

# Infiltration Reduction Plan

## The Green, Southwick

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Version 1.2



from  
**Southern  
Water** 

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## Document Control

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## Glossary

AMP – Asset Management Programme  
CCTV - Closed-circuit television  
EA - Environment Agency  
GW – Ground Water  
IRP - Infiltration Reduction Plans  
l/s - litres per second  
MH – Manhole  
RPS - Regulatory Position Statement  
SW – Southern Water  
WaSC - Water and Sewerage Companies  
WC – Water Closet  
WPS - Wastewater Pumping Station  
WTW - Wastewater Treatment Works

# 1. Background

This Infiltration Reduction Plan (IRP) for The Green, Southwick in the Southwick catchment has been prepared in response to the Environment Agency's (EA) Regulatory Position Statement (RPS). Southern Water (SW) has been carrying out work for many years to survey and repair sources of infiltration in the catchment for Shoreham Wastewater Treatment Works (WTW) in Sussex.

Figure 1 shows flows to Shoreham WTW. Flows from The Green, Southwick drain to Albion Street, Portslade WPS which are then pumped forward to discharge directly to the inlet works at Shoreham WWTW.

The repairs carried out by SW improve the integrity of the sewerage system. SW has been working with the following organisations and is dependent on their support to achieve the objective of reducing non-sewage flows into the sewers.

- Environment Agency,
- West Sussex County Council,
- Adur and Worthing Council
- Adur District Council

Southern Water has consulted with representatives of these parties during meetings with local councils.



Figure 1.1 – Location of The Green, Southwick draining to Shoreham WTW

## 2. Groundwater Infiltration at The Green, Southwick

### 2.1. The significance of groundwater infiltration.

The Green, Southwick is an area in Southern Water's operating area where, during excessively wet winters, customers have been inconvenienced by the effects of groundwater infiltration into sewers. Such effects can include flooding and restricted toilet use (RTU).

Southern Water strives to maintain services for customers by a programme of investigation, repair, maintenance and mitigation. Mitigation measures include the use of tankers and over-pumping. Such mitigation measures are not sustainable, so since 2013 SW has invested in carrying out major improvements to the integrity of the sewers and manholes in the vicinity of The Green, Southwick in order to minimise the occasions on which over-pumping is required.

### 2.2. What would happen if Southern Water did not take action?

Despite the significant groundwater flow through the catchment during these conditions, incidents of sewer flooding have been relatively infrequent. Table 2.1 below shows reported incidents of sewer flooding since April 2010. Average winter rainfall has also been included in Figure 2.1.

**Table 2.1 – Reported Flooding Incidents by Category, at The Green, Southwick**

Year	External Flooding	Internal Flooding	Restricted Toilet Use	Total	Average Daily Rainfall (mm)
2010_2011	0	0	0	0	2.02
2011_2012	0	0	0	0	1.03
2012_2013	5	0	2	7	1.92
2013_2014	3	0	2	5	2.97
2014_2015	0	0	0	0	2.62
2015_2016	0	0	0	0	3.02
2016_2017	0	0	0	0	2.11
2017_2018	0	0	0	0	2.35
2018_2019	0	0	0	0	2.73
2019_2020	0	0	0	0	3.83
2020_2021	0	0	0	0	2.47
<b>Grand Total</b>	<b>8</b>	<b>0</b>	<b>4</b>	<b>12</b>	



**Figure 2.1 - Historic Flooding and RTU Records**

A hydraulic model of the Shoreham treatment works catchment can help SW to understand the performance of the system and determine options to address risks. Furthermore, SW is aware of the locations which are likely to suffer first from the effects of flooding.

It is noted that despite the groundwater levels in 2021 being comparable to those experienced in 2013/14 (see Figure 4.1), the impact of this on the customers with respect to flooding and restricted toilet use is much less. This demonstrates the effectiveness to date of the sewer sealing work undertaken in the network.



