Pollution Incident Reduction Plan

5 August 2020

Contents

Letter of executive support

The pollution incident reduction plan represents another step forward for Southern Water in demonstrating real progress in our commitment to reduce pollution and improve and protect the environment.

Southern Water is one of the only organisations in the sector to have developed a pollution reduction programme based on extensive data analysis. It means we are improving our understanding of what can go wrong and why. The result is that our systems and processes are improved and we avoid the same issue occurring twice. However, as we intensify our focus and find more issues, it does mean that there will be more reported incidents in the short term. This is comparable to when the health and safety triangle was introduced and near misses increased but serious injuries decreased.

Over the past year our teams have also been through rigorous training and our 24/7 response 365 days a year is stronger, quicker and more resilient than in the past.

We very clearly understand that in the past Southern Water did not deliver a service that fully prioritised the environment. The Pollution Incident Reduction Plan is another indication of our determination to put this right.

Since I joined the organisation in 2017, there have been wholesale changes to people, processes and systems which has been recognised by our regulators, including:

- A complete restructure of the Executive Team and additions to our Board with strengthened governance
- Invested £26m in wastewater sites over the past year
- Five year plan overspend funded by shareholders of £150m to transform the business
- Appointment of a Director of Risk and Compliance to challenge front-line teams
- Enhanced compliance across all wastewater treatment works including compulsory compliance and Code of Ethics training for all relevant colleagues.
- Refreshed company vision, values and purpose which support and align to a modern compliance framework.
- More than £100m invested in IT systems and processes.

However, we are not complacent. We know there is more to do and my team, the Board and I are fully committed to continuing to improve our business and deliver the services our customers deserve while fulfilling our purpose to protect and improve the environment upon which we all rely.

Best regards

Ian McAulay

1. Pollution and Southern Water

1.1. Culture of accountability

There has been strong and demonstrable cultural shift in Southern Water, particularly since we relaunched our values in 2018, towards putting the environment first. Our core value '*doing the right thing*'[1] is at the heart of ensuring we deserve the trust of our customers, our regulators, our work colleagues and other stakeholders. Awareness of importance of pollution, and the need to do the right thing for the environment has grown in our staff, through general pollution awareness training for first responders, permit training and other campaigns created by our own Pollution Incident Reduction Programme (PIRP). Our Chief Executive has acknowledged that '*The mistakes of the past cannot happen again, and we will ensure they do not by being open, transparent and honest*.'[1]

In 2018 our 'self-reporting' (reporting of our own pollution incidents direct to the Environment Agency) performance was 83%, second only to Northumbrian Water at 84%. Our performance continued to improve in 2019, underpinned by our new company values and ethics training, and is expected to be one of the highest in the UK. This increase has come predominantly from 'site staff' and the spill reporting team, who analyse the data from event duration monitors. The improvement is directly attributable to:

- recent awareness campaigns that have encouraged self-reporting as pollutions are better understood by site staff
- enhanced management of our instrumentation, including investing in a new spills management system, which has produced better quality data and enhanced the visibility of pollution issues
- critically reviewing our wastewater practices to create a positive cultural change that has resulted in greater reporting and a stronger emphasis on data integrity.

We recognised that reducing pollutions requires changes in many areas and by many people. Any organisation is made up of people, processes and systems. Our plan demonstrates a defined and engaged commitment to reducing pollution incidents.

1.2. The Pollution Incident Reduction Plan

Southern Water has developed an agile, detailed programme of activities to deliver a sustainable reduction in Pollution Incidents. We are well progressed in delivering our programme and are fully committed to delivering our 'glidepath' of pollution reductions (see Figure 2-3). Our programme is regularly reviewed internally by our dedicated function Pollutions team as well as by senior management (at governance meetings).We will also review it externally with the Environment Agency at our quarterly operational performance overview meetings The programme will evolve to capitalise on the outcomes of our pollution reduction activities.

The aim of the Pollution Incident Reduction Plan (PIRP) is to explain our programme aspiring to deliver zero incidents by 2040. We aim to improve our understanding of pollution and to drive appropriate, effective interventions by learning from the evidence base of our historical pollution incidents and industry best practice.

