Margate Pathfinder

Technical Report

June 2022

from Southern Water

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Document History

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Executive summary

The Margate catchment was specifically chosen as a pathfinder catchment due to recent pumping failures in storm conditions at Margate Wastewater pumping station (WPS), which have resulted in discharges of wastewater to coastal waters and have led to the closing of bathing beaches.

Almost all of the drainage system in Margate combines sewage and rainfall together into one combined drainage system, which is owned and maintained by Southern Water. Also within a combined sewer catchment are a number of storm overflows (CSOs) that act like a relief valve to the system during periods of heavy rain. These CSOs release flows into the environment to avoid sewage flooding in the catchment.

Having surface water from rainfall mix with the sewage creates a number of issues, including: an increased risk of flooding, contamination of rainwater that could be fed straight back into the environment and increased costs of pumping and treating diluted sewage, as well as the impact of storm overflow spills into the environment.

However managing surface water is a complex, shared problem, as it means making sure that water drains effectively from homes and gardens, roads, fields, businesses and public spaces.

Southern Water has set up a Taskforce with a number of aims, the key one being to significantly reduce the use of storm overflows by 2030. To investigate how this can be achieved a number of pathfinder projects have been set up and the Margate catchment is one of those. These pathfinders have a staged approach as follows:

Stage 0 – study and surveys
Stage 1 – no regret interventions and trials
Stage 2 – More complex interventions and large scale pilots
Stage 3 – Larger scale investments to deliver the outcome

The interventions identified are likely to be a mix of types of innovative and traditional solution such as:

- Upstream source control (removing and slowing the flow of rain water)
- System optimisation (making better use of the existing infrastructure)
- Infrastructure enhancements (build new or larger infrastructure)

The mechanism that these interventions will be delivered by is also likely to be innovative, with Southern Water working in partnership with Kent County Council, local council projects and community groups to provide solutions that provide multiple benefits.

We have initially identified some areas that we would like to investigate for sustainable urban drainage systems but in addition, further survey work and modelling will be required to confirm if these potential interventions will provide the benefit required. We will continue to identify and, where appropriate, enact these interventions whilst we collate the results of the rest of the surveys.

This report is only the start of the journey towards a sustainable drainage system in Margate. We will work as partners to investigate and better understand the existing drainage systems, to identify and deliver opportunities for improvement, and plan together for the sustainable growth of the town of Margate.

What we ask of our partners and the community is to continue to support that journey, with photos and data, ideas and enthusiasm. So that together we can agree how decisions can be made, now and in the future for our mutual benefit.

1.0 Introduction and document purpose

This report is an output of a Stage 0 study for the Margate catchment. The Margate catchment was specifically chosen as a pathfinder catchment due to recent pumping failures in storm conditions at Margate Wastewater pumping station (WPS), which have resulted in discharges of wastewater to coastal waters and have led to the closing of bathing beaches. Part of the problem is the high peak flow arriving at the site from the combined sewerage system. This was chosen as a pathfinder project to understand the source of all flow into the system, with a view to removing a proportion to reduce storm releases and the loading on the pumping station and therefore improving its resilience in storm conditions.

2.0 The problem

2.1 The management of surface water

Managing surface water is about making sure that water drains safely from homes and gardens, roads, fields, businesses and public spaces. Good surface water management is about making sure that rain can drain effectively straight through our environment, using a combination of natural and manmade drainage networks.

Sometimes rainwater falling on impermeable surfaces such as roofs and roads can be contaminated by surface contaminants; it can also get into the sewer system and be contaminated by foul sewage. This contaminated water needs to be pumped & treated and if the volume overwhelms the downstream assets, then sometimes diluted sewage has to be discharged into rivers and the sea via a Storm Overflow, see Section 4 for more details. Storm Overflows, previously known as combined sewer overflows (CSOs) are a relief valve for the drainage system to prevent the devastating impact of sewer flooding.

Water companies have a critical part to play in improving surface water management.

2.2 Margate Drainage system

Almost all of the drainage system in Margate combines sewage and rainwater together, see section 3. This means that during wet weather the flow that arrives at Margate Pumping station can rise from a modelled Dry weather ‘base’ flow of 250l/s to over 8,000 l/s in a matter of minutes. This large and sudden change can put a huge stress on the pumping and storage assets. Most of this is stored at the pumping station but once this storage is full the overflows have to activate to prevent upstream flooding.

3.0 Particulars about Margate Drainage

3.1. Location and local government services

The Margate and Broadstairs catchment is located on the Isle of Thanet, on the north Kent Coast in south-east England and 16 miles north-east of Canterbury. The catchment is generally split into two hydraulically separate areas, Margate and Broadstairs. The Margate catchment contains the towns of Birchington, Westgate-on-Sea, Westbrook, Margate and, to the south the semi-rural sub-catchments of Acol, Brooks and Twenties. The Broadstairs catchment is situated around Viking Bay and includes the sub areas of Westwood, Lidden and Kingsgate, with parts of Northwood and Dumpton. Margate is 16 miles north-east of Canterbury. The local services for Thanet are provided by Thanet District Council and include: leisure, environmental health, housing and rubbish collection. Kent County Council is responsible for more strategic services such as education, libraries, main roads, social services, trading standards and transport.

3.2. Topography

The topography of the catchment is mildly undulating with the highest point of the catchment in the south eastern area, close to the border between Margate and Broadstairs with a height of approximately 52m AOD, falling towards the coast.[1]

Figure 1– Margate Topography OS mapping[2]

[1] Margate & Broadstairs (WEHB) AMP6 Drainage Area Plan (DAP), 2019
[2] Southern Water Asset Miner OS copyright

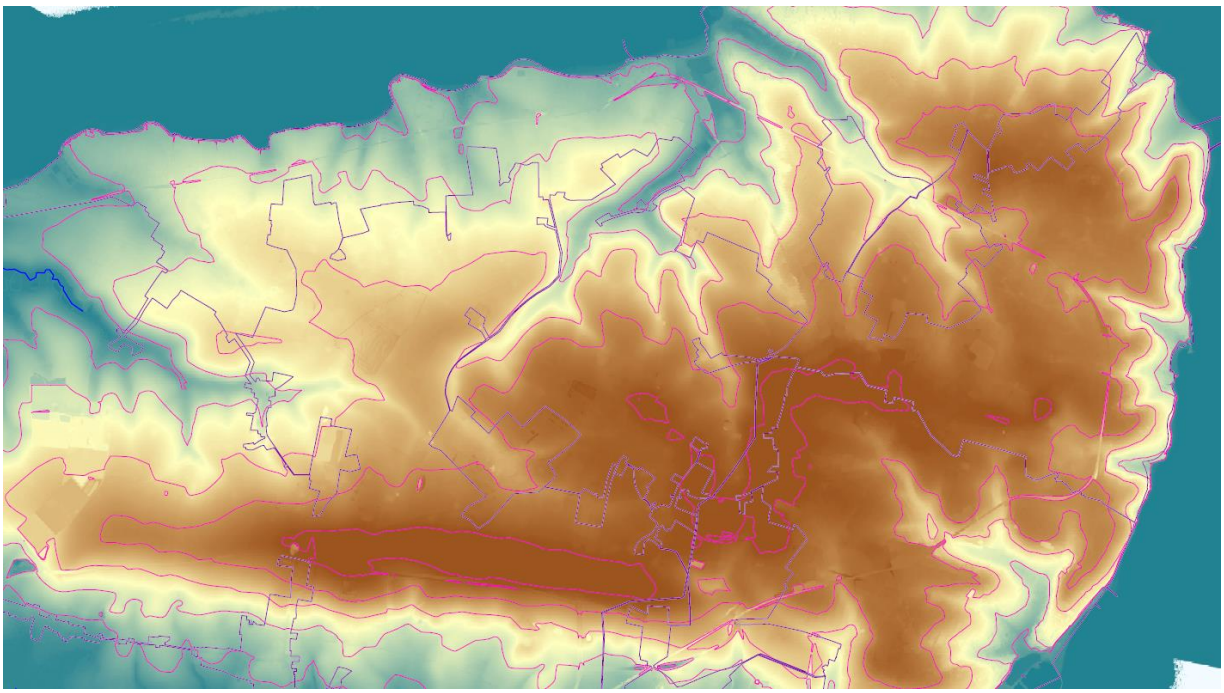


Figure 2– Margate Topography EA LiDAR[3]

3.3. Geology

There are two near surface geological deposits of Margate that are of particular interest when looking at surface water drainage. These are as follows:

Head Deposits – These occur across approximately 50% of the study area; the distribution is random, mainly individual narrow linear strips along river and stream valleys, and randomly shaped individual patches on higher ground.

Head Deposits in this area are expected to be derived from the chalk. Head is poorly sorted and poorly stratified, angular rock debris, it comprises of gravel, sand and clay depending on the upslope source and the distance from the source. Locally there may be areas of silt, clay or peat and organic material. As it is derived from the chalk, fine material is expected to dominate, meaning low or only moderate permeability.

The Head deposits are underlain by a solid geology of Chalk. If the head deposits are thin, and/or the infiltration solutions are deep enough to penetrate through the Head, then they will drain into the underlying chalk.

Chalk - For the remaining 50% of the catchment Chalk is shown outcropping at the surface. Chalk is exposed at surface in about 50% of this area. The Chalk is expected to be weathered at surface to broken/fragmented chalk, grading down into better chalk with depth. Chalk generally has a high permeability even when weathered and so infiltration is expected to be reasonable.

[3] 2020 2m DTM LIDAR Composite model, Environment Agency

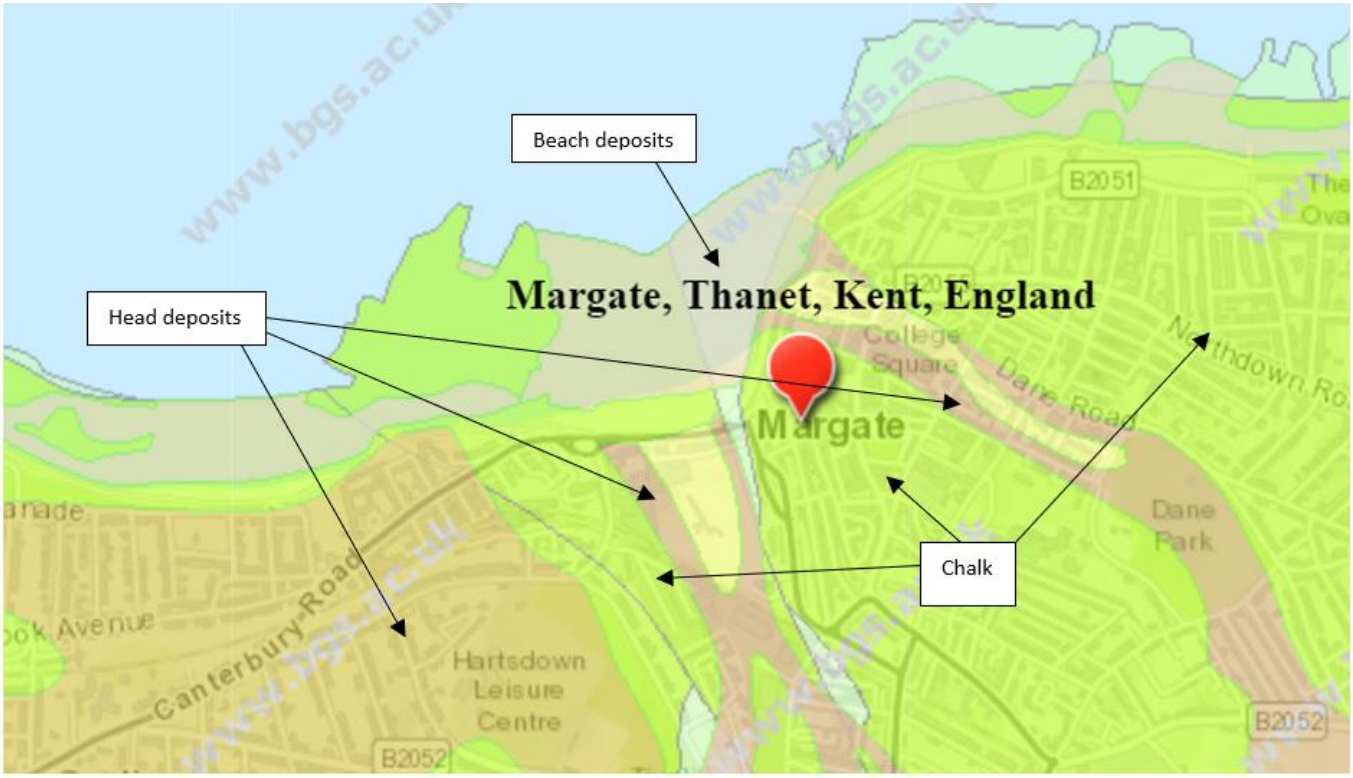


Figure 3 – Geology of Margate[4]

3.4. Southern Water Drainage system

Drainage systems can be made up of single pipe systems (combined) and two pipe systems (foul and surface water). Appendix B provides some background information on how drainage systems have developed and in particular the contribution that legacy housing (houses where the roof drainage and sewage drainage combine) makes to surface water management.

