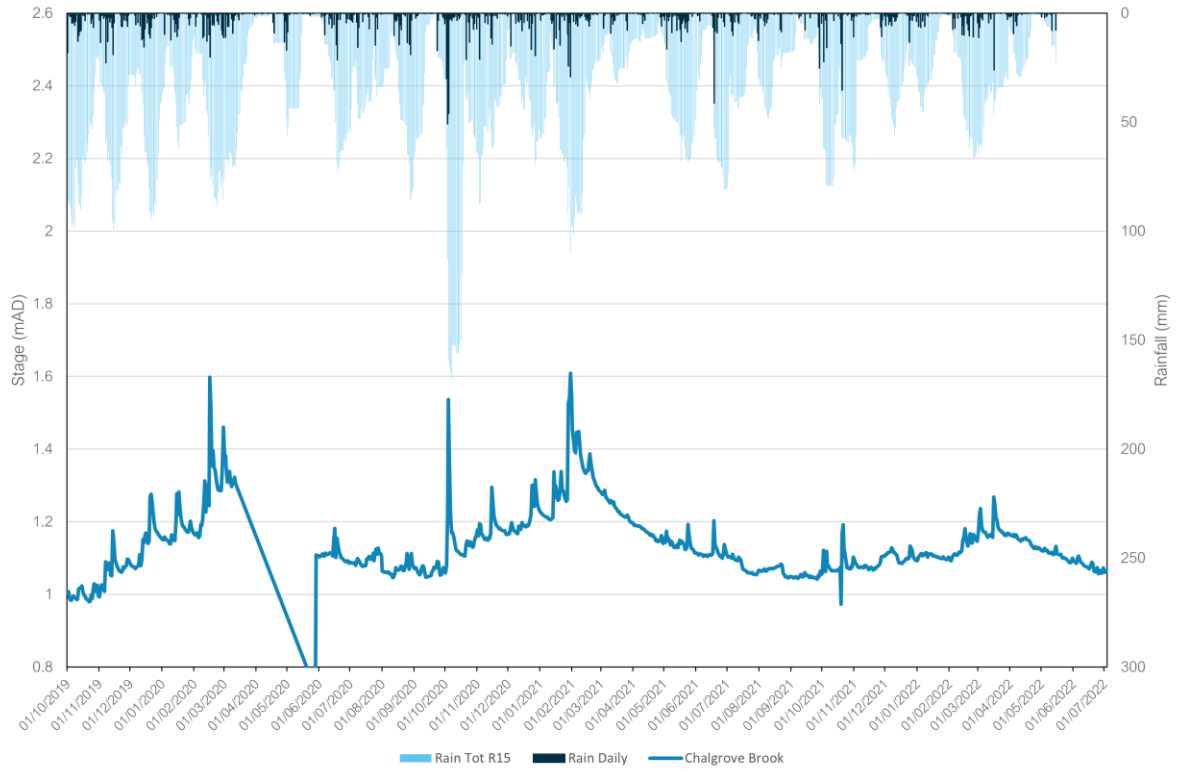
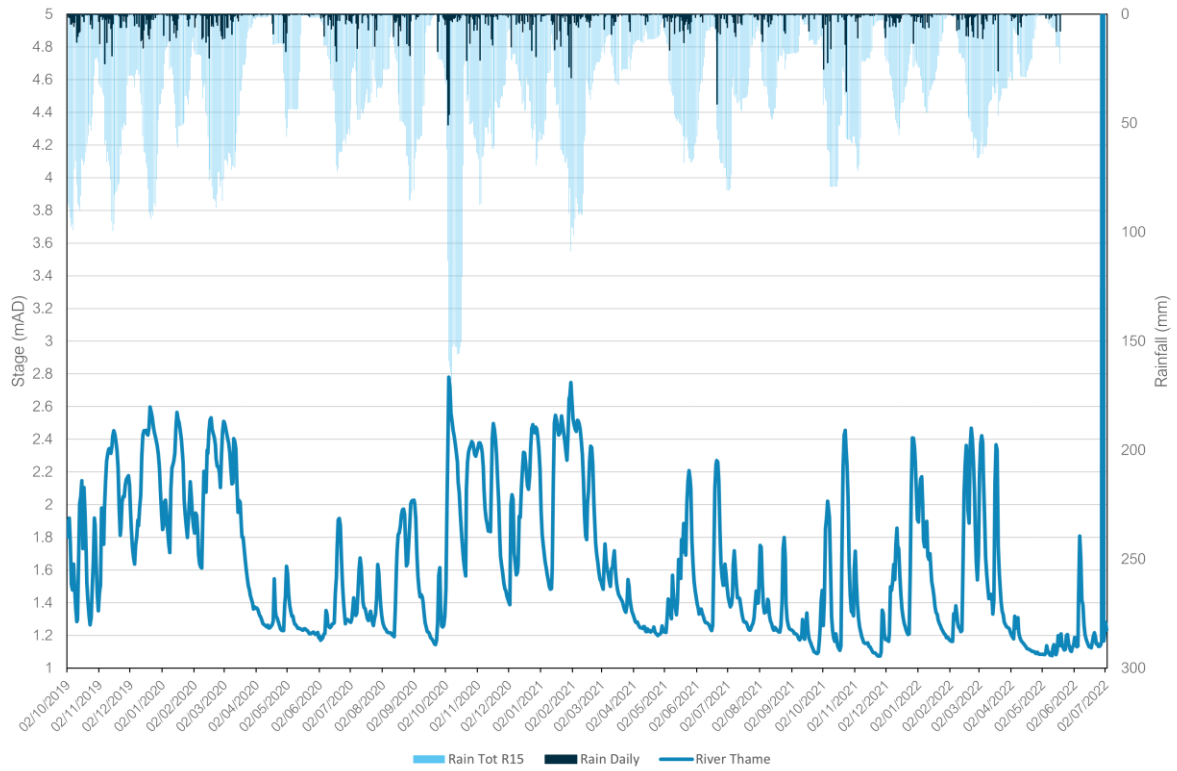
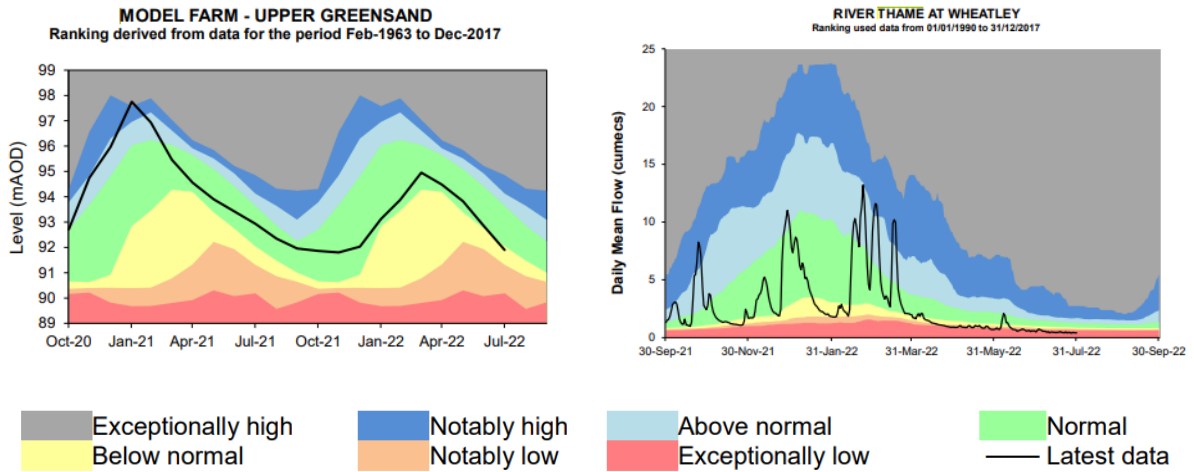


Figure 5B – River Thames, Thame Bridge



In addition to this specific station, 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 Chinnor catchment there is one site detailed within the Environment Agency Consents Database which has an Event Duration Monitor (EDM) fitted.