## 3. Investigation & repairs

### 3.1. Outline Plans to Investigate Sources of Infiltration

The Generic Plan describes Southern Water’s Infiltration Reduction process. The specifics of the investigations and repairs at The Green, Southwick are captured in Section 3.2 below, and includes the following elements:

- Manhole Inspections and CCTV Surveys
- Flow Monitoring Surveys
- Manhole and Sewer Repairs
- Follow-Up Surveys and Repairs

### 3.2. Investigation and Repairs at The Green, Southwick

Groundwater infiltration into sewers has been a long-running issue for The Green, Southwick. SW has been making significant investments over many years to minimise infiltration and the need for over-pumping.

SW recently completed a major programme of survey and repairs to the sewers in The Green, Southwick catchment. The investigations and repairs followed the process set out in the Generic Plan. The extent of the repairs is shown in the plans in Appendix A. The timing and status of each step is shown in Table 3.1 below.

**Table 3.1 – Summary of Survey and Repairs at The Green, Southwick**

Step.	Description	Approx Date	Status
1.	manhole lifting followed by CCTV Investigation	Spring 2013, Spring 2014 and October 2018	Completed
3.	Determination of required repairs (700m of sewer identified for repair)	Summer 2014	Completed
5a.	Dry Weather Flow Survey	July 2013	Completed
4.	Repairs	January 2015 – April 2015: part completed. Remainder completed April 2018.  Further work undertaken in October & November 2018	Completed
5b.	Wet Weather Flow Survey	N/A	Not carried out
6.	Targeted follow-up survey	N/A	None scheduled
7.	Further Targeted Repairs	N/A	None scheduled

<b>Step.</b>	<b>Description</b>	<b>Approx Date</b>	<b>Status</b>
8.	Ongoing monitoring	Commenced December 2015	Ongoing
9.	Further surveys and subsequent repairs	Post 2022	If required

In addition to physical investigations on site, SW has instigated a long-term monitoring programme in critical catchments, which includes The Green, Southwick. Details are given in Section 5.5.

## 4. Over-pumping

### 4.1. Circumstances that lead to over-pumping

Since 2013, SW has made significant investment to reduce infiltration and to protect specific properties at risk of flooding, with the objective of reducing the frequency of discharges to watercourses.

If flows continue to increase, as groundwater levels rise, mitigation measures at certain locations will be required. Using previous experience, areas likely to be the first affected, are identified. The requirement for pumping will be driven by levels in the manholes locally. In many catchments, tankering is used prior to over-pumping. However, at The Green, because the area is very flat, tankering is ineffective. When levels have risen sufficiently to cause problems to customers, a pump becomes the only effective means of removing the volumes of dilute effluent. When overpumping is in place the discharges are initially to an adjacent foul sewer though if flow cannot be managed by this method overpumping to a surface water sewer, which discharges into the harbour is initiated as a last report measure to prevent flooding.

Based on experience in 2013 and 2014, over-pumping could be expected to be required when the groundwater level at Whitelot Bottom BH reaches 40.3m. However, to allow time for investigation and preparation, SW is using a lower groundwater ‘trigger level’ in the winter planning report. A trigger level of 35m is being used.

Figure 4.1 shows the groundwater level at Whitelot Bottom BH over the last nine years.