The drainage system within Margate consists predominantly of combined sewers which are owned and maintained by Southern Water. The entire catchment is split into two hydraulically separate areas, Margate and Broadstairs. The sewerage system of Margate operates on two distinct and separate levels. The first, older, 'high level' system is made of mainly brick egg and clay sewers. The second, newer, 'low level' carrier system was constructed in the 1960's using tunnelled concrete pipes. Dry weather flow passes down the older networks of pipes until, in storm conditions, they become overloaded and discharge over a series of weirs to the system below. All flows from the Margate Catchment end up at the Margate Wastewater Pumping Station (WPS).

From the Margate WPS, all flow is pumped to the Weatherlees Hill B wastewater treatment works (WwTW) for treatment, which is approximately 11km away. Treated flows are returned to the Margate Pumping Station for discharge via the existing long sea outfall (LSO).[5]

[4] www.bgs.ac.uk
[5] Margate & Broadstairs (WEHB) AMP6 Drainage Area Plan (DAP), 2019

3.5. The Combined Sewerage system

We have a network model of the existing foul & combined sewer system of Margate, which we use to run different rainfall scenarios to understand the impacts on the system. As more information about the catchment is gathered and the catchment changes then this model must be updated, calibrated and verified. Figure 4 below shows the current extent of the model.

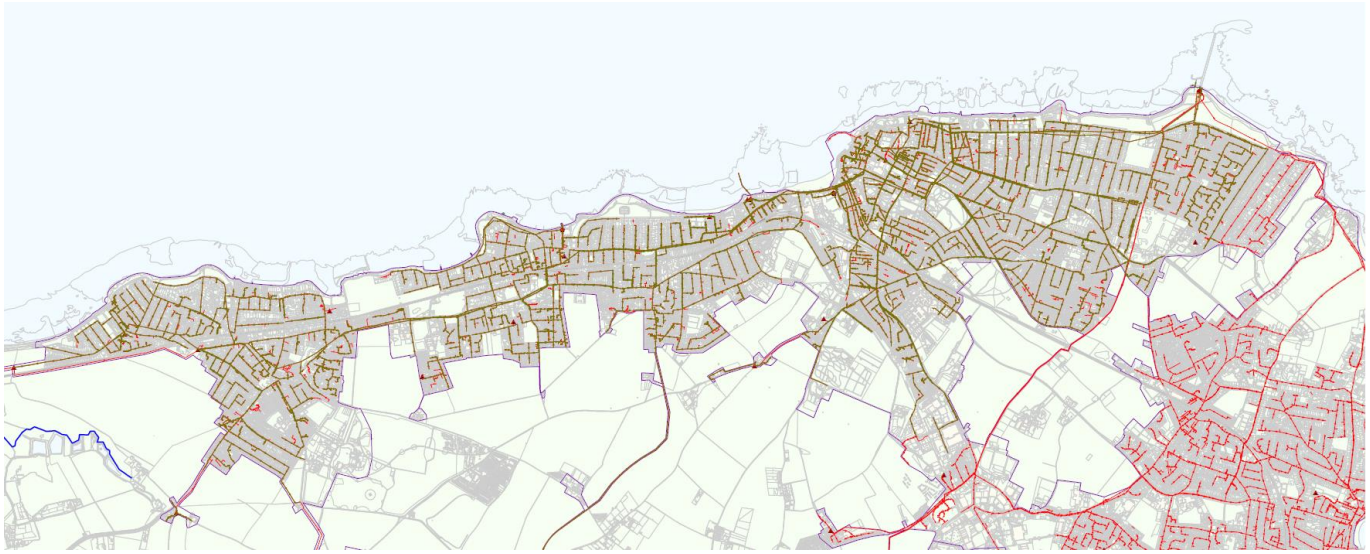


Figure 4 – Foul/combined sewer system in the Margate catchment[6]

A recent project has undertaken a large quantity of surveying including flow surveys and manholes surveys. This information will be used to improve the network model for the Margate area.

In addition there is a programme to install over 300 level monitors in the Margate catchment. This will also give us more 'real-time' data of water levels in the sewers.

This information and the improved network model will support making decisions around other potential large interventions, see section 6.

There is a separate network model for the Broadstairs catchment.

3.6 Catchment Pumping Stations

Within the Margate & Broadstairs catchment there are 27 pumping stations.

	Pumping Station Name
1	SEAVIEW TERRACE MARGATE WPS
2	DANE ROAD BIRCHINGTON WPS
3	THE PINES BROADSTAIRS WPS
4	BROOKS END WPS
5	KNOLD PARK MARGATE WPS

[6] Southern Water Asset Miner System

6	BROADSTAIRS WPS
7	TWENTIES MARGATE WPS
8	HARBOUR STREET BROADSTAIRS WPS
9	MARGATE WPS
10	THE COTTAGE BIRCHINGTON WPS
11	KING STREET MARGATE WPS
12	PLUM PUDDING BIRCHINGTON WPS
13	GORE END BIRCHINGTON WPS
14	ROYAL ESPLANADE MARGATE WPS
15	ACOL WPS
16	LYDDEN WPS
17	OCEAN CLOSE BIRCHINGTON WPS
18	SAXON ROAD WESTGATE ON SEA WPS
19	MARINE TERRACE MARGATE WPS
20	FORT PARAGON MARGATE WPS
21	WHERRY CLOSE MARGATE WPS
22	MAPLE CLOSE BROADSTAIRS WPS
23	COLUMBUS AVENUE RAMSGATE WPS
24	48B DUNSTAN AVENUE WESTGATE-ON-SEA WPS
25	61 RALPH GRIMSHAW COURT WESTGATE WPS
26	VERE ROAD BROADSTAIRS WPS
27	WALPOLE BAY CLIFTONVILLE WPS

Table 1: Wastewater Pumping Stations in the Margate and Broadstairs Catchments[7]

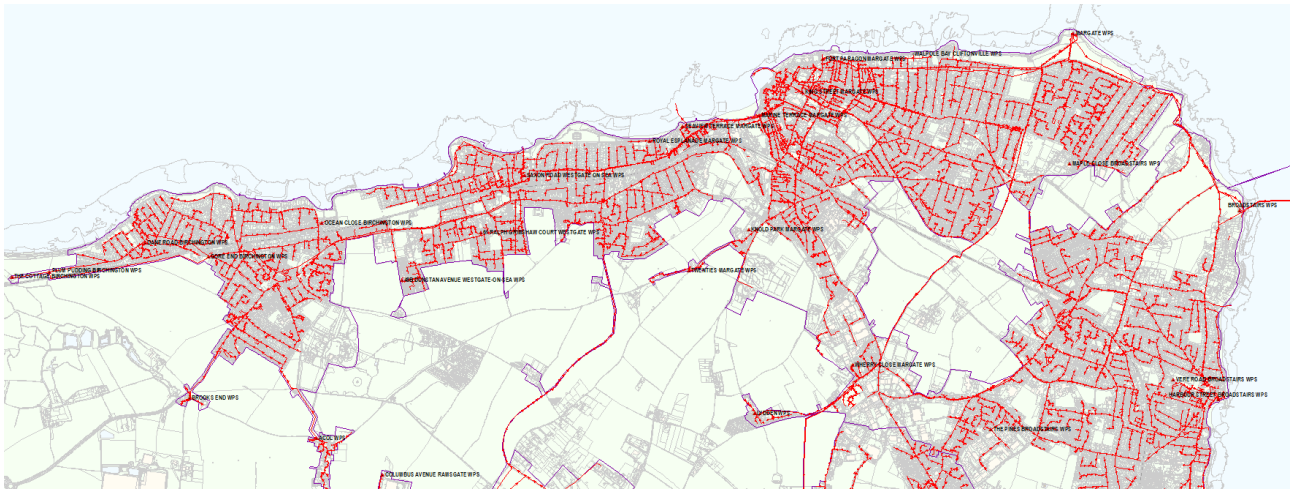


Figure 5 – Location of Pumping Stations within the Margate and Broadstairs catchment[8]

[7] Margate & Broadstairs (WEHB) AMP6 Drainage Area Plan (DAP), 2019
[8] Margate & Broadstairs (WEHB) AMP6 Drainage Area Plan (DAP), 2019

3.7 Margate WPS & Broadstairs WPS

The catchment is generally split into two hydraulically separate areas, Margate and Broadstairs. See section 3.15 for a schematic diagram.

All flows from the Broadstairs catchment drain to the Broadstairs WPS. Flows are then pumped to Margate WPS via a terminal pumping station at a peak rate of 264 l/s. Flows in excess of 264l/s are screened and spill down the Long Sea Outfall (LSO). The capacity of the LSO is approximately 400l/s but generally only 277l/s is discharged based on the capacity of the duty/standby high level pumps. These can run duty/assist if required to maximise the flow discharged into the LSO. There are also low level storm pumps with a capacity of 2.6m3/s, flow is screened and discharged down the Short Sea Outfall (SSO). Flows in excess of the storm pumping capacity are discharged via the Emergency Overflow (EO) which is an unscreened 'letter box' discharge to the SSO.

All flows from the Margate catchment end up at Margate WPS. Flows up to 809 l/s combine with pumped flow from Broadstairs WPS in the inlet chamber. The combined flow is then lifted by 2 No. duty, standby screw pumps to 2 No. 6 mm, 2D inlet screens, each rated at 2380 l/s. Screened sewage gravitates to 1 No. detritor with a bypass. Screened and de-gritted sewage flows to the wastewater transfer pumping station where it is pumped forward to the Weatherlees Hill B WwTW for treatment, which includes the 264l/s flow from the Broadstairs catchment. The treated effluent is returned from Weatherlees WwTW to Margate WPS for discharge down the long sea outfall (LSO).[1]

Flows in excess of 809 l/s overflow at the storm weir and gravitates to 3 No. duty, assist and standby horizontal storm screens, each rated at 2380 l/s; screenings are retained in the main flow. Screened storage sewage gravitates to the storm lift pumping station where it is lifted by 5 No. storm pumps (D/A/A/A/S) to 1 No. storm tank. The storm pumps have a capacity of approximately 6440l/s, and discharge via screens to the storm tank. The Storm tank has a capacity of 4000m3, when the storm tank is at approximately 90%, flows initially discharge at 300l/s down the Long Sea Outfall. The permitted FFT for settled storm overflow (Long Sea Outfall) is 1100 l/s i.e. 809l/s from Weatherlees B WwWT plus the 300l/s from the long Sea Outfall. Once the storm tank is 100% full flow weirs down the Short Sea Outfall. When all storage is at capacity and maximum flows are being transferred there is an Emergency Outfall which discharges directly on the beach.

As mentioned in section 2.2, due to the fact that the Margate drainage system is mainly made up of combined sewers it is very reactive to rainfall. Flows to Margate WPS can increase from a dry weather base flow of approximately 250l/s to a peak of 8000l/s during a storm.