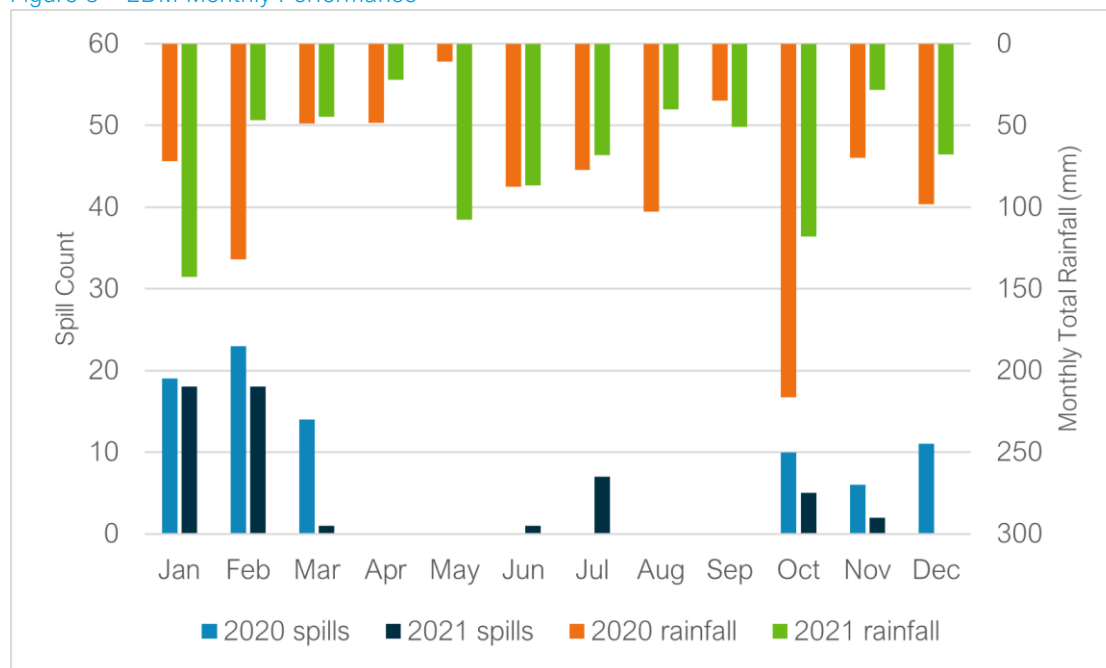
Table 7 below details the last 2 years performance of overflows within the catchment.

Table 7 – Event Duration Monitoring

Overflow	2020		2021	
	Spills	Duration (hours)	Spills	Duration (hours)
Chinnor STW	83	601.38	52	421.27

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 an overall focus on spills during the autumn and winter months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. A slower tail off in spills is evident within the first three months of 2020, when the indicator sites shown in Figure 5 suggest groundwater levels in the catchment were higher than in 2021. Despite broadly similar rainfall, no spills were recorded at Chinnor STW in December 2021, compared to 11 spills in December 2020. The indicator sites suggest groundwater levels in the catchment were higher in December 2020.

Investigations & Interventions

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

Monitor Installations

The sewer depth monitor (SDM) programme supports long term groundwater understanding within GISMP catchments. Currently, there are a total of 3 monitors installed within the Chinnor 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 Chinnor 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 Chinnor catchment over the 2021/22 hydrological year has been below average, with groundwater levels in the aquifer beneath Chinnor 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 fact no EDM spills were recorded at Chinnor STW in December 2021, compared to 11 in 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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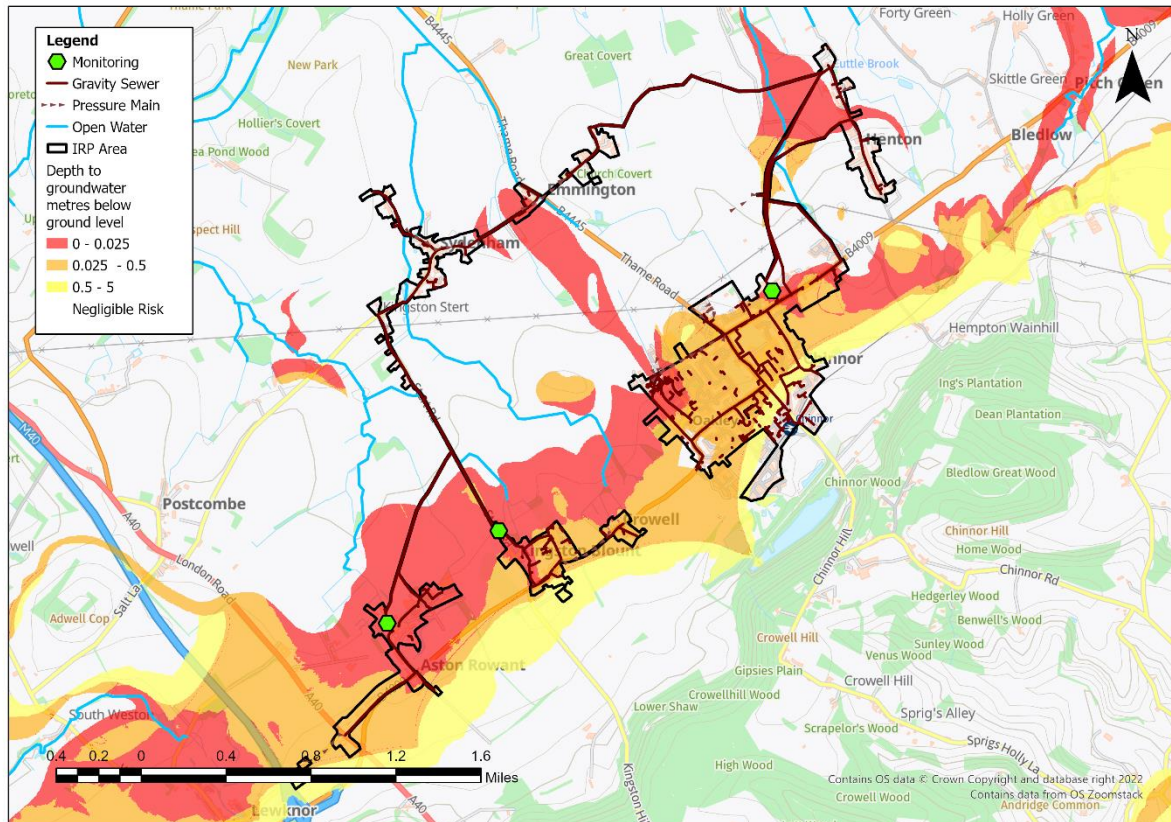
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- Summary and plan for 2023/24

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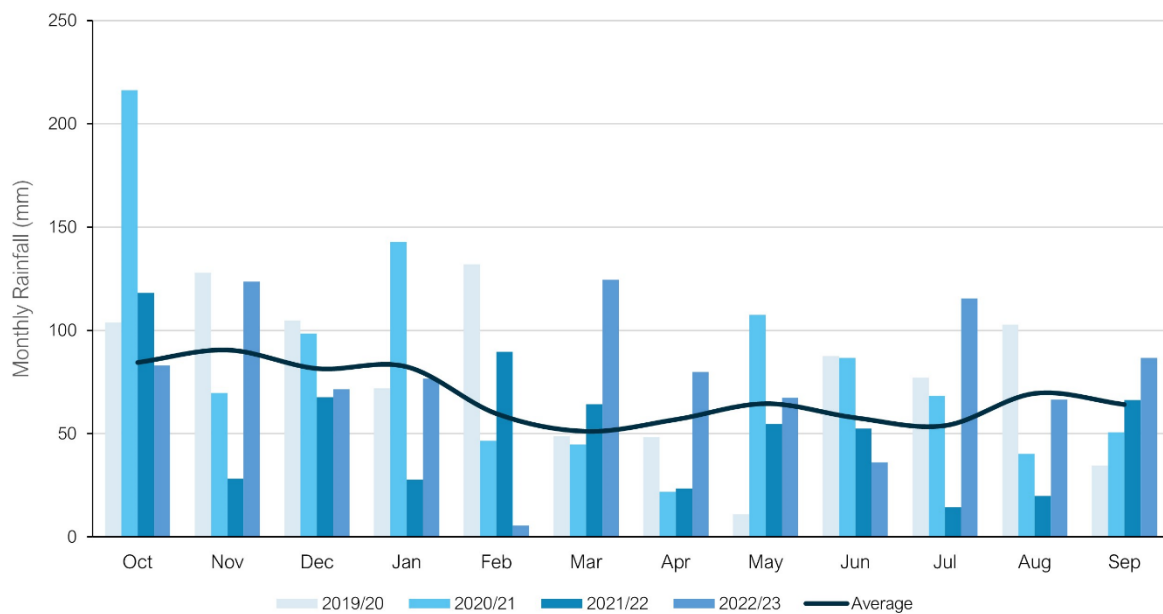
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Catchment Rainfall