[1] southernwater.co.uk/media/2871/sw-code-of-ethics-2019.pdf

Our objective is encapsulated in our vision: ‘our pollution reduction programme drives improvements to our organisational capability, systems & assets to meet the commitments we’ve made to reduce pollution to zero by 2040.’

The PIRP forms part of a wider initiative at Southern Water called Environment+. Environment+ is about using our people, processes and systems to deliver a resilient water future for Southern Water’s customers, by protecting our natural environment as well as our customers’ properties. Environment+ covers five distinct workstreams:

- Pollution reduction
- Wastewater treatment compliance
- Bioresources and energy
- Abstraction management
- Flood avoidance

Each workstream adopts a programme of work that firstly ensures compliance with environmental standards and then delivers improved environmental performance.

To achieve our vision for pollution reduction, we are pursuing four themes in the PIRP in which we are delivering improvements. Each covers two Critical Success Factors (CSF) that are essential to delivering the overall programme successfully.

Staff and customer participation

Creating an environment that enables staff to be knowledgeable and empowered to take action to reduce pollutions combined with educating customers about the relationship between disposing of fats, oils and grease (FOG[2]) and other ‘unflushables'[3] to the sewer in reducing blockages. (CSF 1 and 8.)

Improving the resilience of assets and processes

Including identifying those assets where, if pollutions do occur, the environmental consequences are greatest and improving the resilience of those assets. (CSF 2 and 6.)

Trusted monitoring and analysis

Ensuring we reliably receive all data from our assets, that we can rely on it and that it is available in a readily understood and reliable format that simplifies analysis and reporting. (CSF 3 and 5).

Smart networks / fast and effective responses

Improving the quality and quantity of the data from our assets received by our control room and improving our processes to deliver a fast and effective response; improving the data from our networks and using it to inform proactive activity. (CSF 4 and 7.)

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[2] southernwater.co.uk/help-advice/fat-oil-and-grease
[3] southernwater.co.uk/help-advice/the-unflushables

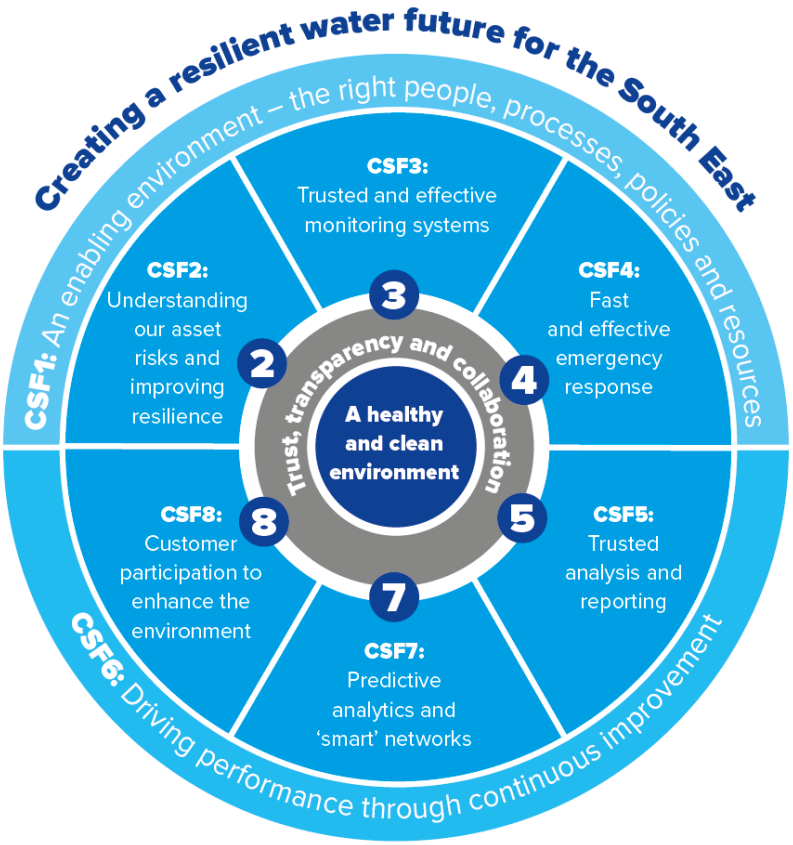

Figure 1-1: Critical Success Factors for pollution incident reduction

The CSFs are shown in Figure 1-1 above and described in further detail in Section 4.2.