3.8 Weatherlees WwTW

The Margate and Broadstairs drainage catchment is served by the Weatherlees Hill B Wastewater Treatment Works (WwTW). The WwTW is located in on the same site as Weatherlees Hill A WwTW, serving Deal, Sandwich and Ramsgate; it is located between Sandwich and Ramsgate.[9]

Weatherlees Hill B WwTW has a three phase treatment process, the key elements of the process stream are:

[1] Margate & Broadstairs (WEHB) AMP6 Drainage Area Plan (DAP), 2019
[9] Margate & Broadstairs (WEHB) AMP6 Drainage Area Plan (DAP), 2019

- Preliminary treatment - screening and de-gritting is undertaken at Margate WPS prior to transfer to Weatherlees Hill B WwTW
- Secondary treatment - secondary treatment consisting of four activated Sludge Lanes
- Secondary treatment (2nd stage) - it is consisting of four Final Settlement Tanks
- Tertiary treatment (3rd stage) - consists of UV channels.

Treated flows are returned to the Margate WPS for discharge via the existing long sea outfall. See section 3.15 for a schematic diagram.

3.9 Margate & Broadstairs CSOs

Storm Overflows are a relief valve for the system to prevent the devastating impact of sewer flooding, see Section 4.0 for more information.

There are 9 Sewer overflows within the Margate & Broadstairs catchment:

	Overflow	*Type*	*Releases in 2020 (12\24 – EDM report)*
1	*Marine Terrace Margate CEO*	*Combined Sewer/Emergency Overflow*	*0 activations in 2020*
2	*St Mildreds Bay CSO*	*Combined Sewer Overflow*	*0 activations in 2020*
3	*Margate EMO*	*Combined Sewer/Emergency Overflow*	*0 activations in 2020*
4	*Margate Short CEO*	*Combined Sewer/Emergency Overflow*	*10*
5	*Margate Long CEO*	*Combined Sewer/Emergency Overflow*	*14*
6	*Seaview Terrance Margate CSO*	*Combined Sewer/Emergency Overflow*	*0 activations in 2020*
7	*Broadstairs CEO*	*Combined Sewer/Emergency Overflow*	*18*
8	*Broadstairs Unscreened CEO*	*Combined Sewer/Emergency Overflow*	*1*
9	*Broadstairs pumping station screened CEO*	*Combined Sewer/Emergency Overflow*	*0 activations in 2020*

Table 2: List of Storm and Emergency overflows within the Margate & Broadstairs catchment

3.10 The Surface Water system

Figure 6 below, shows the current surface water sewers in the Southern Water GIS system. As you can see there is very limited coverage and it is believed that most of the surface water of Margate drains into the foul/combined system.

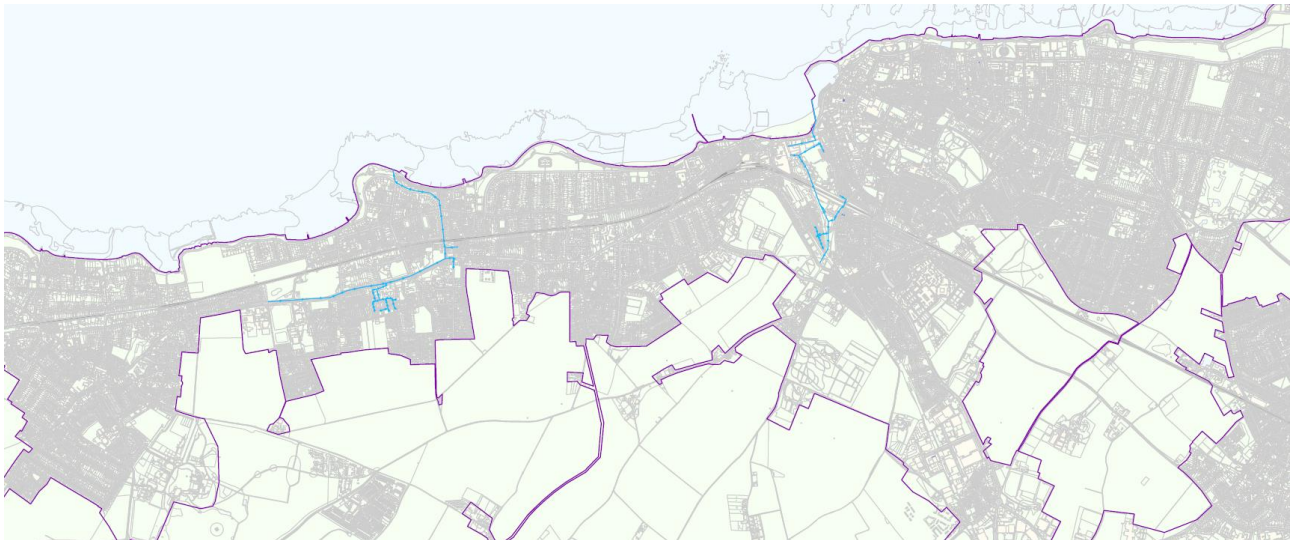


Figure 6 – Current mapping of Surface water system in Margate catchment[10]

3.11 The Highway drainage system

Highway drainage generally consists of road gullies connected to the surface water and combined sewers system. For Margate, the highway drainage/public surface water sewers are owned and maintained by Kent County Council (KCC) as the Highway Authority.

Kent County Council (KCC) Highways Department have provided us with mapping information for the road gullies across the Margate Catchment (Figure 7). We will be working with KCC to understand how the gullies connect to the combined and surface water sewers.

We will use this information to work with KCC to identify future opportunities to disconnect highway drainage from the combined system, as the project progresses through the stages. See section 4.4 for further details.

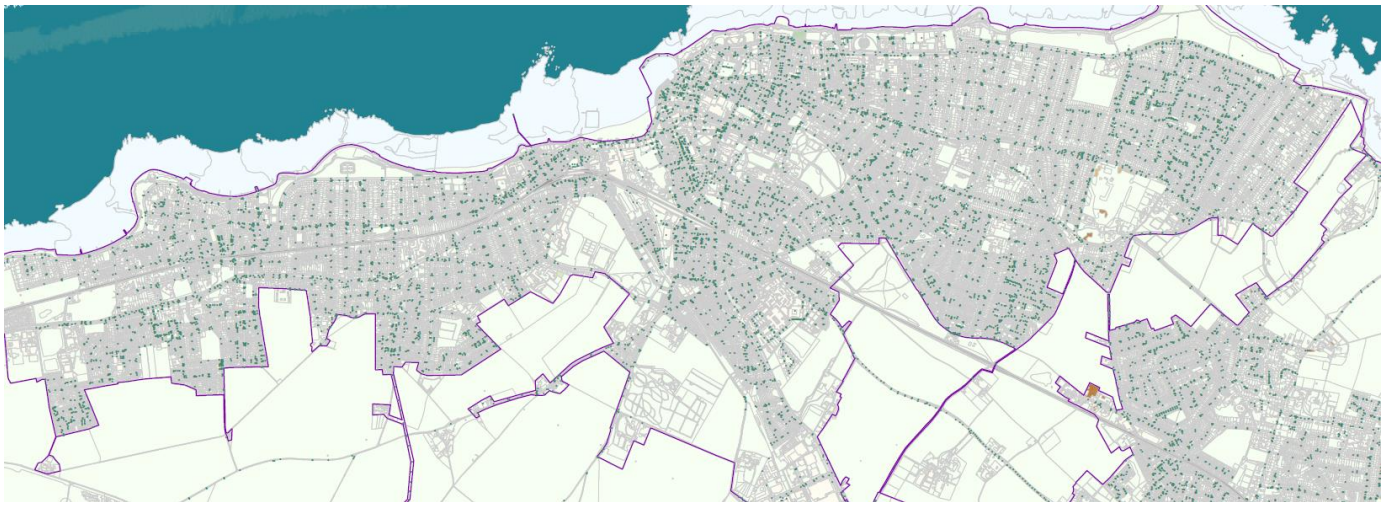


Figure 7 – The spread of highway gullies across the Margate catchment[11]

[10] Southern Water Asset Miner System
[11] KCC highways department, 2021.

3.12 Internal Drainage Board

The River Stour (Kent) Internal Drainage Board (IDB) is a public sector organisation, responsible for flood protection and land drainage in North East Kent. The extent of the Drainage District can be seen in Figure 8. Each IDB has permissive powers to undertake work on behalf of their local community to carefully manage water levels and reduce the risk from flooding within its drainage district. Much of this vital work involves the maintenance of rivers and the related infrastructure. IDBs also advise on planning applications and facilitate the drainage of new developments to help reduce future flood risks.

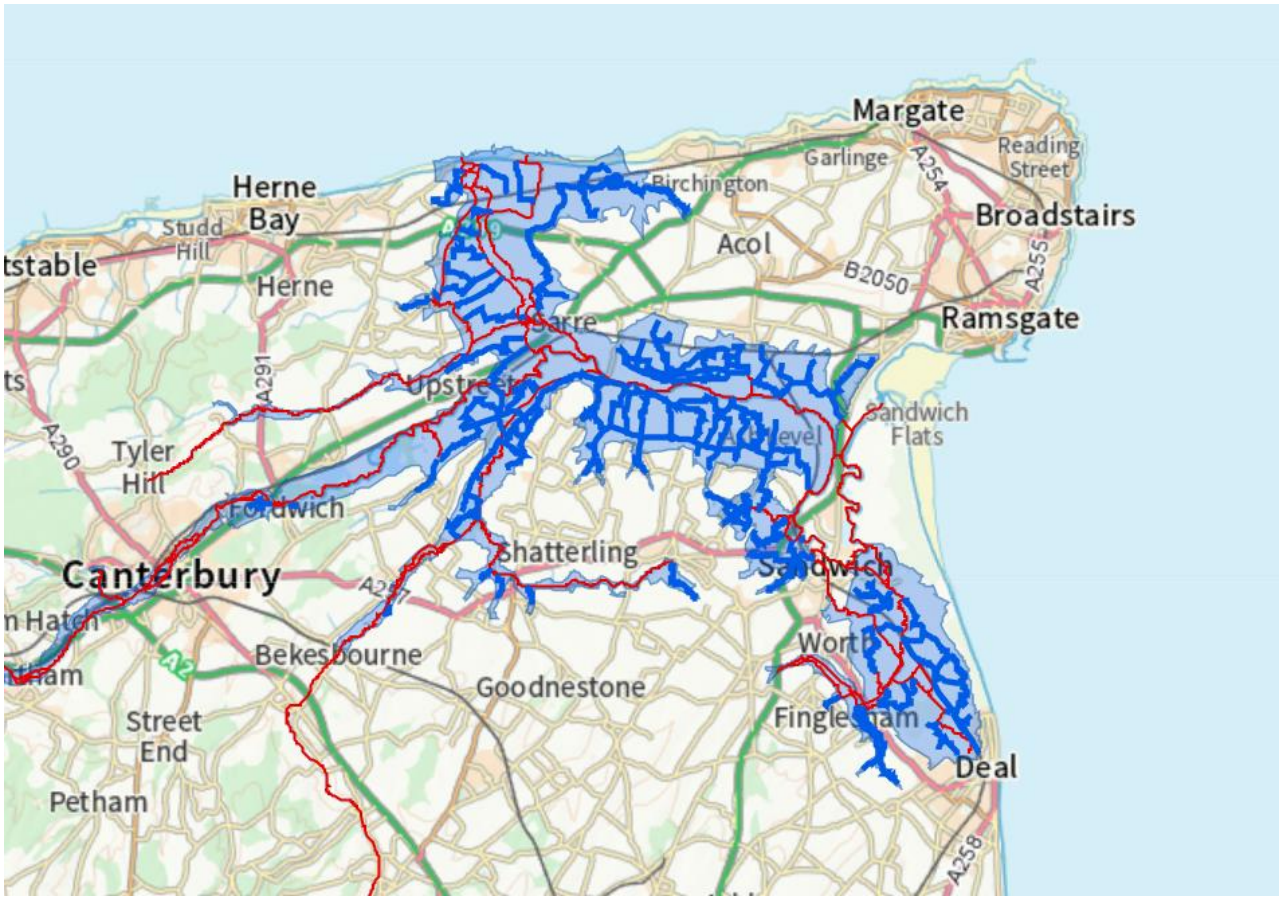


Figure 8 – River Stour Drainage District[12]

[12] River Stour Internal Drainage Board (rsidb.org.uk)

3.13 River and Coastal flooding

There is a very low risk of river and coastal flooding in Margate.