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 High Wycombe based on the period 1991-2020

The total rainfall for the 2022/23 hydrological year is 15% above the annual average total. Total rainfall values are presented in Table 3 below.

Table 3 –Total Rainfall Based on Hydrological Year

Average (mm)	2019/20 (mm)	2020/21 (mm)	2021/22 (mm)	2022/23 (mm)
817	951	994	627	938

Groundwater / Local River Level

The Chinnor catchment is situated in the Thames water resources area. It sits in the West Melbury Marly Chalk Formation of sedimentary bedrock, the Upper Greensand Formation of siltstone and sandstone and the Gault Formation of mudstone. The West Melbury Marly Chalk Formation and Upper Greensand Formation are designated principal aquifers within the UK.

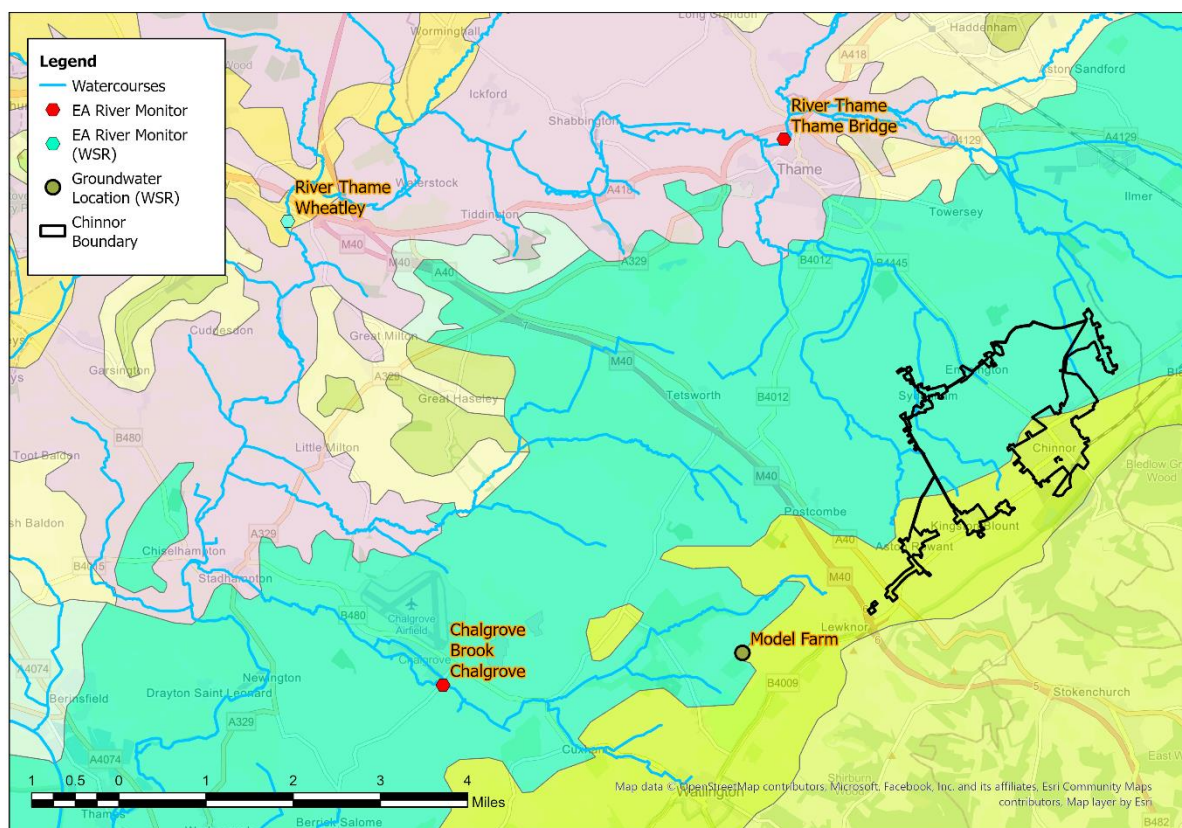
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Figure 4 – Local Monitoring Stations