2. Pollution reduction

2.1. Existing situation

Pollution incidents in the water industry are categorised using the Environment Agency's Common Incident Classification Scheme or CICS[4]. Under CICS, every incident is assigned a category from 1 to 4:

- **Category 1 (Cat 1)** – major, serious, persistent and/or extensive impact or effect on the environment, people and/or property.
- **Category 2 (Cat 2)** – significant impact or effect on the environment, people and/or property.
- **Category 3 (Cat 3)** – minor or minimal impact or effect on the environment, people and/or property.
- **Category 4 (Cat 4)** – substantiated incident with no impact.

During 2019, we had in excess of 300 category 1 to 3 wastewater pollutions. Cat 1–3 pollutions (particularly Cat 3) have increased in this period, however the most significant increase has been in Cat 4 (near miss) events and non-pollutions (hazards). The growth in non-pollutions and Cat 4 results from our behavioural changes following ongoing awareness raising campaigns.

Despite the increase in category 1 to 3 pollutions, the trends in Figure 2-1 are encouraging because they show the results of a changing culture and behaviours (see below and Section 1.1). The more hazards and near misses our staff raise, the greater the chance of avoiding more serious accidents or pollutions. This type of phenomena, where '*things are going to get worse before they get better*'[5] is not uncommon in process improvement and demonstrates that the systems and culture are changing.

The data indicate that pollutions were relatively steady through 2017 and 2018 but there has been a step change increase in 2019, principally as a result of an increase in pollution at Wastewater Treatment Works (WTW) and Wastewater Pumping Stations (WPS). The PIRP is therefore focused on pollutions from WPS and WTW initially, then foul sewers (FS) in later stages.

[4] ofwat.gov.uk/wp-content/uploads/2017/12/20171129-Incidents-and-their-classification-the-Common-Incident-Classification-Scheme-CICS-23.09.16.pdf

[5] R.Valerdi & B.Fernandes: *Underestimation in the "when it gets worse before it gets better" phenomena in Process Improvement*; Proceedings of the 18th ISPE International Conference on Concurrent Engineering (ISPE/MIT 2011)