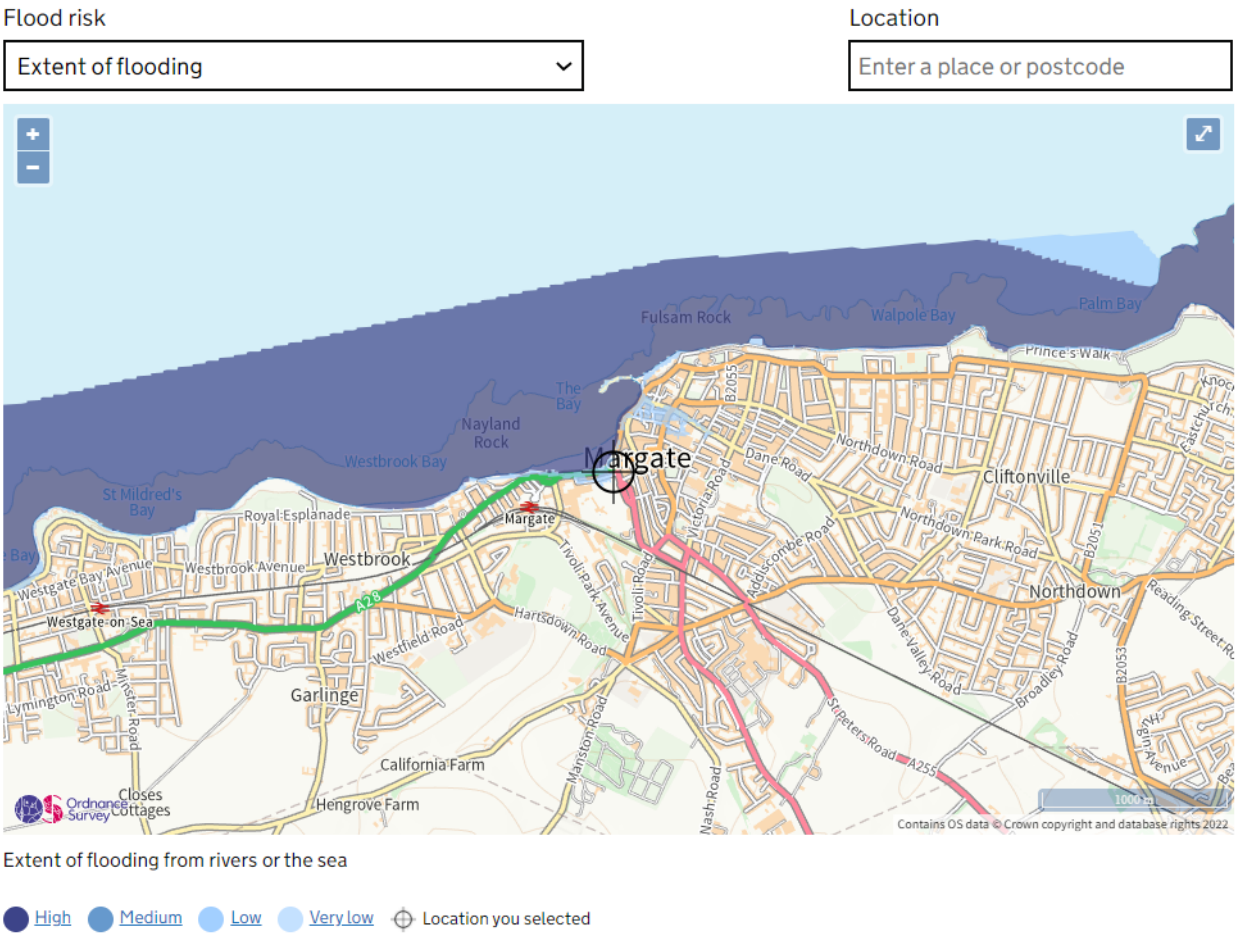


Figure 9 – Environment Agency River and Coastal Flood Map[13]

3.14 Surface Water Flooding

Flooding from surface water is typically associated with natural overland flow paths and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events. The Environment Agency's map is shows in Figure 10.

[13] Your long term flood risk assessment - GOV.UK (check-long-term-flood-risk.service.gov.uk)

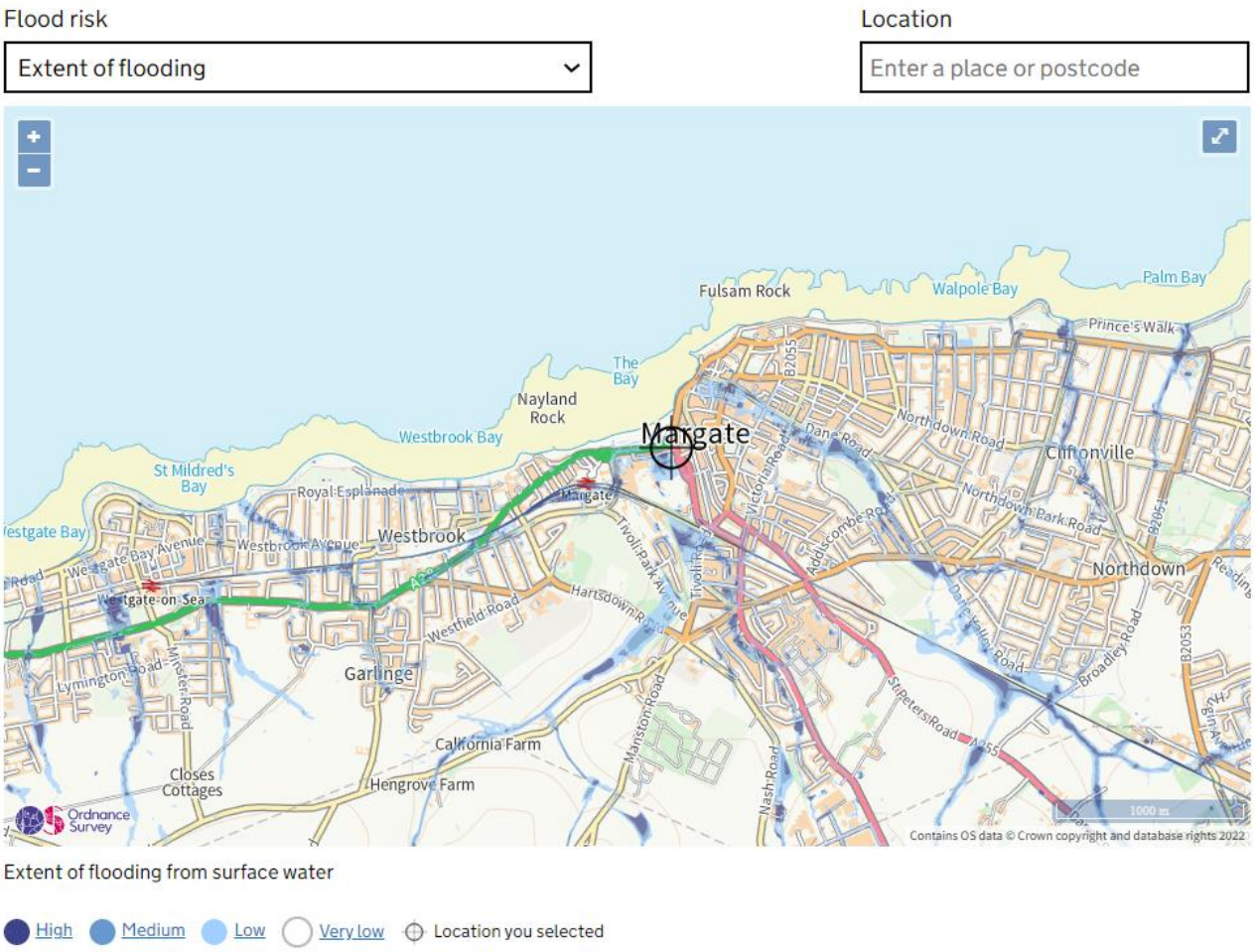


Figure 10 – Extract from the Environment Agency's Flood Risk from Surface Water map[14]

[14] Your long term flood risk assessment - GOV.UK (check-long-term-flood-risk.service.gov.uk)

3.15 Simplified Margate drainage system

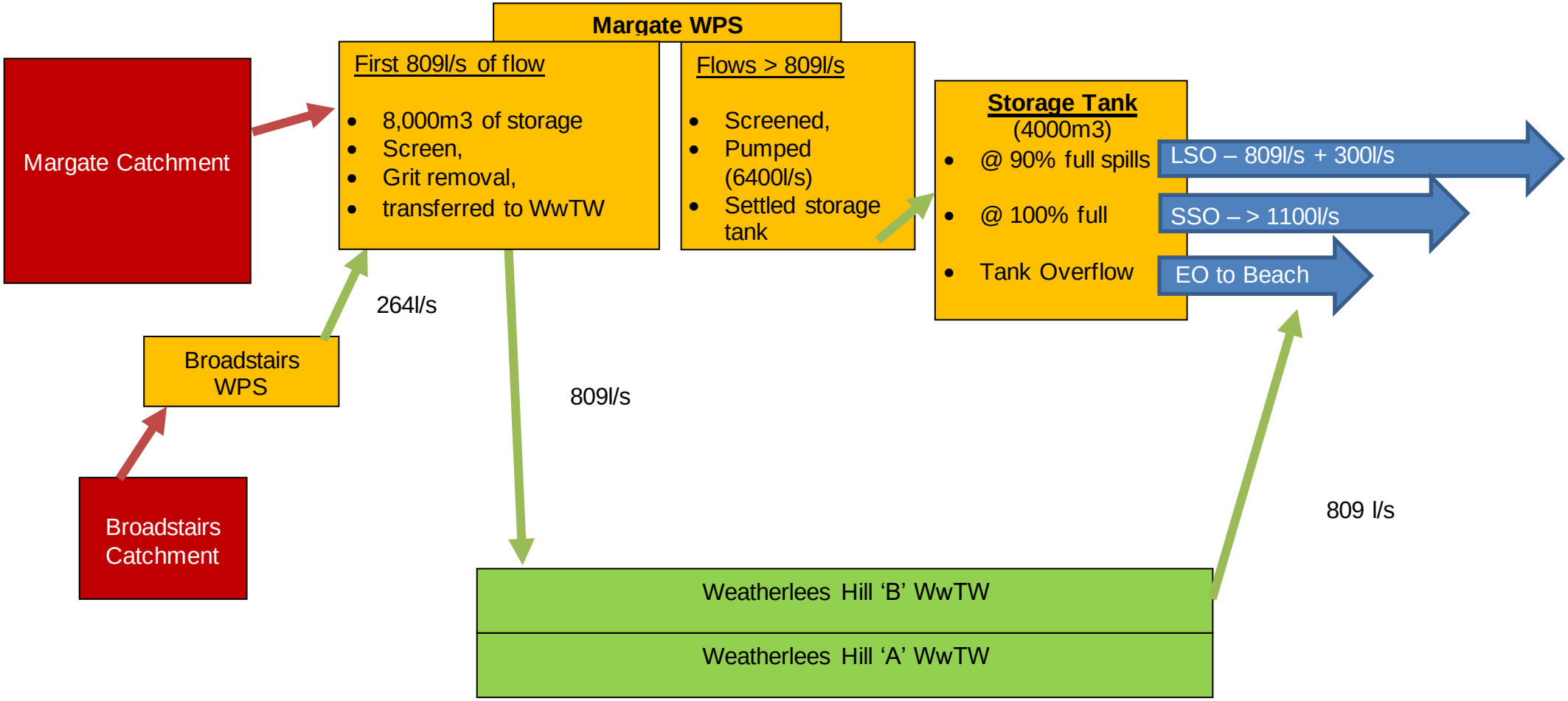


Figure 11 – Simplified diagram of the Margate Drainage System

4.0 Why change is required and what are we doing.

4.1 Why change is required

The next few paragraphs describe some of the reasons why we need to make a change now. It is to everyone's benefit if rainwater can be channelled safely back into the ground or environment at a local catchment level rather than being pumped, treated and discharged to rivers or the sea.