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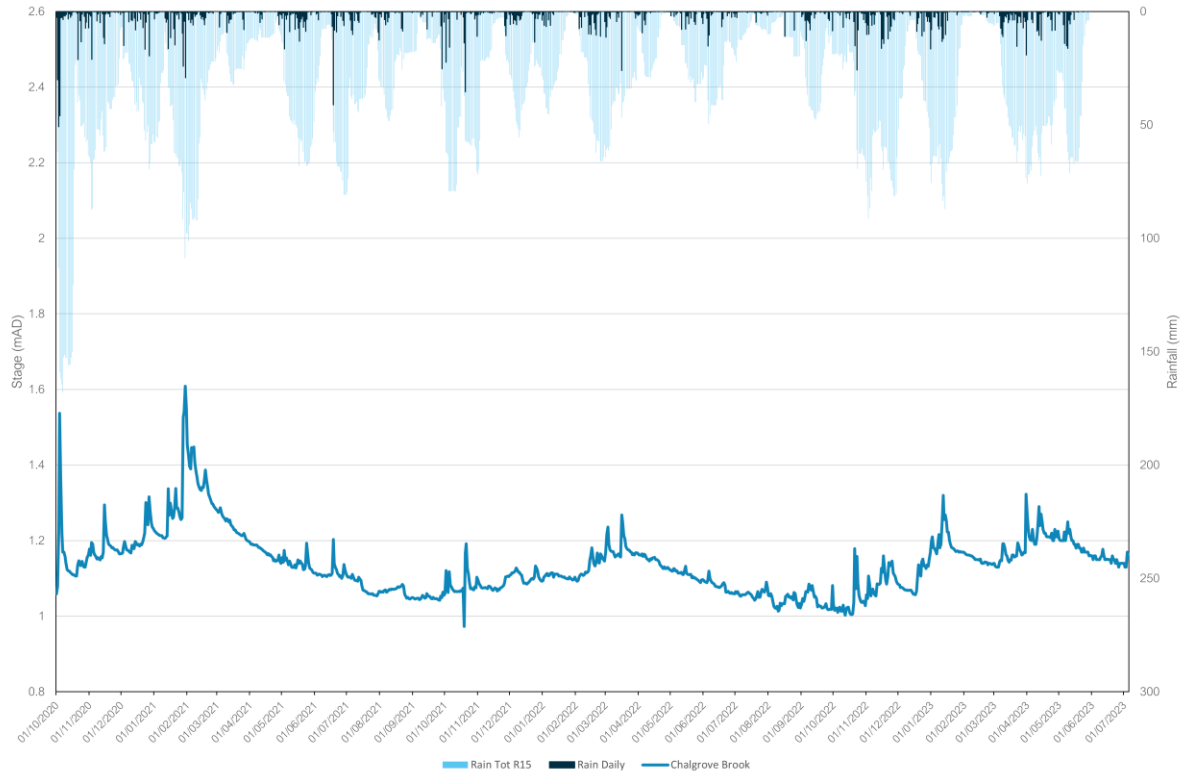
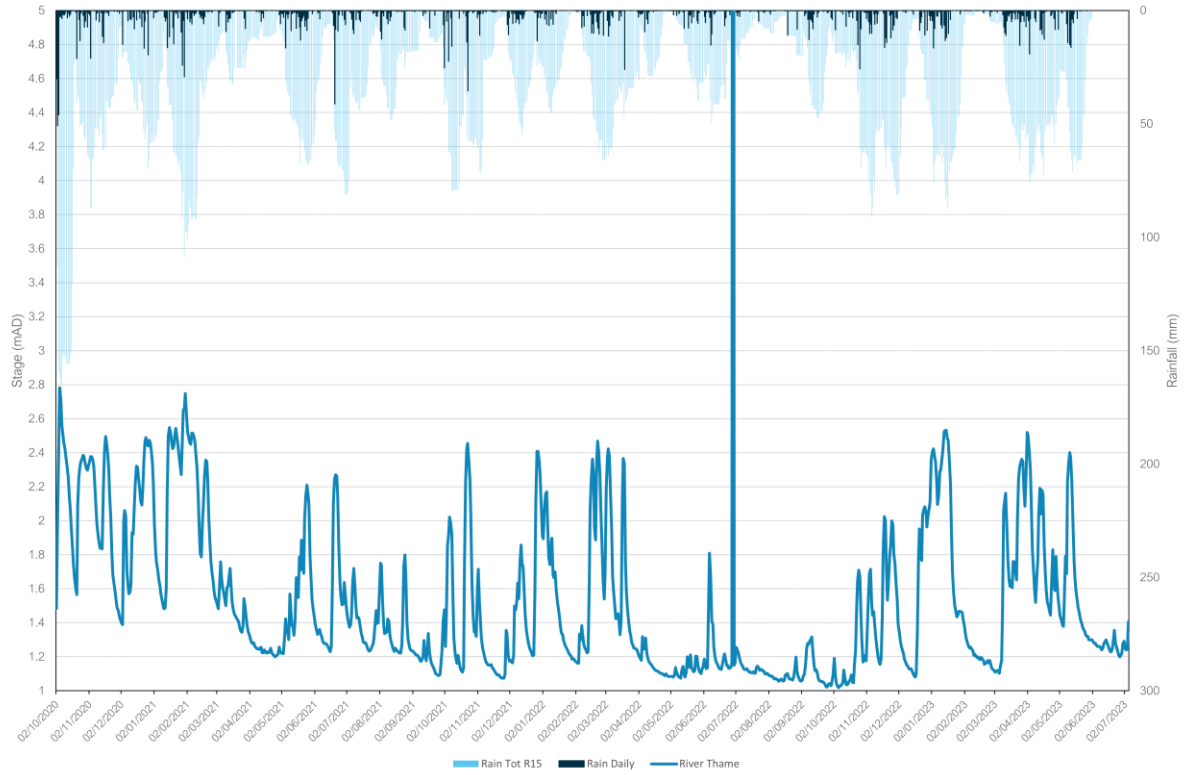
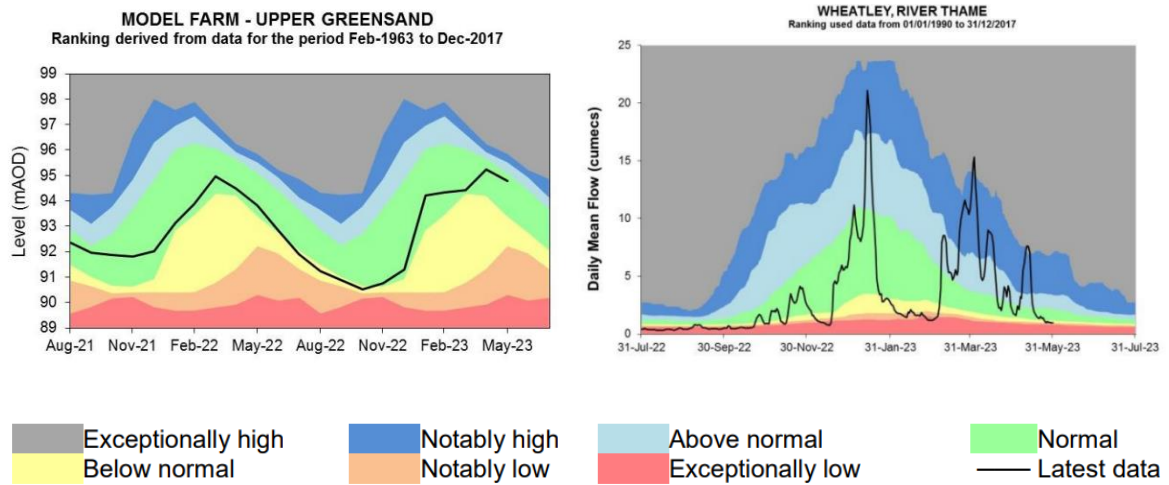


Figure 5B – River Thames, Thame Bridge



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for the Thame. This site shows normal or below normal groundwater levels during 2022, with groundwater levels observed to be at normal levels during 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



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Network Performance

Within the Chinnor catchment there are two sites detailed within the Environment Agency Consents Database which has an Event Duration Monitor (EDM) fitted.

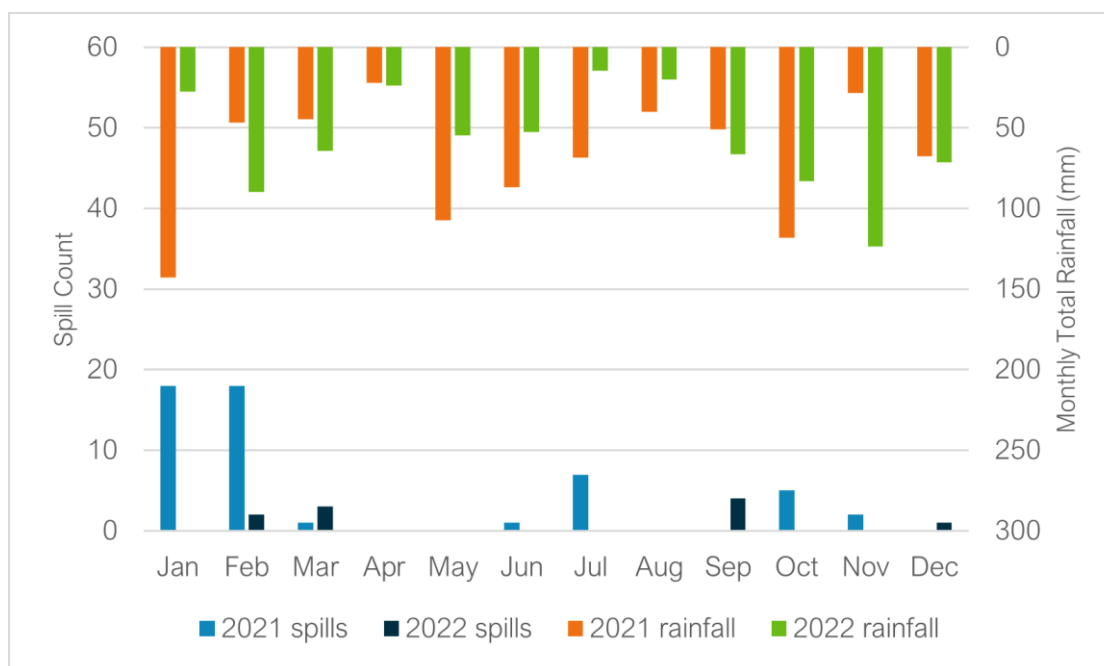
Table 7 below details the last 2 years performance of overflow ‘Chinnor STW’.