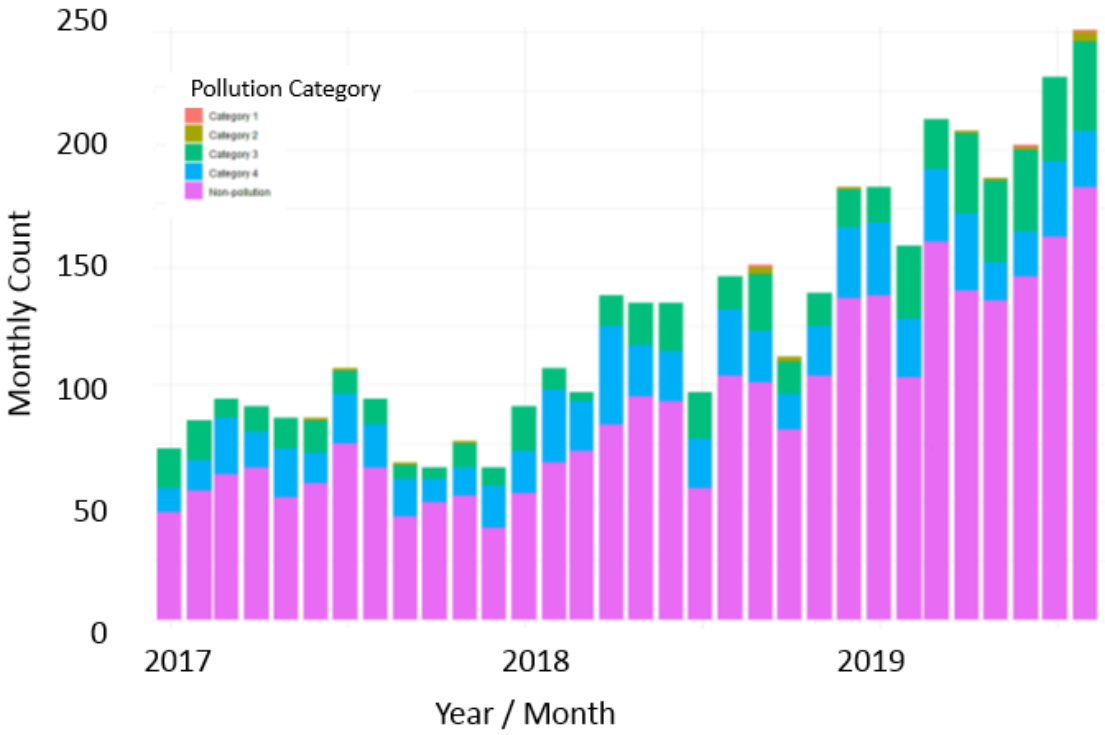

Figure 2-1: All pollution (wastewater only) events January 2017 to August 2019

Another example of the progressing culture transformation in Southern Water is the increase in the number of our own pollution incidents that we have reported directly to the Environment Agency. These self-reported (SR) incidents are shown as bars for each premise type in Figure 2-2.

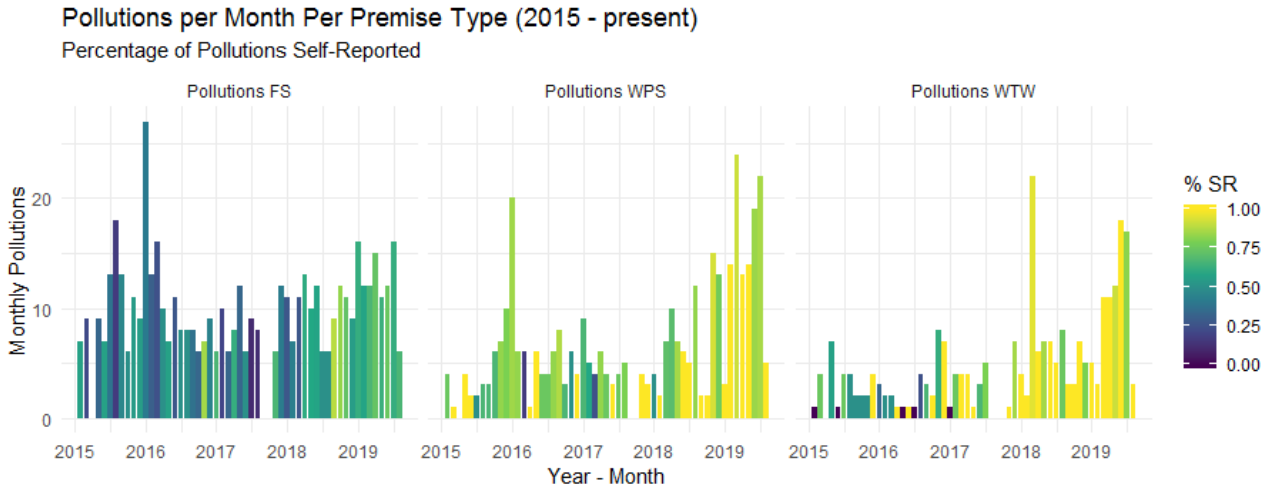

Figure 2-2: Self-reporting pollutions and self-reporting per month by premise type

The colour of the bar indicates the proportion that is self-reported; bright yellow indicates 100% and dark blue 0%. This demonstrates a strong relationship between self-reporting and the increases in pollution events at both WPS and WTW, with a smaller increase evident between FS pollutions and self-reporting.

When we looked at our historical pollution incident data, we saw the following trends:

- There is a strong seasonality in pollutions in FS and WPS but not WTW.
- Improving trends in all three premise types between 2011 and 2015.
- Pollutions from WPS and FS increased once above a rainfall threshold.
- Pollutions increased during the abnormal wet and stormy weather of 2013–14.
- Pollutions from WPS have increased since second quarter of 2018.
- Abnormal weather is unlikely to be an explanatory factor for recent increases.
- Repeated pollutions from WTW have been increasing since late 2017 mainly influenced by cultural improvements.

The PIRP is a transformation programme, one of several within our Environment+ programme (see Section 1.2) that share the common objective of protecting and improving the environment and are part of our company's cultural transformation (see Section 1.1).