Flooding

Unmanaged surface water especially after extreme events can cause uncontrolled flooding which is unacceptable. Section 3 begins to describe the various drainage pathways for surface water and how they are interconnected. To help solve this problem we need a different approach to surface water management.

Urban creep

"The country's built environment is constantly changing and "urban creep" – home extensions, conservatories and paving over front gardens for parking – can all add to the amount of water going into our sewers and drains. Green spaces that would absorb rainwater is covered over by concrete and tarmac that will not. In fact, studies show that "urban creep" results in a larger increase in predicted flooding than new housing, because it adds more rainwater to these systems"[15]

Climate change

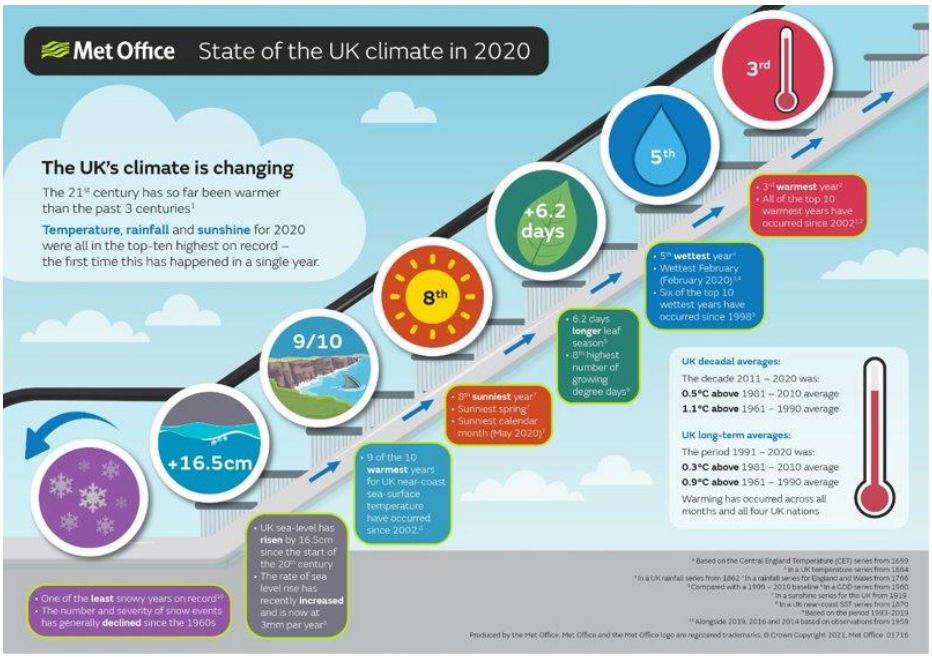


Figure 12 – Climate change drivers[16]

[15] 21st Century Drainage Programme – the context, Water UK
[16] Met office, 2020

"More people, bigger towns and cities and the effects of climate change will mean a greater demand for water when it is hot and dry, and fewer green spaces to absorb rainwater when it is wet and more unpredictable weather"[17]. As global temperatures rise, the number of extreme rainfall days is expected to increase with increased intensity short duration storms may exceed the capacity of the surface water and combined systems and risk more frequency of flooding.

Figure 13 shows the Met office classification of rainfall intensity in mm/hr, which has been matched, for these purposes, to an appropriate type of storm to aid understanding.

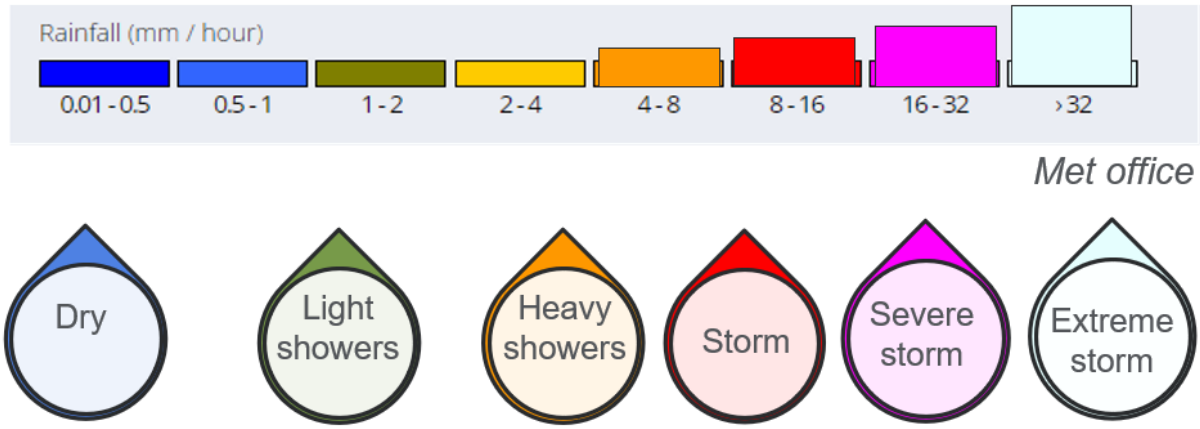


Figure 13 – Rainfall intensity/storm size diagram

As the South East is already water-stressed it may be particularly susceptible to the impacts of climate change. Water resources are already scarce, and rising temperatures will reduce them further, leading to more frequent droughts[18]

Greenhouse gases and energy use

Water industry operations require large amounts of energy for treating drinking water, processing wastewater, and pumping large volumes around an extensive network. Wastewater treatment processes use about half of the total operational energy across the water sector. Greenhouse gas emissions from the operational side of the water industry are around 0.7% of UK emissions (Ofwat, 2010). In 2011-12 companies reported that they emitted the equivalent of about 4 million tonnes of carbon dioxide[8]. It is therefore very important that the impact on carbon emissions is carefully considered and holistic catchment solutions are likely to drive the most sustainable solutions.

[17] 21st Century Drainage Programme – the context, Water UK
[18] Southern Water climate change adaptation 2021

Storm Overflows to rivers and the sea

Storm Overflows are a relief valve for the system to prevent the devastating impact of sewer flooding. However we cannot just block them up as this could cause flooding.

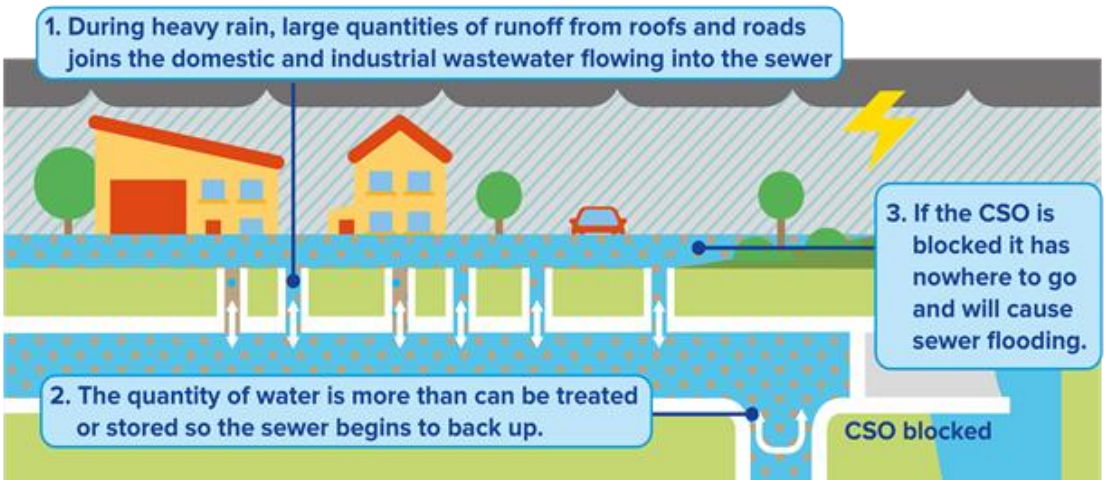


Figure 14 – Why do we need Storm Overflows?

4.2 The Southern Water Storm Overflow taskforce

Southern Water have set up a storm overflow task force. There are 4 streams to the Storm Overflow taskforce:

1) The pathfinder projects.
2) Developing a regional plan to significantly reduce the use of storm releases by 2030.
3) Complaints & Engagement – create and communicate a common narrative.
4) Beachbouy and transparency.

4.3 The pathfinder projects

The first workstream of the task force are the pathfinder catchment projects. The pathfinder projects have been set up to develop and trial a better more collaborative approach to surface water management.

The initial 5 pathfinder catchments are:

- Deal, Kent
- Margate, Kent
- Swalecliffe, Kent
- Sandown, Isle of Wight
- Seven Parishes (Pan Parish) near Andover, Hampshire

4.4 Margate pathfinder objective

A published study with intervention options to deliver a significant reduction in spills frequency from a 2020 baseline.

Demonstrate the principles at scale and reduce the measured storm flows in sub-catchments.

4.5 A staged approach

We are undertaking a staged approach to the pathfinder project which allows us to identify and deliver some low risk interventions and pilot schemes quickly; whilst we undertake further modelling to provide confidence and ensure we understand and manage risk for larger interventions.

Learning from the pathfinders will also feed into the Southern Water 5 yearly funding request process.

The staged approach is described below:

Stage	Description
Stage 0	Initial surveys and study with identification of early 'no regrets' low risk interventions and any additional surveys and modelling requirements
Stage 1	No regret interventions and small trials (SWS and partner organisations)
Stage 2	More complex interventions and scaled pilots (SWS and partner organisations)
Stage 3	Larger scale investments to achieve pathfinder outcomes (SWS and partner organisations) - Model updates - Large Scale interventions

Appendix C shows how additional the data that we want to capture around the catchment will be combined to provide a holistic view for storm water management. This is an ongoing process. Early small interventions with low risk of unintended consequences can be enacted quickly. As we gain a more detailed understanding of the catchment then our understanding of the risks associated with a larger scale more complex intervention improves, which provides confidence a successful outcome.

5.0 Potential solutions and the wider benefits

As mentioned in section 4 floods and Storm overflow spills are caused by rainwater in the sewer overwhelming it. The key to reducing these risks are either by reducing the volume of rainwater getting into sewer or increasing the sewer's ability to cope with it. To that end we have split this into 3 main types of intervention to reduce the risk of flooding and storm overflow use:

- *Upstream source control (removing and slowing the flow of rain water)*
- *System optimisation (making better use of the existing infrastructure)*
- *Infrastructure enhancements (build larger infrastructure)*

5.1 Upstream source control - removing and slowing the flow of rain water

Types of solution

- Rainwater harvesting

Water butts can be retrofitted easily to existing downpipes, they hold back the peak run off from roofs and adjust the amount of water drained to the drainage system, provided they are regularly emptied. They also provide rainwater for domestic garden use.

- Permeable paving

Impermeable Footpaths and driveways, car parks and parking bays can be converted to a surface which allows water to soak into porous ground or where the ground is less porous into a gravel filled base which slows the flow into the drainage system or into the ground

- Green roofs

Green roofs are generally made up of a shallow layer of material planted with low-growing, stress-tolerant grasses, mosses and sedum. These lightweight systems require little maintenance. They not only attenuate run off i.e. 'slow the flow' but have other benefits such as providing insulation in winter, and cooling in summer by absorbing heat from the sun.

- Bioretention - tree pits

Bioretention areas/tree pits are designed to collect, attenuate and or infiltrate runoff by providing both storage volume and infiltration area within the underlying structure. The soils around the trees can also be used to filter out pollutants from runoff directly. These are particularly useful in urban roads and pavements to help manage surface water from highways.