Table 7 – Event Duration Monitoring

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Chinnor STW	52	421.27	10	68.61

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. Note that the spill frequency of ten stated for 2022, is one higher than the published figure of nine. The spill count has been revised/ revalidated, and ten is the post-validation value. Figure 8 below presents the EDM performance trend and rainfall for recent years.

Figure 8 – EDM Monthly Performance



The trend in spill performance across the two recorded years does show variation in spills, with an overall focus on spills during the autumn and winter months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. Despite a higher rainfall total in February 2022 compared to February 2021, significantly more spills were recorded at Chinnor STW in February 2021. The indicator sites shown in Figure 5, suggest groundwater levels in the catchment were higher in February 2021. The significant number of spills recorded in July 2021, is also indicative of spills occurring a result of intense rainfall events in the catchment, outside of periods of elevated groundwater levels.

As part of the process of matching GISMP catchments to EDM sites, an additional EDM site has been identified for inclusion in this year’s Addendum Report.

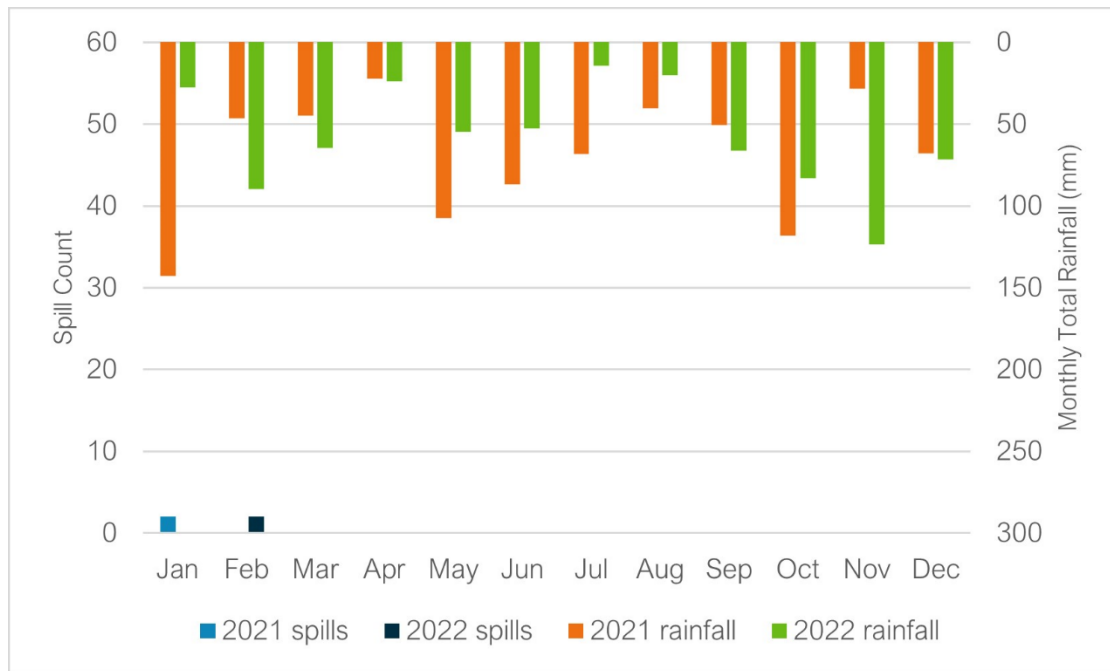
Table 9 below details the last 2 years performance of overflow ‘Manor Farm SPS’.

Table 9 – Event Duration Monitoring

Overflow	2021		2022	
	Spills	Duration (hours)	Spills	Duration (hours)
Manor Farm SPS	2	6.15	2	15.41

Figure 10 below presents the EDM performance trend and rainfall for 2022.

Figure 10 – EDM Monthly Performance



The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency, as the only spills recorded across 2021/22 were in winter months, when the indicator site data shown in Figure 5 suggests groundwater levels in the catchment were elevated. However, spills were recorded at Manor Farm SPS in February 2022, but not in February 2021, despite the indicator site data shown in Figure 5 suggesting that groundwater levels in the catchment were higher in February 2021. This indicates that the total depth and intensity of individual rainfall events, occurring during periods of elevated groundwater levels, is also critical to determining overflow performance at Manor Farm SPS.

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

Table 11 – 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
Manhole covers and frames replaced	N/A	N/A

No interventions/ investigations were carried out in the catchment this hydrological year. However, the catchment will continue to be monitored and appropriate investigations/ interventions carried out as appropriate and when conditions allow.

Chinnor STW is also being upgraded at a cost of more than £10 million. This project will provide a major increase in treatment capacity, reducing the need for untreated discharges to the environment. The project is expected to be completed in 2023.

Summary

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

Lift and look and CCTV surveys will 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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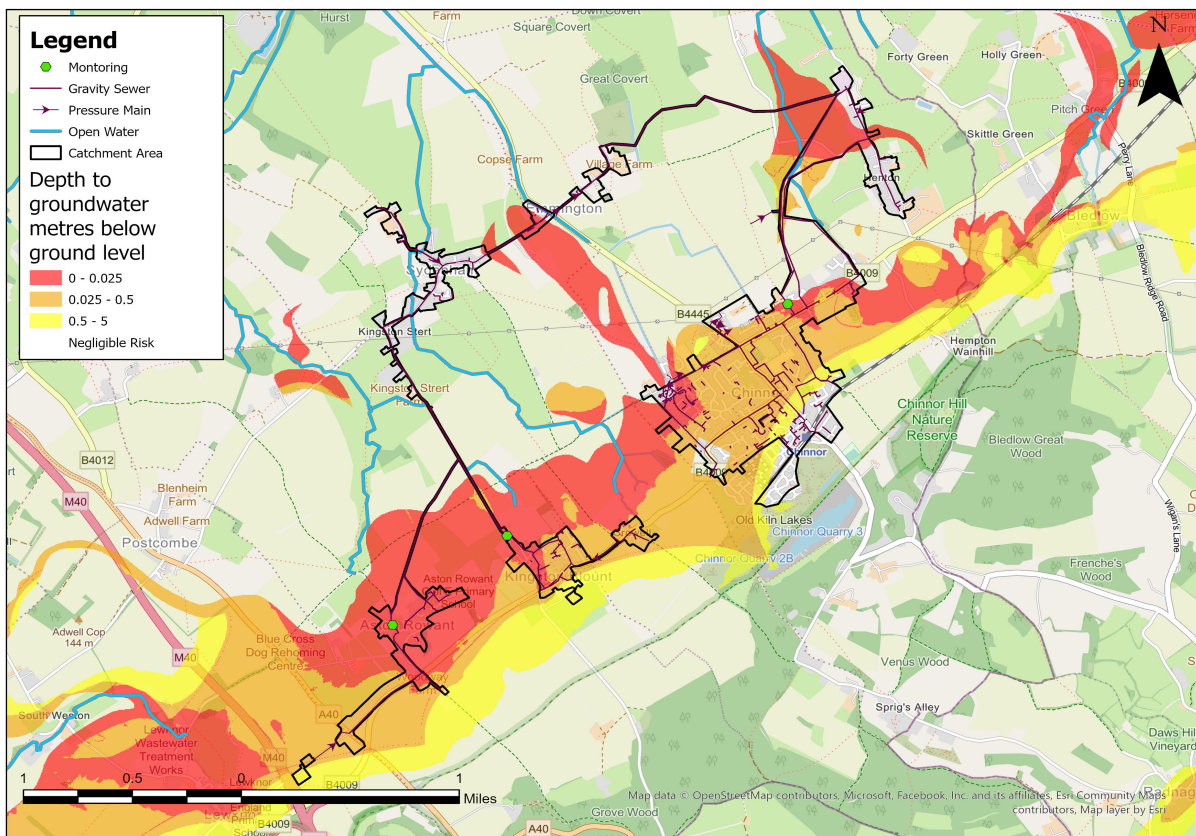
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Overview

This addendum to the Chinnor 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 – Chinnor Monitoring Plan