The PIRP has a high tempo, with a strong focus on delivering improvements. As such, our dedicated function Pollutions team has weekly internal conference calls and meets fortnightly to review progress and address issues. This collaborative approach has helped drive the right solutions – for example, the optimal solutions for power resilience at our WPS (see Section 3.3).

The programme is highly visible both within Southern Water and externally. Senior management are directly involved with the oversight of PIRP, with the Pollutions Team Lead providing frequent updates directly to our Chief Executive and regular board reporting. The programme will be monitored by our own Audit Committee and two non-exec directors will act as sponsors for the PIRP. We also report progress directly to the Environment Agency at our quarterly Operational Performance Overview meetings.

2.2. The glidepath

The PIRP describes our plan for achieving our vision of zero pollutions by 2040 and our target of fewer than 80 pollutions by 2024. In order to achieve this, we need each of our CSFs to be progressed concurrently. We have forecast the benefits of individual activities, although this is not an exact science yet. The aggregated results are used to develop our 'glidepath' to zero pollutions by 2040; a concept glidepath profile is shown in Figure 2-3 demonstrates the scale of the challenge ahead.

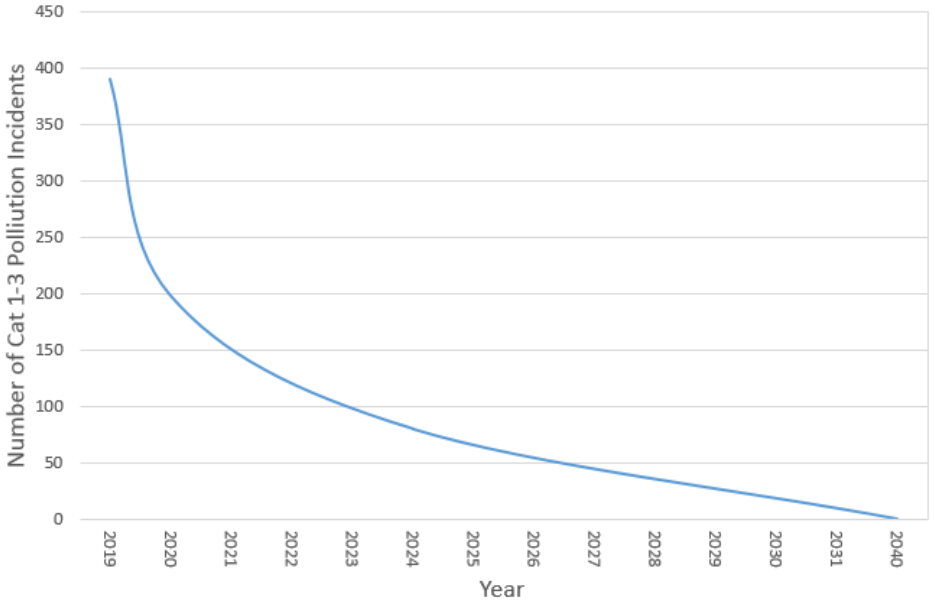

Figure 2-3: Glidepath for pollutions reductions to 2040 to indicate the scale of the challenge

The pollutions forecast to be avoided by each activity are based on historical pollutions attributed to the cause which will be addressed by the relevant activity. For example, it is assumed that pollutions caused by pumps stopping due to power 'brown-outs' (see page 11) will be addressed by the activity of installing auto-resets.

Benefit forecast method

To be able to reliably forecast a reduction in pollutions, we initially carried out an analysis of the 2018 pollution data and used root cause analysis (RCA) to identify the reasons for each pollution. A flow chart of the applied method is presented in Figure 2-4 below. Incorporating this analysis, we have – and continue to – iteratively develop our programme, including its priorities and focal areas, by prioritising those activities most likely to be cost-beneficial in achieving our vision and targets to improve the environment.