- Bioretention - planters

Planters are typically raised above ground features or repurposing of existing raised areas to attenuate run off, 'slow the flow'. Above ground planters can be easily retrofitted to accept diverted flows from downpipes where there is space.

- Rain garden (swales)

These are vegetated channels which are used to convey, treat and infiltrate surface water; and disconnect conventional roofs and paved areas from the combined and

surface water drainage. Swales can be retrofitted into existing systems by re-purposing existing landscaped or grassed areas to contain swale features.

Natural and social capital impact

Southern Water defines natural capital as the element of nature that provides value to society. Social capital is defined as Southern Water's relationships and others' trust in the business. In addition to the drainage benefits that the above solutions provide, they also give many other benefits, some of which are listed below.

Water resource and water quality benefits

- Water butts can reduce the volume of mains water used for gardening.
- Infiltration supports aquifer recharge and can improve raw water quality by filtering water through the soil.
- 'Slowing the flow' measures intercept flows containing sediment and other pollutants washed from fields, roads etc and can improve water quality by trapping these in situ.

Urban environment benefits

- Planted vegetation can contribute to a reduction in the urban heat island effect by providing shade and reducing local temperatures. Green roofs can reduce the need to heat & cool buildings.
- Vegetation helps to absorb carbon and helps to remove pollutants from the air resulting in improved public health and reduced costs associated with treating health issues (e.g. asthma).
- Removing rainwater from the system avoids the carbon costs of pumping effluent across catchments and to wastewater treatment works. Chemical carbon costs associated with treating this diluted sewage are also reduced.

Natural environment and wellbeing benefits

- Vegetation can provide habitats for pollinators and other wildlife.
- Vegetation can sequester carbon.
- Green spaces improve the aesthetics of local communities and enable people to connect more with nature.

5.2 System optimisation – making better use of existing infrastructure

If we cannot remove or slow the flow of water before it gets into the system then we would look at our existing infrastructure, pumps, storage tanks and instrumentation to enable us to control the system better, i.e. Smart network control with increased digitalisation.

Types of solution:

Improvements in storage tank use and control

By being able to adjust how a storage tank fills and releases then there is more flexibility to manage the variable types of storms that could hit a catchment. e.g. intense short summer storms after a period of dry weather or prolonged winter rain storms.

Improvements in pumping station use and control

Optimising the use of pumping stations across the catchment can also mean we utilise the catchment storage better, reduce wear, and improve resilience of the assets. This can also result in reduced energy and hence carbon use.

Better data availability

Level monitoring in the catchment and at storage tanks and flow meters on pumping stations means that more data is available to identify issues proactively, plan maintenance, optimise the system and design solutions.

Natural and social capital impact

Whilst system optimisation may require some additional instrumentation it enables us to make full use of existing assets as well as potentially providing energy and carbon benefits.

Optimisation of existing assets also avoids the disruption of large construction projects. More data can also aid real time reporting to the public, enabling trust with local communities and impacted groups such as recreational bathers

5.3 Infrastructure enhancements – build larger infrastructure

In some instances we may not be able to remove enough surface water or optimise a system sufficiently to avoid constructing new assets. These may be:

Types of solution

- Larger sewers & pumping stations – to transfer the rainwater and/or diluted sewage more quickly away from an affected area.
- Larger storm tanks – to store more of the volume of rain during storms.
- Large treatment works – to treat the rainwater and/or diluted sewage before it is discharged back to the environment.

Natural and social capital impact

- There will be high carbon costs (embedded and emissions) associated with the construction and operation of these new assets.
- There is the potential for the direct loss of vegetation and habitat during construction which could lead to the loss of a range of ecosystem services (e.g. biodiversity, air quality, health and wellbeing etc).
- There will be disruption to the local community whilst these assets are being constructed (traffic, noise, air quality impacts etc).

6.0 What are the next steps for the Margate catchment?

There are many interventions that could be considered for the Margate catchment. Is underlying geology of chalk mean that sustainable drainage systems directly infiltrating to the ground are a good option. The large proportion of combined sewerage system also means that slowing the flow will benefit the frequency of Storm Overflow spills.

This section sets out the additional investigations that we intend to do with our partners in the Margate catchment but also some of the trials and early interventions that we would like to construct. These investigations & pilots will further influence our understanding of the issues, risks, impacts and benefits of various solutions.

Some actions are no regret and can be implemented immediately, some will require design and procurement time, and others will need to be trialed and/or modelled to ensure that the impacts are well understood. Southern Water along, with its partners, will log and monitor these interventions, applying them as per the staged approach described in Section 4.4.

The sections below list some of the interventions that have been completed, are in progress or will be considered and modelled to assess their impact. This list is not exhaustive, and we intend to continuously evolve it as the pathfinder project progresses.

6.1 Upstream source control - removing and slowing the flow of rain water

The current network model for the foul/combined system for Margate catchment WwTW indicates that across the total catchment there is about 221 hectares of impermeable area that drains into the system.

Margate Combined sewer network model

The GIS data and network model have historically been updated separately. New survey specifications ensure that both records are now updated together. As this has not been done historically an exercise to identify where data is missing and prioritise collection (depending on flooding/Storm Overflow discharge benefit) will be undertaken.

Southern Water are undertaking to build a new network model of the combined sewer network within Margate.

Impermeable area removal:

We are using Geographical information systems (GIS) to identify large roofs and large impermeable areas that may connect into the combined system. We will then work with the owners to identify **if** these are connected and what are the opportunities to divert the flow or slow it, before it connects to the combined system, using some of the measures identified in section 5.0

For example, Figure 15 shows an area of Margate that has a large number of buildings with large roofs, if we confirm that these are indeed connected to the combined sewer system then we can work with the owners to support them identifying alternatives.

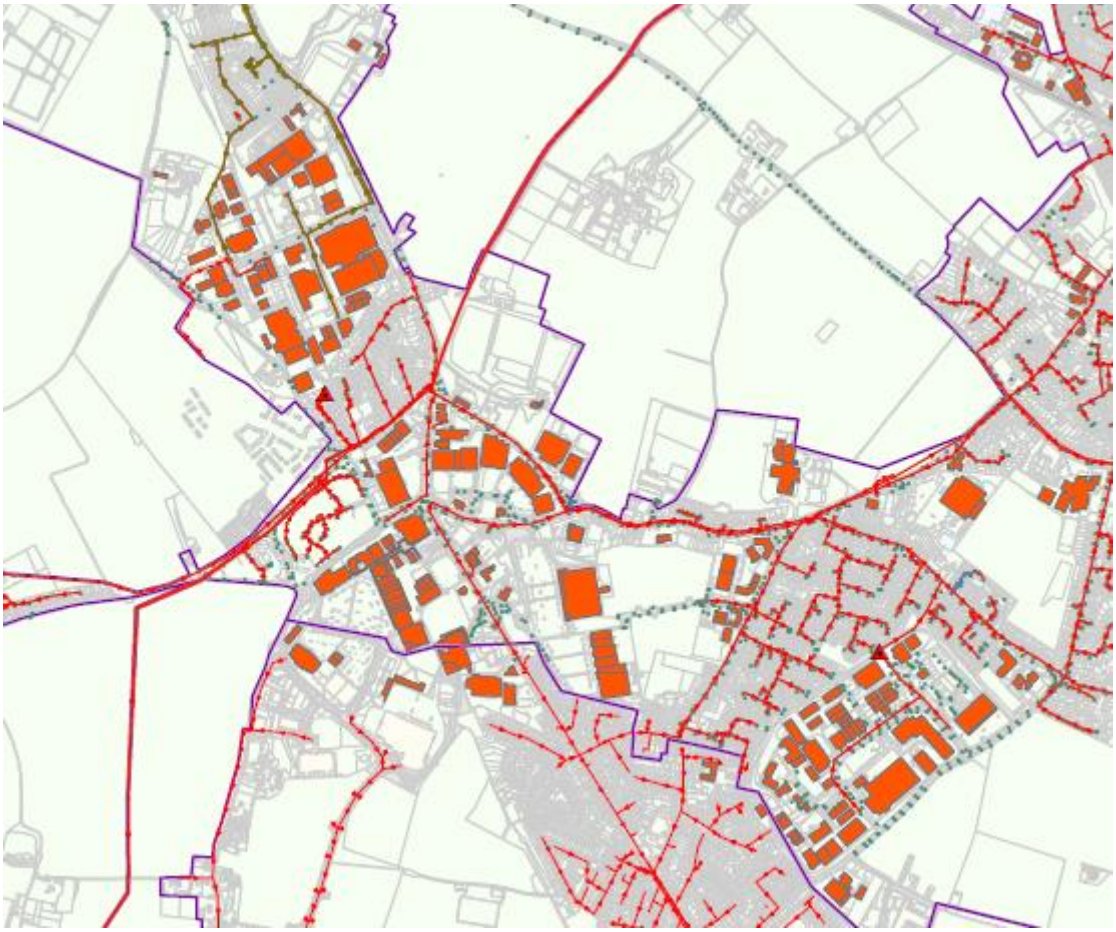


Figure 15 – Potential Pathfinder Focus area in Margate Catchment (large roofs)[19]

[19] Stantec Surface Water Assessment Tool

Highway drainage disconnection

We will continue to work with KCC to identify areas of highway drainage that could be disconnected from the combined sewer and connected to a surface water system or an infiltration solution (sustainable urban drainage type).

An example of a scheme that KCC installed that removed highway drainage from the combined system is in George Park Margate.

Figure 16 – Photos of George Park Sustainable Urban Drainage scheme

Figure 17 – Potential Pathfinder Focus area in Margate Catchment (wider roads yellow)[20]

Figure 17 gives an example of an area where, if appropriate, road drainage could be diverted to local infiltration areas (such as treepits or road side basins) or larger green spaces, similar to the George park example.

Domestic solutions to slow the flow and remove impermeable area.

We are looking to identify pilot areas for various domestic solutions within the catchment to assess the benefit, adoption and maintenance requirements, including:

- Smart water butts
- Raised planters
- Property level Rain gardens
- Soakaways
- Porous paving.

6.2 System optimisation – making better use of existing infrastructure

Improvements in pumping station use and control

We are starting a programme where we review the control and output of the key WPSs in the pathfinder catchments. We are investigating to understand if any optimization of pumping station control can be done to better utilise catchment storage and smooth the flow being passed forward by the pumping station. By doing this we may be able to reduce the frequency that the system is overwhelmed and therefore spills via the Storm Overflows.

[20] Stantec Surface Water Assessment Tool

6.3 Infrastructure enhancements – build larger infrastructure

Within this Asset management period (AMP), 2020- 2025 there a number of projects being undertaken at Margate WPS & Broadstairs WPS. These are not pathfinder projects but they are part of Southern Waters Capital delivery programme. Construction of these schemes is likely to complete by 2023.

Margate WPS – Phase 2

Works at the WPS include:

- Install Control Penstocks to improve isolation for maintenance
- Carry out concrete repairs
- Carry out screw pump replacement
- Improve instrumentation arrangement and access.
- Relocate existing storm return flow meter
- Install new bypass channel to enable.
- Carry out works to the software network.

Broadstairs WPS – Phase 2

The design.

- Replace the existing DWF lift pumps.
- Install one new and replace two existing isolation penstocks upstream of the inlet pump sump.
- Install one new wall mount distribution board
- Incorporate the existing inlet and storm lift pump flow transmitters into the pump monitoring system.
- Make PLC/HMI/SCADA software modifications associated with the new works.