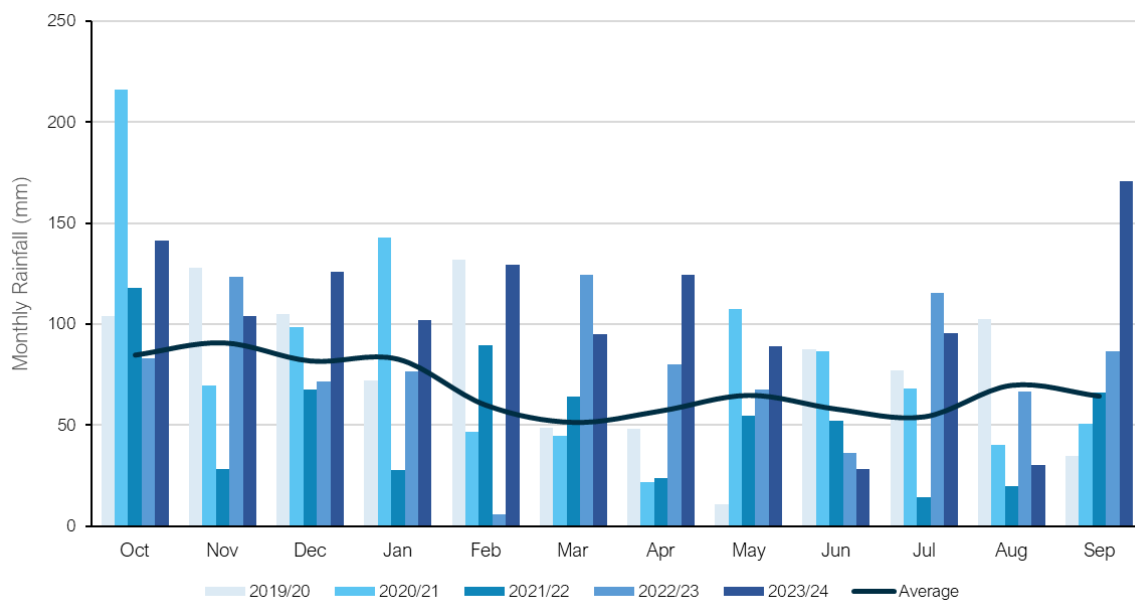
Hydrological Review – 2023-2024

This section summarises the hydrological conditions within the Chinnor 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 51% above the annual average total. Total rainfall values are presented in Table 3 below.

Table 3 –Total Rainfall Based on Hydrological Year

Average (mm)	2019/20 (mm)	2020/21 (mm)	2021/22 (mm)	2022/23 (mm)	2023/24 (mm)
817	951	994	627	938	1236

Groundwater / Local River Level

The Chinnor catchment is situated in the Thames water resources area. It sits in the West Melbury Marly Chalk Formation of sedimentary bedrock, the Upper Greensand Formation of siltstone and sandstone and the Gault Formation of mudstone. The West Melbury Marly Chalk Formation and Upper Greensand Formation are designated principal aquifers within the UK.

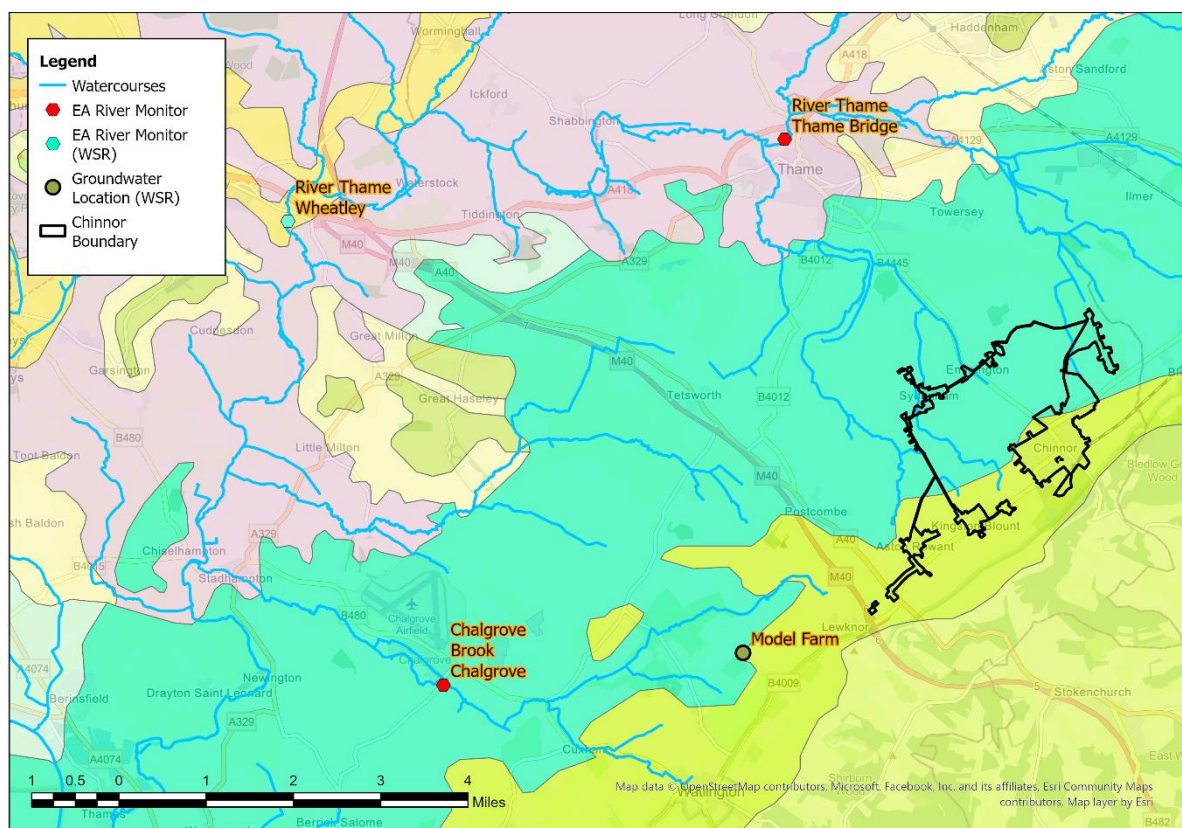
The Environment Agency has gauging stations on local watercourses measuring stage and observation boreholes (OBH) measuring groundwater levels locally to the catchment which can be used to provide indicative local groundwater performance.

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

- Chalgrove Brook, Chalgrove.
- River Thames, Thames Bridge.