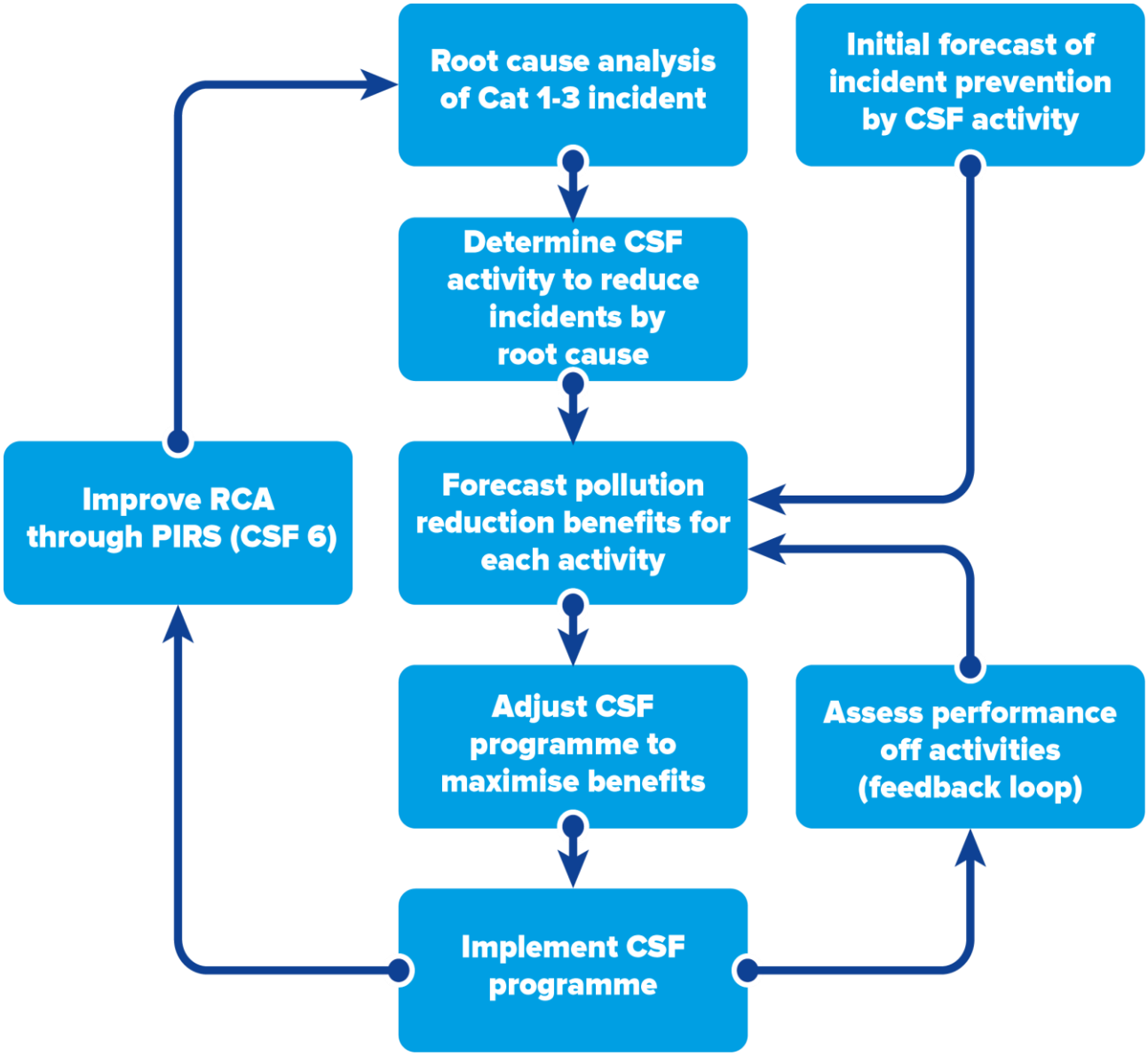

Figure 2-4: Flow chart on initial method informing the PIRP

3. Analysis

3.1. Best practice review

Southern Water is committed to sharing our best practice for pollution reduction with the other Water and Sewerage Companies (WaSCs). We are striving to work in partnership with them and the Environment Agency to protect the environment and minimise the number of pollution incidents by the industry.

We organised the Zero Pollutions Conference 2019 (London 11 July 2019), attended by representatives of the all the UK WaSCs, supply chain and the Environment Agency. The event was a success and good opportunity to share ideas in reducing pollution incidents. Common insights that emerged from this conference were:

- the importance of aligning and focusing the company culture around improved pollution management and to do this through stronger communications with the Environment Agency
- the value of root cause analysis informing improvement programmes
- the value of collecting the right data and being flexible in response to evidence
- the value of creating a dedicated and focused team for pollution reduction.