Stage	Description	Types of intervention	Timescales
Stage 0	Initial surveys and study with identification of early 'no regrets' low risk interventions and any additional surveys and modelling requirements	• Flow monitoring surveys • WPS monitoring • Manhole Surveys • Storm overflow surveys • Connectivity surveys of large roof areas	• Spring/Summer 2022
Stage 1	No regret interventions and small trials (SWS and partner organisations)	• Baseline monitoring of existing SuDs Schemes • Design development of a number of SuDs schemes in the catchment	• Summer 2022 • Spring/Summer 2022
Stage 2	More complex interventions and scaled pilots (SWS and partner organisations)	• Deliver the initial SuDS scheme pilots.	• Autumn 2022 onwards depending on partnership and community engagement.
Stage 3	Larger scale investments to achieve pathfinder outcomes (SWS and partner organisations) - Model updates - Large Scale interventions	• Further roll out of SuDS schemes • Remove large roof areas from the combined system and connect to the surface water or SuDs solutions.	• 2023 onwards
Other Southern Water Projects and Studies	Margate and Broadstairs catchments:	• Margate WPS – Phase 1 • Margate WPS resilience work • Broadstairs WPS resilience work • Thanet Phase 3 project • Bathing Water Ambition investigation o Margate the Bay o Margate Fulsam Rock o WalpoleBay Margate	• Complete • In progress • In progress • In progress • In progress

Table 3: Draft interventions for Stage 0-3 in Margate catchment

7.0 Partnership and Community working – what can you do to help?

As shown in section 3.0 “water companies are not solely responsible for stormwater management; they are one of many organisations involved in ensuring communities stay protected. The change in the weather is testing all sectors of UK society, and we are all moving towards changes in population and in weather conditions that we have never before had to plan for”[21].

To achieve what is needed then utilities, councils and communities need to work together to achieve mutual benefits. Southern Water have committed to doing this by engaging with our partner organisations and the community to solve the problems.

So what can the community do?

7.1 Support further investigations

We are interested in time and date stamped photos and videos to help us understand how the Margate catchment reacts to rainfall. With time and date stamped evidence, and a clear location, we can match this information with other information to better understand how the whole system interacts. This includes:

- Photos and videos of overland flow.
- Photos and videos of flooded areas.
- Photos and videos of the level of the surface water ditches.
- Reporting blocked highway gullies to KCC.

7.2 Protect the pumping stations, foul and combined sewers

Fat, oil and grease[22]

Fat, oil and grease often ends up being washed down the kitchen sink. Over time, they harden to a concrete-like material and restrict the flow of wastewater in the pipes or even block them. These blockages can cause wastewater to back-up through toilets and sinks into homes and businesses, or escape through manholes into streets and rivers

Unflushables[23]

Items such as wipes, nappies and cotton buds are the scourge of our sewers - they create blockages, cause flooding in homes and damage the environment. Every year in England and Wales water companies deal with over 300,000 blockages – thousands of which see people’s homes and belongings ruined by sewer flooding. Wastewater companies are still spending around £90 million each year clearing blockages nationwide, while damage to the environment by the plastics used in unflushable items has become a real focus.

[21] 21st Century Drainage Programme – the context, Water UK
[22] Fat, oil and grease (southernwater.co.uk)
[23] The Unflushables (southernwater.co.uk)

Our sewers are only designed to take away the three Ps – pee, poo and paper.

In the kitchen, follow our top tips to avoid fat, oil and grease building up in the sewer.

- Use containers – butter tubs, yoghurt pots or jam jars can all be used to collect cooled fat and oil – then just put them in the bin
- Clear your plates – scrape any leftover food or grease and fat residue from plates, pans or cooking utensils into the bin before washing up
- Bag it and bin it – put a bin in your bathroom for anything that isn't pee, poo or paper. Perhaps use scented nappy sacks or dog poo bags (degradable if you can) to throw away any nappies, sanitary items or condoms.
- Compost your food waste – collect uncooked fruit and vegetable peelings for use as compost in your garden.
- Strain the pain – a simple sink or drain strainer can stop food and hair getting down the pipes.

7.3 Protect surface water and combined sewer capacity – existing developments

You can help release capacity in the existing sewer systems by using less water, removing Surface Water connections and slowing the flow

Households:

- Install water butts and planters on your property that take the rainwater from your roof and either slow its connection to the sewers or ideally divert it to a soakaway.
- Could you convert your paved, impermeable driveways into permeable surfaces?
- Try to ensure that existing impermeable surfaces drain to a permeable surface rather than the road or the sewers.
- If possible, disconnect existing drainage from the combined and surface water sewerage systems
- Report blocked highway gullies and drains asap to KCC
- Report blocked sewers to Southern Water

Target 100[24]

Population growth, climate change, increased urbanisation and environmental protection mean we all need to change how we understand and value water. Target 100 is a commitment by Southern Water to its customers to support them to reduce personal consumption to an average of 100 litres each per day by 2040; while we reduce leakage by 15% by 2025 and 40% by 2040. As well as making sure there is enough water to go round, households could cut their bills and less water used mean less water going into the foul and combined sewers creating more capacity.

Community, Businesses, Developers & Partnerships:

Engage with SWS, KCC, DCC and other partners to identify areas for surface water removal, ownership and maintenance. As described in Section 5 there are multiple benefits that can be achieved for the whole community.

[24] Target 100, together let's hit target 100. (southernwater.co.uk)

7.4 Protect surface water and combined sewer capacity – future developments

Households:

- If you extend your house or create additional roof areas (urban creep) if possible, make sure these drain to a soakaway or surface water system or consider green roofs.
- If developing your drive or garden, could you install permeable paving rather than connect to the surface water system or drain to the highway system.
- Avoid misconnections - Misconnections can happen during work to extend or improve a house, when a new house is built or simply when a new appliance is plumbed in. If any of your plumbing drains to a surface water sewer, the wastewater will pollute local watercourses. Similarly if clean water drains are misconnected, they can overload the foul sewer and lead to flooding. It's the homeowner's responsibility to ensure there are no misconnections at their property. If you're unsure what to do you can go to ConnectRight or contact Southern Water directly. Alternatively, for a list of plumbers in your area, visit the WaterSafe website.[25]

Community, Businesses, Developers & Partnerships:

- Ensure new developments are sustainable i.e. they are not connected to the combined sewer and where possible also avoid connection to the surface water system to allow rainwater to infiltrate to the water table. Thus increasing the water availability for rivers and streams for biodiversity and for extraction for drinking water.

[25] Bad plumbing and pollution (southernwater.co.uk)

8.0 Future sustainable Growth

Southern Water are looking to work with our drainage and surface water management partners, including Thanet District Council and KCC, at how surface water management can be better considered and incorporated into the sustainable growth plans for Margate. These conversations could include areas such as:

- More detailed consultation on specific proposals, including small scale developments
- Support to encourage more use of sustainable urban drainage schemes and nature based solutions, including upstream 'slow the flow' type measures.
- Ensuring that post construction, the installations comply with the requirements
- Collaboration to make policies more aligned with sustainable drainage and climate change requirements.

9.0 Conclusions

The Margate drainage system is a combined sewer system and because of this it is highly reactive to rainfall. During rainfall events the volume of flow reaching Margate WPS increases dramatically and therefore increases the volume that must be pumped through the system. This sudden increase can also put pressure on the pumps and pumping system, risking failures.

From the initial studies, removing surface water from the combined system in Margate looks to be viable as the chalk geology of Margate looks to be compatible with some infiltration solutions. However the actual viability of such schemes will need to be confirmed on a site by site basis, such as the scheme at George Park.

Future stages of this project will identify areas where we can work with our partners and the community to identify either removal or 'slow the flow' opportunities that will also provide multiple benefits to the region such as water resource, water quality, green space and biodiversity benefits.

Appendix A – Margate Technical Group

Southern Water have set up a Technical group with prospective partnerships so that we can discuss some of the opportunities to manage surface water and rainfall better in the Margate catchment.

- Max Tant, KCC
- Earl Bourner, KCC
- Luke Glover, Thanet District council
- Nick Mills, Southern Water
- Rob McTaggart, Southern Water
- Penny Green, Southern Water

Appendix B – How does Urban drainage work?

B.1 The development of the urban drainage system

Victorian drainage – single pipe solution

The modern built sewerage network began to appear in the mid-19th century. Overcrowded cities had no means to control the disposal of wastewater. Rivers were overloaded and public health was under threat. Over the next 70 – 100 years thousands of kilometres of sewers were laid. These combined sewers, as we know them today not only took wastewater from homes but also rainfall runoff from paved and roofed area. Roofs and Paved areas (Urbanisation) and the provision of artificial drainage, or sewer systems, has a twofold effect on the natural drainage process. Firstly, it reduces infiltration thereby increasing the volume of run-off. Secondly, artificial surfaces, pipes and channels convey run-off more rapidly, making drainage areas more responsive to short duration/high intensity storms. This two-fold effect significantly changes the rates of run-off, by a factor of 10 or more when compared to a natural drainage system.
In addition to the intensification of peak flow, the single pipe system mixes untreated wastewater and surface water runoff. Conveyance capacity and disposal capacity at wastewater pumping stations and treatment works has traditionally been limited such that during heavy rainfall (to protect life and property) Storm Overflows operate to discharge a mixture of 'clean' surface runoff and screened untreated or partly treated wastewater, see Figure 18.

Early 20th Century drainage - Two pipe solution

With the advent of modern sewers and cleaner streets it became feasible to separately drain the two flows, wastewater and surface water. Between the first and second World Wars the building of new combined systems declined in favour of the new separate systems. The roofs and paved area were drained by a surface water system and the wastewater was drained by a foul water system. These foul water systems, from new developments would typically connect to their older combined systems for conveyance and disposal at wastewater treatment works. Surface water systems would discharge direct to receiving waters (water courses, estuaries and coastal waters). Although separate systems removed the need to install new overflows, the rapid collection and conveyance of rainwater away from where it fell, continues to cause problems particularly in intense storms.

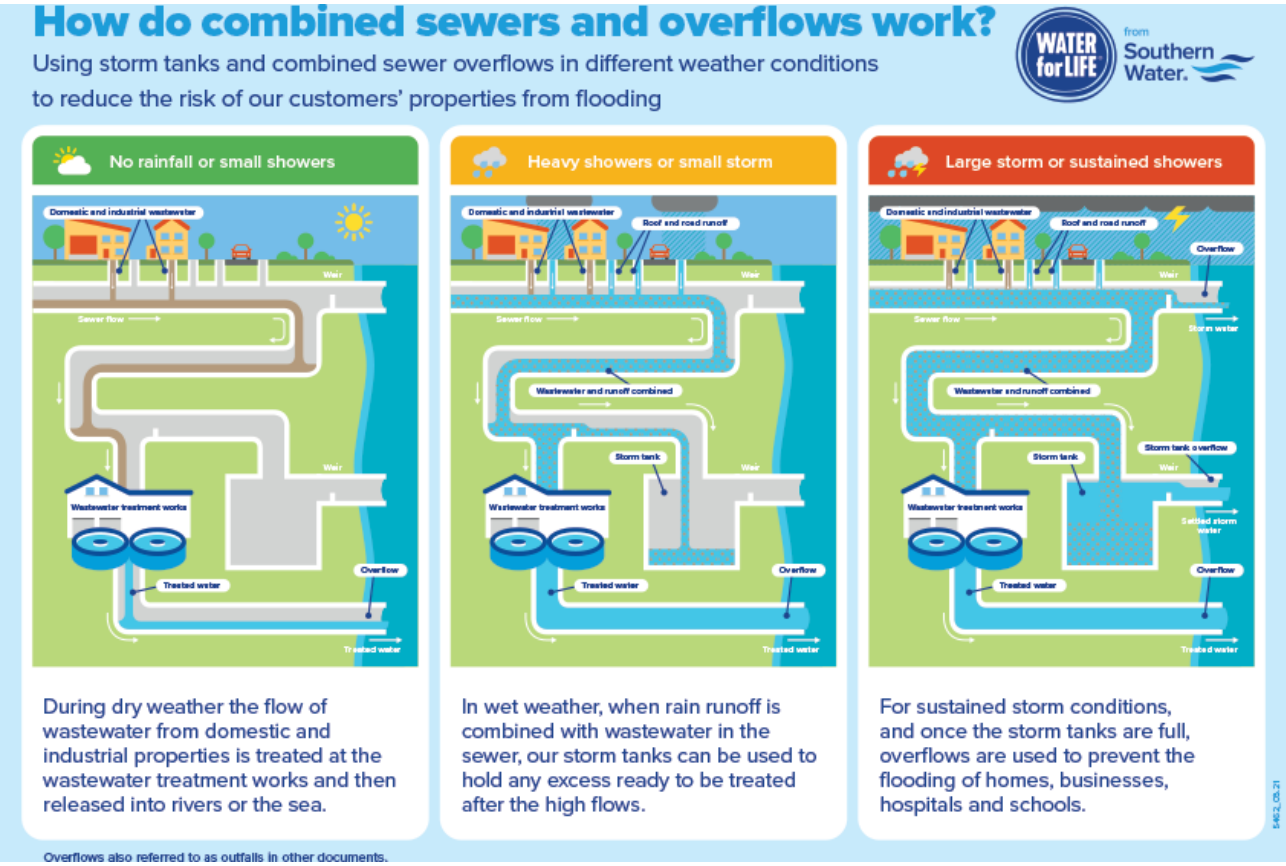


Figure 18– How do combined sewers and overflows work

Late 20th Century drainage – Sustainable drainage

In the last 30 years planning regulation has changed and there is now a requirement to reduce peak runoff rate from urbanized areas. Flows from new developments are restricted to 'greenfield' runoff i.e. a rate equivalent to that of a green field and are typically built with a Sustainable Urban Drainage System (SuDs). These systems closely mimic a natural drainage system.