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

Figure 4 – Local Monitoring Stations



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

Figure 5A – Chalgrove Brook, Chalgrove

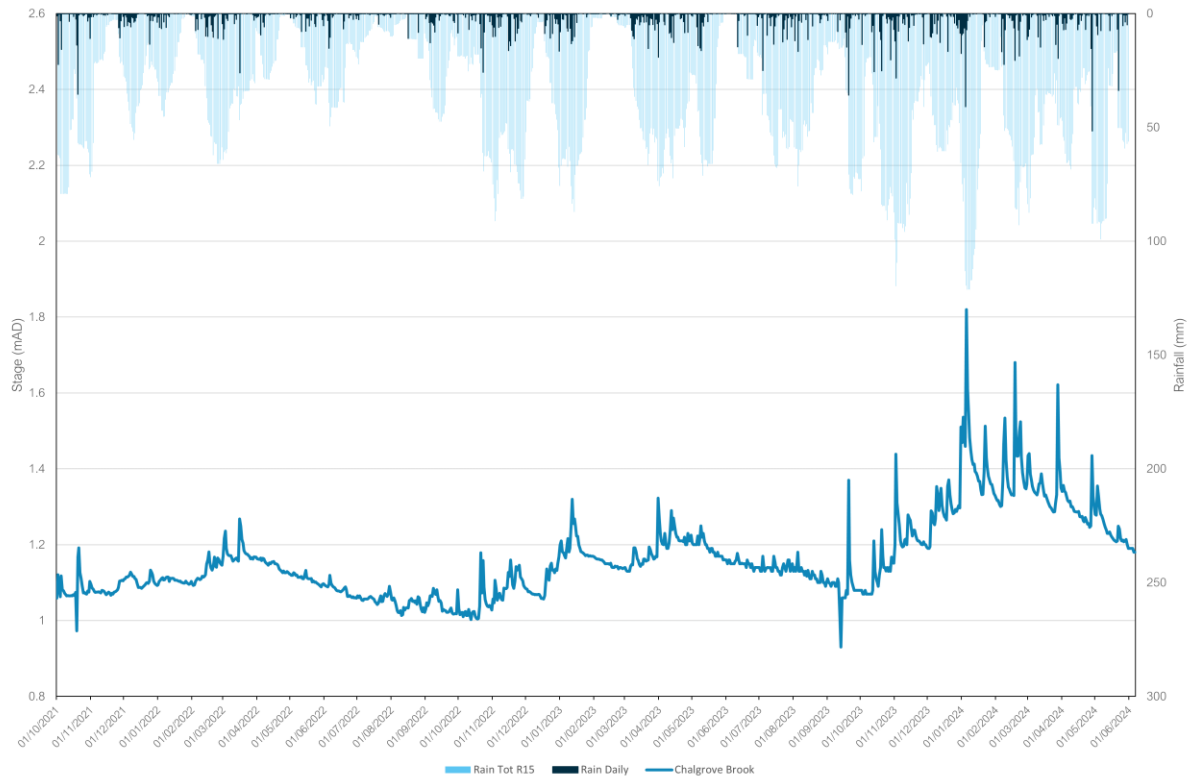
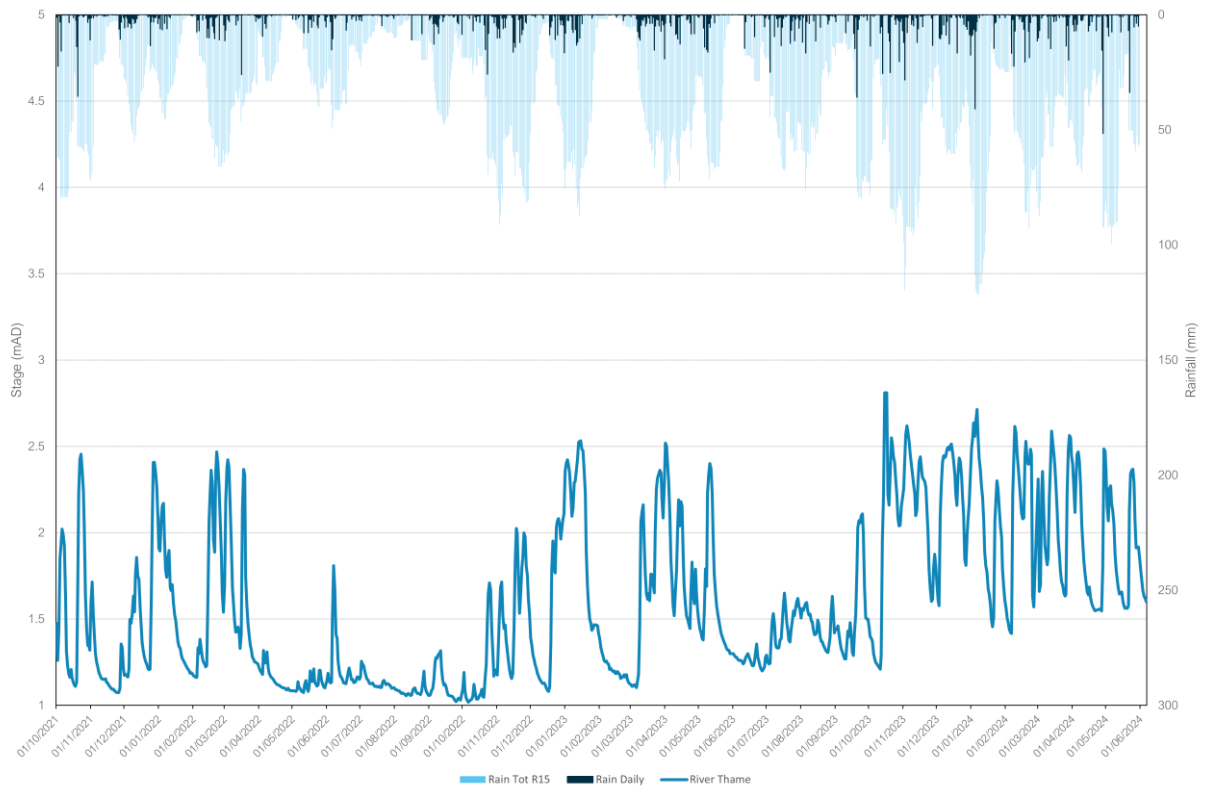
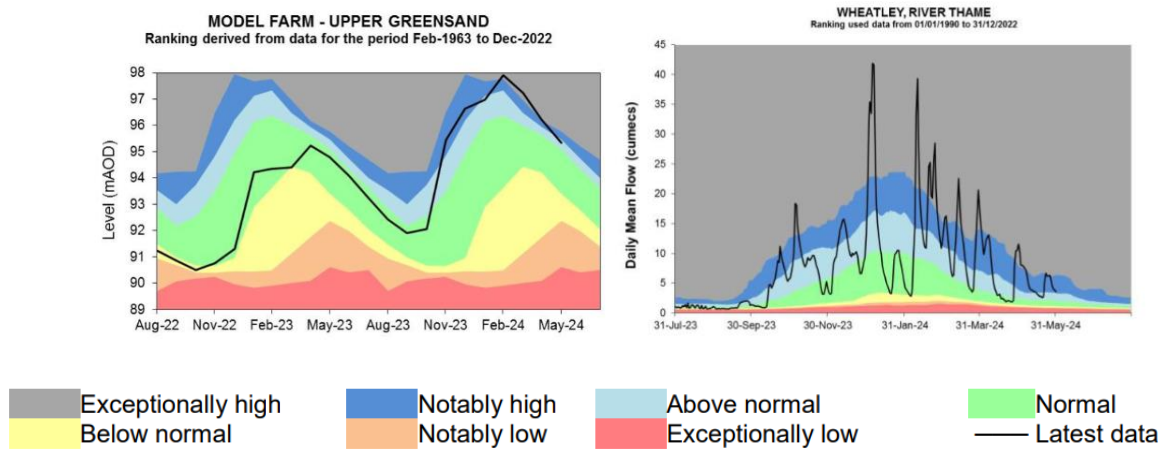


Figure 5B – River Thames, Thame Bridge



In addition to these specific stations, the wider groundwater context is illustrated in the Water Situation Report for the Thames. The nearest groundwater reference station is Model Farm. This site shows groundwater levels generally at normal levels in 2023 before increasing towards the end of the year. November 2023 to February 2024 saw above normal/ notably high groundwater levels and exceptionally high groundwater levels were observed around March/April 2024. 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 Chinnor catchment there are two sites detailed within the Environment Agency Consents Database which has an Event Duration Monitor (EDM) fitted.