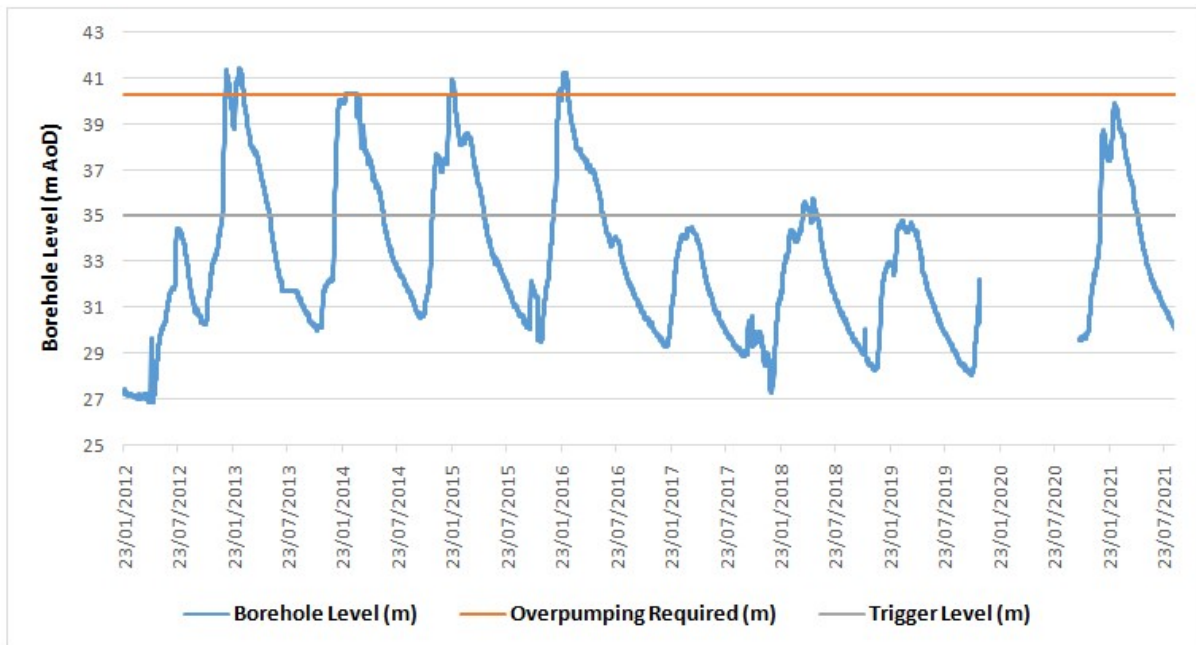


Figure 4.1 - Groundwater levels from 2012 to 2021

The locations of where over-pumping has been necessary in the past are given in Appendix B. The repairs carried out, combined with the winter preparation checks, are expected to minimise the number of locations where over-pumping would be required. However, as a consequence of repairs and potentially other factors outside SW’s control (such as the severity of the weather), the hydraulics may dictate that over-pumps are

required at other locations either in place of, or in addition to, the sites described in Appendix B. However, it is not envisaged that any change of location would result in discharges being made to watercourses.

## 4.2. Steps to prevent discharges and alternatives to over-pumping

The Generic Plan details the typical activities that Southern Water undertakes to minimise the requirement for discharges to watercourses. Since 2013, SW has undertaken extensive surveys and repaired sewers and manholes where infiltration had been found (the extent of the work is shown in Appendix A). This built on the repairs that had been carried out in previous years (shown in Appendix A).

The Generic Plan outlines activities that SW undertakes to minimise the requirement for discharges to watercourses.

## 4.3. Over-pumping arrangements (flow rates and minimisation of effect on watercourse)

A typical arrangement of an over-pumping setup is provided in the Generic Plan.

Depending on local conditions, a typical over-pumping site consists of a pump located at ground level adjacent to a sewer manhole from where wastewater heavily diluted by groundwater is pumped into a nearby watercourse or other conduit. At The Green, Southwick, flow is pumped into a foul sewer and if required into a surface water sewer. There is no discharge to a watercourse.

The locations where over-pumping has been used in recent years are shown in Appendix B. These locations were effective in restoring service to customers and are the default locations should the situation re-present itself. Dates of historic over-pumping are also provided in Appendix B.

In addition to the measures described above to remove solid matter, SW invested in ten portable biological treatment units in January 2014 for use at flooded areas throughout its area. The units were trialled but found to be unreliable, so UV units have been used instead when over-pumping is required.