Retrofitting Sustainable drainage

Homes and paved areas drained by combined sewers can be retrofitted with a range of Sustainable Urban Drainage systems (SuDS) features which either 'slow the flow' or fully disconnect the surface water flow from the combined sewer system. Both methods reduce the intensity of the peak flows to a more consistent level and mimic natural drainage systems.

By using sustainable drainage systems they can also reduce flooding in the catchment, increase infiltration to replenish ground water systems and restore capacity in the network. They also reduce pressure on the system and therefore increase the asset life of existing infrastructure. This also results in Storm Overflows operating less often with more flow being treated at wastewater treatment works before discharge to the environment.

B.2 The contribution of Legacy Housing

Legacy housing are houses that are connected to the combined system. As you can see from Figure 19 only 13% of the water that falls on a home with sustainable drainage will drain to the sewer therefore significantly reducing the contribution to, pressure on and risk to the downstream assets.

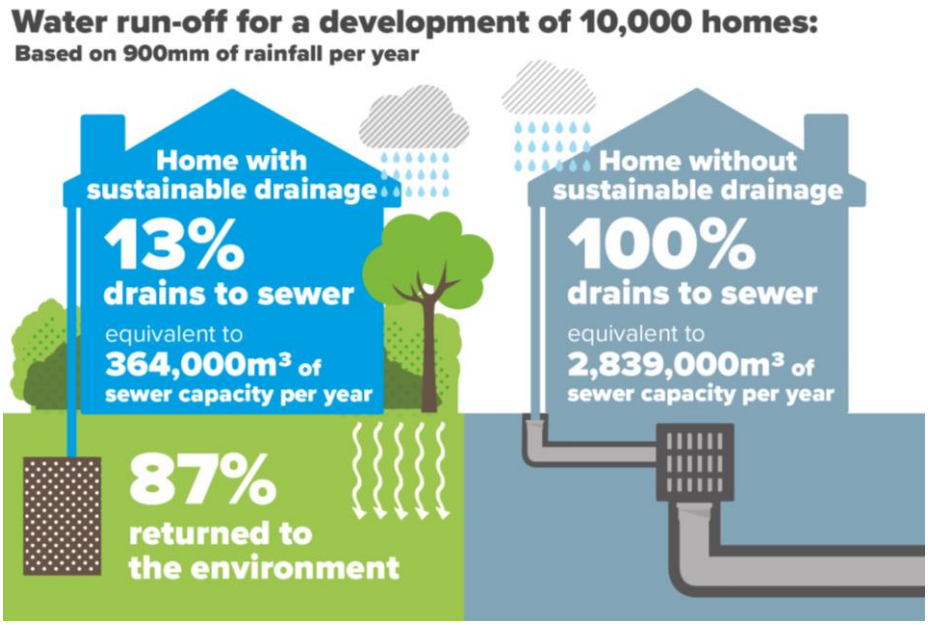


Figure 19 – The impact of legacy drainage systems

B.3 Highway Drainage system

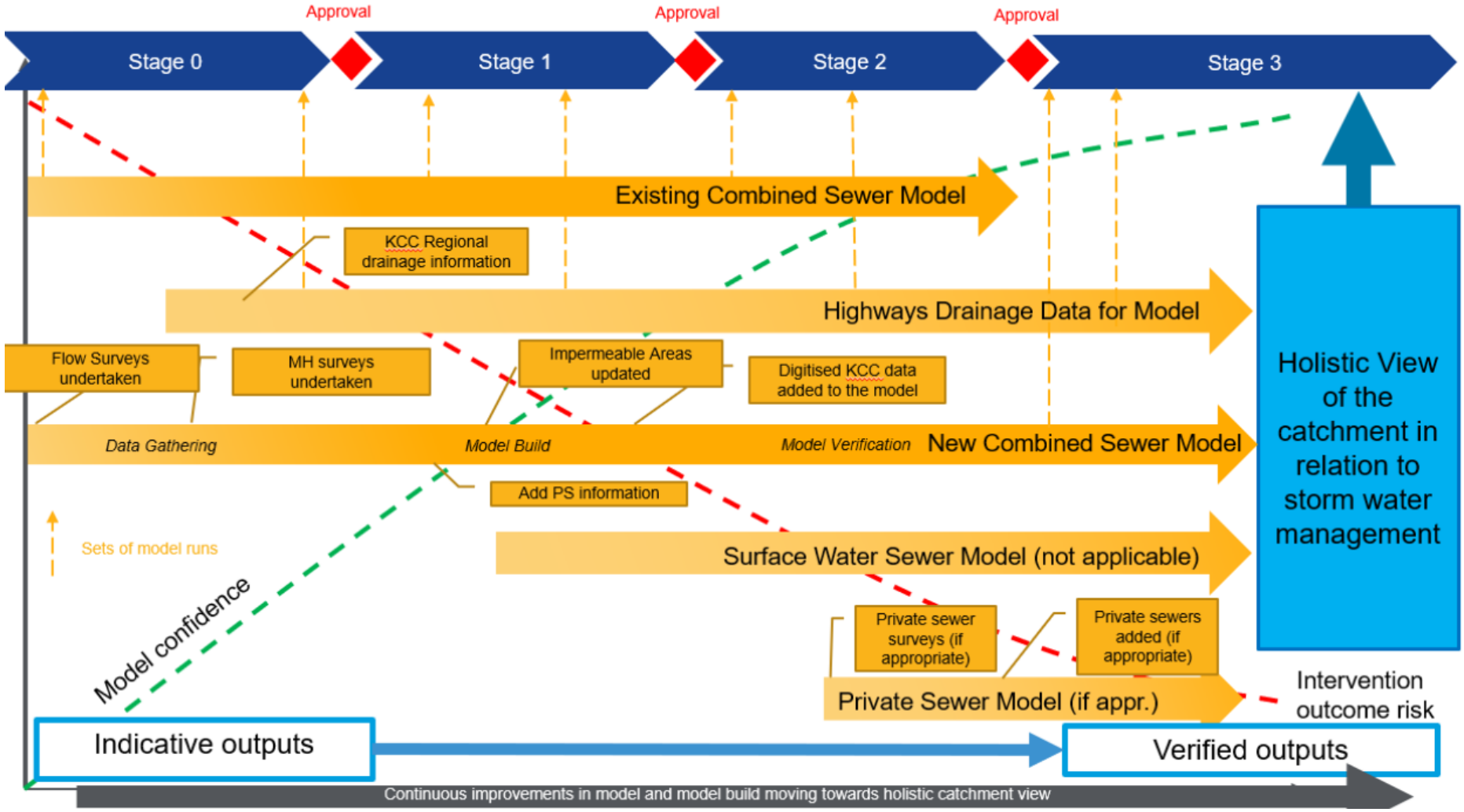
Road or Highway drainage i.e. road gullies, also connect to surface water systems. Often this is the same surface water system that takes roof drainage into the single pipe/combined system described in Appendix B.

When rain falls on the impermeable highway areas this can contribute to rapid increases in flow to the drainage system an overwhelm it. In particularly intense storms and/or if gullies are blocked then overland flow can occur. This overland flow can cause flooding or allow rainwater to enter combined sewers which are not always designed for these extreme flows.

B.4 Internal Drainage Board

Across England there are a number of Internal Drainage Boards who work in partnership with local councils, the Environment Agency and other local partners to reduce the risk of flooding to agricultural, residential and industrial land, and are overseen by the Department for the Environment, Food and Rural (DEFRA). They carry out an annual programme of maintenance works to ensure water levels are kept at an appropriate and safe level.

Appendix C – Building a holistic view of a drainage catchment for storm water management



Glossary

Catchment	An area that is drained by a complex sewerage system comprising a network of pipes, wastewater pumping stations, and wastewater treatment works (WwTW).
CCTV	Closed Circuit Television Video sewer inspection refers to the process of using a camera to see inside of pipelines, sewer lines, or drains.
Combined Sewers	The same pipe that serves the purposes of both above.
Storm Overflow	A traditional storm overflow which will have a condition for pass forward flow, an Event Duration Monitor (EDM) a screen and possibly storage volume.
DEFRA	Department for the Environment, Food and Rural
Dry weather flow (DWF)	Dry weather flow is the flow of wastewater in a sewer system during dry weather that presents with minimal infiltration.
Dry weather flow pumps	These are pumps whose size is calculated to pump an agreed volume of flow forward to the WwTW. This flow rate is agreed with the EA.
Emergency Overflow (EO)	Typically, on a pumping station or WwTW only used the site has suffered a power or mechanical failure. For example, Margate Emergency Overflow (EMO) goes straight on to the beach so when the station failed it the last route used.
EDM	Event Duration Monitor
FFT	Flow to Full Treatment
FOG	Fat, oil and grease
Foul Sewer	A Sewer that that is expected to carry predominately foul sewage from toilets, sinks, baths and appliances from a domestic property. The foul sewer also carries wastewater industrial and commercial properties.
GIS	Geographic Information Systems (GIS) are most often associated with mapping and provides geographic information through maps or databases. GIS combines hardware, software and data to provide visual geographic information. Also known in Southern Water as the sewer record.
Hydro-Brake®	This is a device that controls the flow coming out of a tank. Under regular conditions, water passes through the Hydro-Brake® unrestricted and continues downstream at normal levels. At times of high flow e.g. during a rainstorm, the structure's internal geometry harnesses the natural energy of the flow. This holds back the water, releasing it at a controlled rate.
IDB	Internal Drainage Board

Intervention	An action or project being undertaken in order to provide a solution/benefit for the catchment issue. E.g. flooding risk or number of storm overflow discharges.
KCC	Kent County Council
LSO	Long Sea Outfall
Main River	Main rivers are usually larger rivers and streams. The Environment Agency designates these and carries out maintenance, improvement or construction work on main rivers to manage flood risk.
Natural capital	Southern Water defines natural capital as the element of nature that provides value to society.
Network model	A software model representing the piped drainage system through which different rainfall scenarios can be run. To understand the impact on storage capacity, water levels & pumping stations capacity.
No regret intervention	Where it has been agreed through Governance that intervention will provide a benefit with negligible risk of a negative outcome.
Ofwat	The Water Services Regulation Authority
Rainfall scenario	Different types of storms that can be used in a network model. These storms may vary in length or intensity.
Social capital	Social capital is defined as Southern Water's relationships and others' trust in the business.
SWS	Southern Water Services
SSO	Short Sea Outfall
Storm Overflow	Where a combined sewer discharges a dilute but untreated mix of wastewater and rainwater into a water body during rainfall. The term is synonymous, for the purposes of this document, with the terms, combined sewer overflow, intermittent discharge and storm tank overflow.
SuDs	Sustainable Urban Drainage systems
Unflushables	Items which should be disposed of in the bin, not the toilet.
WPS	Wastewater pumping station
WwTW	Wastewater treatment works