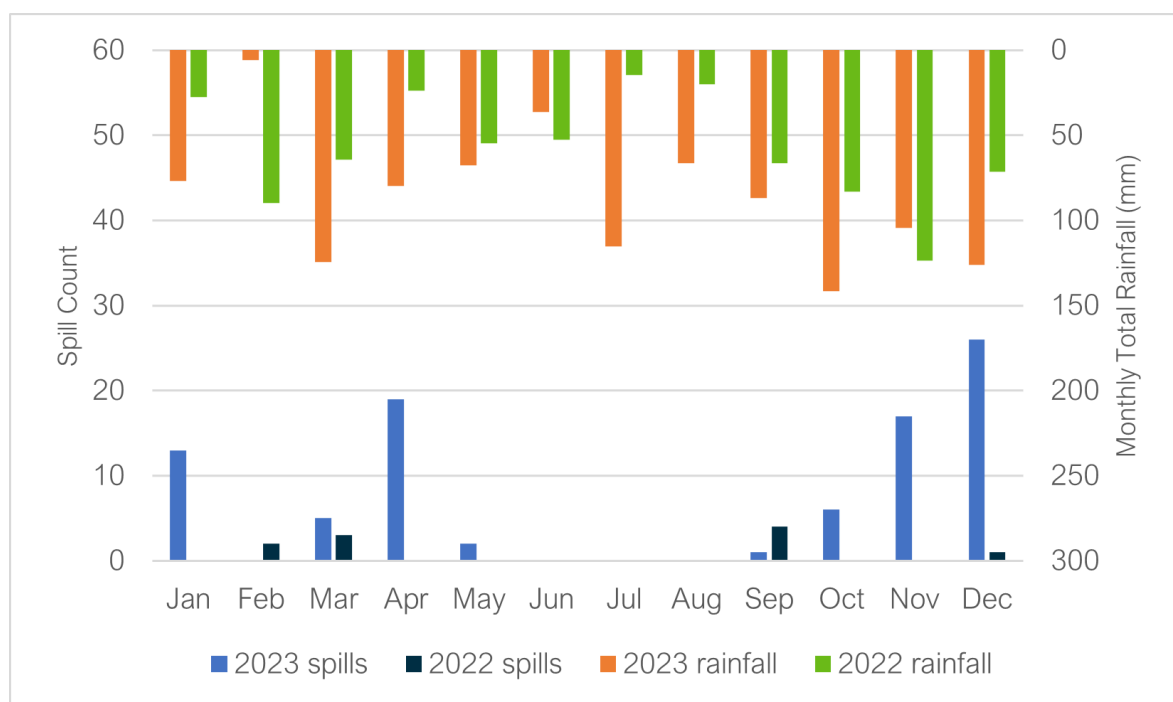
Table 7 below details the last 2 years performance of overflow ‘Chinnor STW’.

Table 7 – Event Duration Monitoring

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Chinnor STW	10	68.61	89	558

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. Note that the spill frequency of ten stated for 2022, is one higher than the published figure of nine. The spill count was revised/ revalidated, and ten is the post-validation value. Figure 8 below presents the EDM performance trend and rainfall for recent years.

Figure 8 – EDM Monthly Performance at Chinnor STW



The EDM data for 2023 shows an overall focus on spills during the winter, spring and autumn months. The data suggests a wider relationship between rainfall, elevated groundwater levels and spill frequency. The indicator site data shown in Figure 6 suggests groundwater levels in the catchment became elevated October – December 2023, reaching notably high levels. A significant number of spills were recorded during this period, compared to the same period in 2022, when the indicator site data shown in Figures 5 and 6 suggest groundwater levels in the catchment were significantly lower. A high number of spills were also recorded in April 2023. The indicator site data shown in Figures 5 and 6 suggests groundwater levels in the catchment were relatively high during this period.

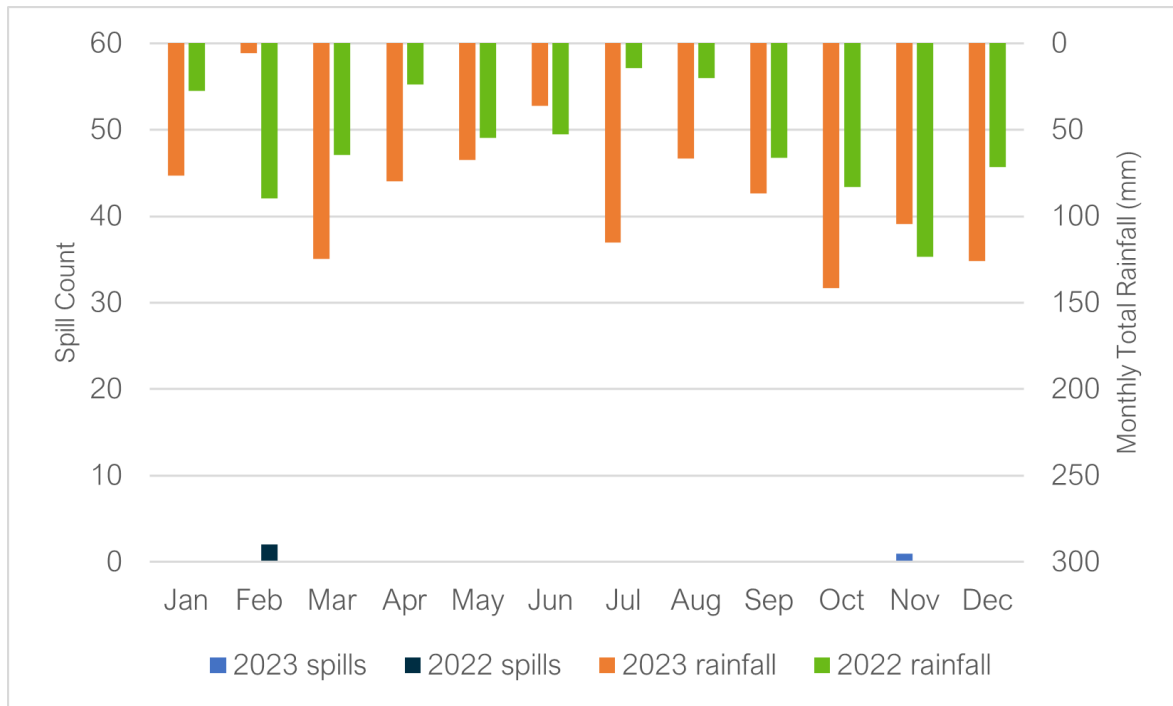
Table 9 below details the last 2 years performance of overflow ‘Manor Farm SPS’.

Table 9 – Event Duration Monitoring

Overflow	2022		2023	
	Spills	Duration (hours)	Spills	Duration (hours)
Manor Farm SPS	2	15.41	1	1.00

Figure 10 below presents the EDM performance trend and rainfall for 2022 and 2023.

Figure 10 – EDM Monthly Performance at Manor Farm SPS



The only spill recorded at Manor Farm in 2023 was in November, which does coincide with when the indicator site data suggests that groundwater levels in the catchment increased to notably high levels (see Figure 6). A limited number of spills at this site does make it difficult to identify a clear relationship between groundwater levels and spills at the overflow. As this overflow is located in the catchment rather than at the downstream STW, the data suggests the impact of groundwater infiltration on spills at the overflow to be more limited. Indicator site data suggests groundwater levels in the catchment have reached higher levels in 2024, therefore analysis of 2024 EDM data will provide an improved insight as to the potential impact of groundwater infiltration on spills at the overflow.

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

Table 11 – 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	559 metres	N/A
Look and lift survey	N/A	N/A	3 surveys
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

In addition to the investigations previously detailed in these Addendum Reports, an additional 559 metres of CCTV survey was undertaken in the catchment over the summer/ autumn 2023 period. The purpose of these surveys was to assess the structural condition of sewers predicted to be at high risk of groundwater infiltration, rather than to identify locations of groundwater infiltration into the network. The majority of the network surveyed (>75%) was identified as being in an acceptable structural condition. The survey results will be analysed further to identify priority locations for remediation works.

Chinnor STW is also being upgraded at a cost of more than £10 million. This project will provide a major increase in treatment capacity, reducing the need for untreated discharges to the environment. The project is expected to be completed 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.

The catchment is expected to meet all government targets for storm overflows by 2030.

Summary

Indicator site data suggests groundwater levels in the Chinnor catchment have generally been higher in the 2023/24 Hydrological Year than in the previous hydrological year. The EDM data for 2023 shows a significantly higher number of spills occurred at Chinnor STW compared to in 2022, when indicator site data suggests groundwater levels in the catchment were lower. The impact of further increases in groundwater levels in 2024, will be assessed using 2024 EDM data once this is available. This will 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