## 4.4. Steps to minimise the volume and duration of over-pumping

The Generic Plan outlines a detailed rationale behind the use of tankers and over-pumping, and summarises the benefits and disadvantages. Some specific issues in relation to The Green, Southwick catchment are captured below.

### 4.4.1. Tankering

#### Benefits:

- See Generic Plan.

#### Disadvantages

- The flat catchment at The Green, Southwick results in large volumes of water to be removed from the sewers which would be uneconomic and disruptive to achieve with tankers.
- See also the Generic Plan.

#### 4.4.2. Over-pumping

##### Benefits:

- Typical pump fuel consumption is 20% of the fuel that one tanker would use in a day.
- The discharge rate is significantly greater. A 150mm (6 inch) pump will discharge typically 50 to 80l/s; the equivalent of a fleet of 24 tankers.
- See also the Generic Plan.

##### Disadvantages

- Visual and noise impact of over-pumping equipment in the built-up area of The Green, Southwick.
- See also the Generic Plan.

### 4.5. 3rd Party Communications about over-pumping

Since the start of the Infiltration Reduction Programme in 2013, Southern Water has been proactive in communicating with stakeholders and customers about planned and completed work to improve the integrity of the sewerage system. Stakeholders have been kept informed of progress on survey and sealing work via emails and or face-to-face meetings.

From time to time, SW updates stakeholders about completed and planned work. SW attends and convenes meetings with a number of local groups. In particular, meetings with the EA and local councils have been influential in helping to shape the IRP. During the flooding of 2013/14 SW had representatives on site who visited affected customers to help them. The latest version of the IRP approved by the EA, will be published on SW's website.

Despite the work being undertaken, if over-pumping is required, the location is provided in Appendix B. The Generic Plan provides more detailed arrangements around over-pumping.

### 4.6. Monitoring quality of the downstream watercourse

The Generic Plan provides details of water quality monitoring that will be undertaken, should over-pumping be required.

## 5. Options to Reduce Infiltration

### 5.1. Sewer Rehabilitation Programme

SW acknowledges that infiltration reduction is on-going process. In recent years, SW has invested £190,000 in surveys and repairs at The Green, Southwick. Some of the work was completed in April 2015, and the remaining work was completed by November 2018.

### 5.2. Property Level Protection

Two NRV's are currently in use in The Green, Southwick. There are no plans to install any more NRVs, but the potential benefit of further property level protection will be considered if it is considered to be required for any further vulnerable properties.

### 5.3. Local Flow Control

The locations and dates where over-pumping has been used in recent years are shown in Appendix B. Over-pumping was required previously between February-March 2013, February-April 2014 and in the winter of 2019-20.

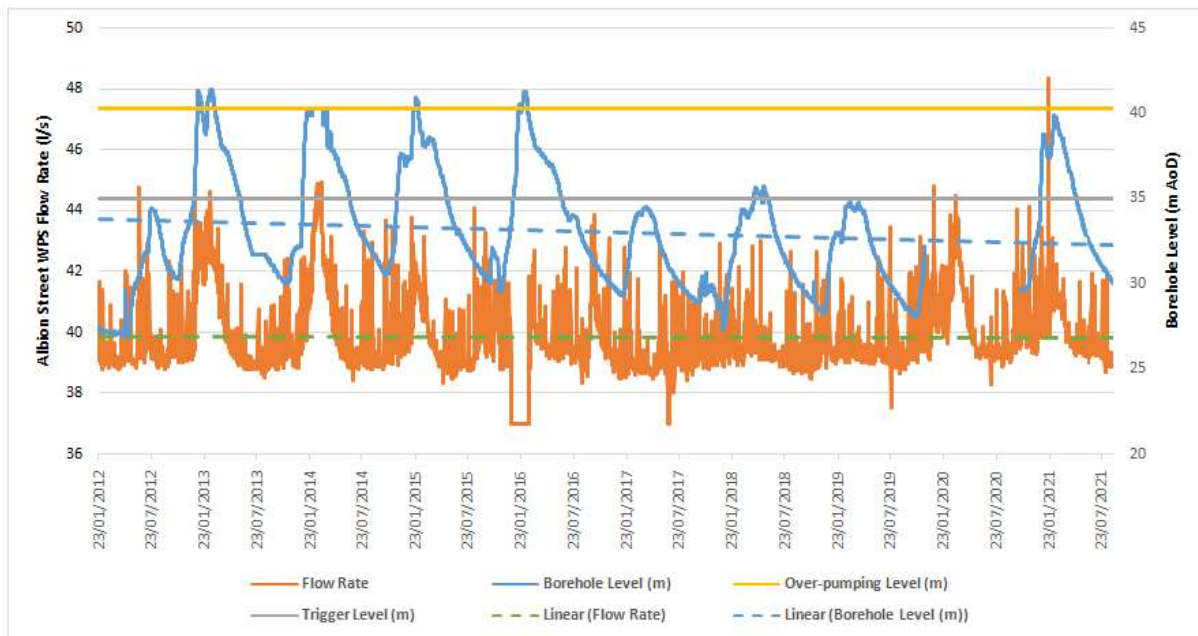
### 5.4. Pumping Stations

In order to minimise the effects of infiltration at the Green, Southwick, SW is continuing to ensure that design discharges at Albion Street, Portslade WPS are maintained.

### 5.5. Monitoring

In addition to monitoring groundwater levels at Whitelot Bottom, SW also monitors the levels in sewers. Sewer flows increase rapidly after rainfall, so sewer levels are helpful to provide back-up information to assess the proposed response to flooding.

The graph below, in Figure 5.1, is an example of those used for predicting the earliest, average, and latest dates for when the trigger levels are forecast to be breached. This graph shows groundwater levels at the Whitelot Bottom borehole, and an indication of flows.



**Figure 5.1 – Forecasting of Trigger Dates**

In addition to the groundwater flooding forecasts explained above, SW is also looking at longer-term trends to monitor the effectiveness of the completed rehabilitation work.

An analysis was performed using long-term data obtained from the Shoreham Catchment. The relationship between groundwater levels from Whitelot Bottom borehole and flows to Albion Street, Portslade WPS was analysed. Whitelot Bottom is the closest borehole for which data is readily available, but it should be noted that groundwater levels at observation boreholes (which tend to be on higher ground) are not always good indicators of groundwater levels at coastal locations such as Southwick.

Based on the groundwater data available, there appears to be no clear relationship amongst the data, and therefore it has not yet been possible to conclude how effective the repairs have been. SW will continue to obtain data so that further analyses can be performed in the future, as repairs progress.

## 6. Action Plans

A significant amount has been achieved in The Green, Southwick catchment since 2013. Some actions are ongoing which reflects the continuous improvement process for dealing with infiltration due to groundwater. To make it easy to track progress, the following tables set out the actions to reduce infiltration and also to mitigate the effects of it, if the infiltration cannot be controlled at economic cost. Tables 6.1 and 6.2 cover the actions by SW and by other parties, respectively, to reduce infiltration. Tables 6.3 and 6.4 cover mitigation of the effects of flooding (Communication and other activities).

SW is committed to continuing to pursue infiltration to reduce the frequency of over-pumping. This IRP describes the work that has been done by SW to improve the situation. In addition, it also describes what is being done to monitor flows, the 'winter preparation' work to be carried out to ensure assets are operating correctly, and the work to be developed with other agencies to improve an integrated plan to address flooding.

Colour coding of actions in tables:

- Green – completed
- Orange – imminent action required
- Red – overdue
- White – on-going actions with no specific end dates.



Table 6.1. Southern Water Current Activities to Reduce Groundwater Infiltration

Ref.	Item	Actions	Timescale and Status	Outcomes
1.1	Develop an approach for reduction of infiltration and maintenance of reduced levels of infiltration.	Refer to Section 1 above and the report in Appendix 1.	Summer 2013, Complete	The steps are being followed to deliver results.
1.2	'Dry weather' flow surveys (to measure background levels of infiltration during low groundwater periods)	Identify suitable measurement points, carry out survey over four week period in Summer, match rainfall records with flow data.	July/ August 2013 - Complete	Groundwater infiltration is greater than would be expected for summer conditions.
1.3	CCTV etc survey of sewers	Identify Strategic Manholes, survey manholes to identify clear flow and infiltration. Carry out CCTV survey where clear flow was identified.	Spring 2013, 2014 and Autumn 2018 - Complete	Identify major sources of infiltration to determine scope of rehabilitation work.
1.4	Carry out sewer rehabilitation work	Use various techniques to seal infiltration points in manholes and sewers	January - April 2015. Remainder completed April 2018. Further work undertaken in October and November 2018.	Structural integrity of sewers restored.
1.5	Maintain IRP as a live document	Review text of the IRP and update if appropriate to describe work carried out and/or developments	Annually	Reviewed/Updated IRP. Last issued for review 2017.

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.5a	Maintain IRP as a live document	Review Tables 6.1 to 6.5 and as appropriate amend to show progress on individual activities.	Quarterly	Up to date tables of Actions
1.6	Install Property Level Protection to Vulnerable properties.	Survey and install NRVs at vulnerable properties.	Autumn 2014 - Complete	The aim is that protection to vulnerable properties restricts tankering to those properties only as opposed to more significant sewer pumping.
1.7	Over-pumping Sites: improve effluent quality	Investigate potential for improved screening and basic treatment at points of discharge into watercourse.	SW, Summer/Autumn 2014	Improved arrangements for discharges when required.
1.8	Over-pumping Sites: minimise flow	Add level control to pumps to reduce durations for pumping	SW, 2014, Complete	Establish whether seasonal discharge (s) will be necessary in order to maintain use of sewerage services for customers during periods of very high groundwater levels.
1.9	Standards for emergency discharges	SW to discuss with EA about best practice set up for over-pumping arrangements.	SW, 2014, included in this IRP	Agree with EA acceptable treatment for discharges and acceptable flow rates.
1.10	Flow, location, screening arrangements for emergency discharges	Determine potential flow rates and screening arrangements and most appropriate locations,	SW, included in this IRP	Agree with EA, West Sussex CC, Adur DC and local Parish Councils acceptable arrangements for future emergency discharges.

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.11	Action Plans	Develop SW action plans documenting set up of pumps, tankers, etc. for emergency situations.	SW, Summer 2014-Complete	Action Plan available for planning sessions with other authorities in preparation for repeat flooding events. Engagement with the local community about the potential arrangements for dealing with excess flows into sewers to mitigate disruption to customers.
1.12	Review effectiveness of any sealing work	Analyse monitoring data and groundwater data to determine benefit of investment.	2022	Develop further plans if required

**Table 6.2. Multi-Agency Activities to Reduce Groundwater Infiltration**

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
2.1	Strategy for infiltration via private drains	Southern Water to propose a strategy for dealing with infiltration via private drains*	SW supported by EA and local Parish Councils, Summer/ Autumn 2014. Completed 2014.	Southern Water objective is to improve awareness of the significance of infiltration into private drains and the importance for customers to ensure infiltration is repaired when it is discovered.
2.1a	Long-term Monitoring	SW will monitor sewer flow to identify significant increases in inflows.	Ongoing	Early identification of areas where infiltration has increased
2.2a	Investigate highway 'mis-connections'	Where non-sewage flow is identified, check highway drainage relative to sewers to ensure road drainage is not a source of flow into the SW sewers	West Sussex Council with support from SW, 2014 onwards. To be pursued as and when required.	Reduced flow of surface water (if connections are found).
2.2b	Investigate groundwater infiltration on domestic drains	Where non-sewage flow is identified from domestic properties, investigate to identify source of flow into SW sewers	SW, with assistance from local councils where required, 2014 onwards. To be pursued as and when required.	Reduced flow of surface water (if connections are found).
2.3	Consider effects of proposed new developments on infiltration.	District Council to continue to consult with SW on development applications.	District Council, Ongoing.	Developments in areas which would be detrimental to sewer flooding, to have conditions recommended by SW and applied, as appropriate, by the County and District Councils.
		SW to determine threshold above which they require to be consulted.	District Council, Ongoing. SW wish to be consulted on all proposed development.	
		Sewerage materials for new developments	SW & District Council, when developments are at	

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Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
			planning approval stage. Ongoing.	

\*Note: Southern Water does not have powers to require residents to repair private drains. Hence the support of the other agencies is required. It is acknowledged that customers may not be aware of infiltration in their private drains, so SW will consider ways of obtaining information to demonstrate the presence of infiltration. District Councils would only be able to instigate action under Section 59 of the Building Act where proof/evidence is provided of the defect.

**Table 6.3. Publicity / Communication Activities to Reduce / Mitigate the Effects of Groundwater Infiltration.**

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
3.1	Public meetings about reducing groundwater infiltration into sewerage system	Attend public meetings with other agencies as appropriate.	SW, as required	Inform stakeholders of progress and planned activities and receive feedback.
3.2	Letters from SW to stakeholders about reducing groundwater infiltration into the sewerage system	Send letters at regular intervals to communicate progress and planned activities	SW, as required	Inform stakeholders of progress and planned activities
3.3	Multi-Agency Group meetings	Discuss and agree actions to reduce requirements for tankering and emergency discharges to watercourses.	All Parties, Discussed and actions agreed in 2013 and 2014. To be discussed in future as required.	Improved understanding and appreciation of issues. Agreement to actions to help reduce the need for tankering and emergency discharges to watercourses
3.4	Implement local campaign to discourage misconnections	Publicise through parish councils. Include article in Parish magazines. **	District and Parish Councils, Summer 2014 Complete	Complete

\*\* SW can provide base information to councils to include in articles publicising the role that everyone can play in minimising non-sewage flows into sewers, and the importance of doing so to reduce the incidence of restricted toilet use during periods of high groundwater.

**Table 6.4. Activities to Mitigate the Effects of Groundwater Infiltration/ Other Flood Protection Mechanisms**

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
4.1	Early Warning system	Joint continuous monitoring of groundwater levels and sewer levels/flows.	SW, EA, 2014. Ongoing. Commenced Jan 2015. Re-commenced annually	Develop trigger levels by comparing historic customer complaints and over-pumping with BH levels (or other reference).
4.2	Tankering arrangements	Investigate options for improving location of tankers and over-pump units for future events. e.g. by use of longer hoses/ pumping	SW, Spring 2014, Complete	Potentially less disruption to residents when tankering / pumping is essential.
4.3	Maximise the capacity of the sewerage system and pumping stations	Ensure foul system is clear of obstruction	SW, July 2014 for capacity determination. Trial - if and when - the sewers are surcharged	Sewer cleaning undertaken where required
4.4	Flooding Management Plan	Develop plan to address the flooding issues caused by high groundwater. Implement recommendations.	West Sussex Council and local councils with inputs from SW, EA, and Parish Councils	Plan including actions for participating authorities, that in unison will reduce the extent of flooding and the impact of flooding.
4.5	Maintenance of watercourses	Riparian owners to carry out their responsibilities to maintain adequate flow through watercourses by clearing vegetation, desilting, etc	Riparian owners with input from District and Parish Councils – ongoing responsibility	Maximise the flow along watercourses in order to minimise surface flooding, which results in inundation of manholes to the sewerage system.
4.6	Review of utilisation of a control structure	Investigate the possible use of a fixed control structure to relieve hydraulic overloading of sewers.	SW	No current plans to progress this option.

# Appendix

A Survey Findings and Rehabilitation Scope

B Emergency Discharge Sites