A key message was the need to focus both on culture and on data; technology is enabling us to move from being asset-led organisations to data-led organisations. With the right culture, and through the transformation of data into information, we can prevent pollutions. Recognising calls for better collaboration and sharing of best practice in the industry, we intend to build on our success and plan to make this conference an annual water industry event. The event will be held again on 14 September 2020 in London and/or virtually and Dr Nick Mills, Head of Pollution and Flooding Resilience at Southern Water, is the chair of the steering committee.

We have undertaken a series of benchmarking interviews with other WaSCs. We also looked at the publicly available commitments to pollution reduction in the PR19 submissions from all the WaSCs to Ofwat and it is clear we are all at different stages in the pollution reduction journey. The five year cycle of investment (known as AMP7) that has just started has many of us featuring greater use of smart technology to improve real-time data and predictive modelling. Similarly, using analytics and technology to enhance customer engagement is also going to be an important issue.

Southern Water has incorporated all of the insights into ‘best practice’ that we have discovered in our end-to-end Pollution Reduction Programme (PIRP). We are looking forward to continuing to share our insights and sharing our achievements with our partners and colleagues in the industry.

3.2. Fault and root cause analysis

Every time we have a pollution incident, we allocate a fault code to what we understand caused it. Analysis of the fault code data for all Cat 1 to 3 wastewater pollution incidents for 2015 to 2019 indicates that mechanical and electrical issues such as pump failures and airlocks, and pump blockage faults are statistically significant causes during this period.

Sewer pollutions are dominated by sewer blockages. Second level analysis inferred from flooding data indicates that a large proportion of these are influenced by customer behaviour – flushing the wrong things down the sink or toilet.

However, fault analysis does not always reveal causality. For example, if a fault is recorded as mechanical, but the underlying cause is that the scheduled maintenance task was not carried out, the true root cause of the fault is misdiagnosed. We therefore undertook a best practice review on causal analysis, which resulted in us using Causal Assessment based on Systems Theory (CAST) to inform a systematic approach to our Root Cause Analysis.

CAST has shaped our approach towards the end-to-end mapping of the pollution incident process. Figure 3-1 shows that the pollution process has six high-level steps that we can map.

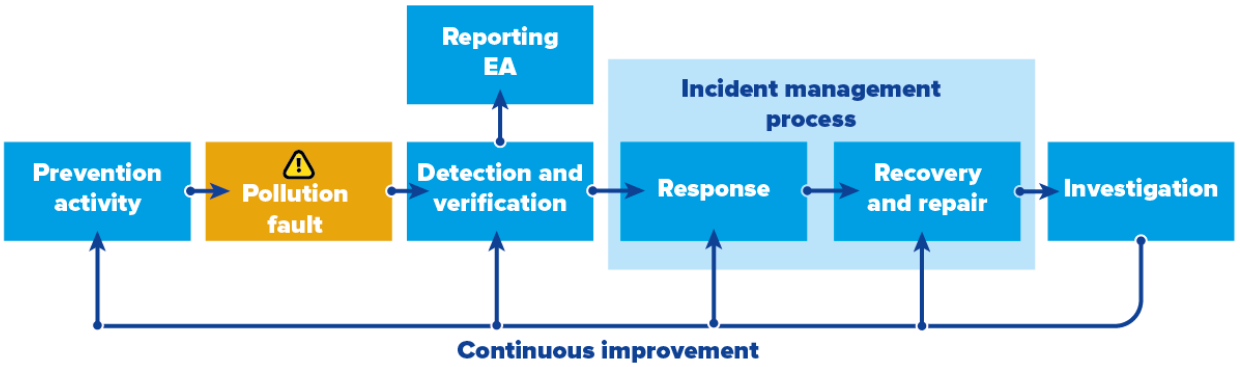

Figure 3-1: The pollution process (simplified for causal assessment)

If measures to prevent pollutions fail, a pollution fault occurs (this is the last failure that caused the pollution event – for example, a mechanical failure of a pump). Following the fault being detected and verified, we then respond to mitigate the effects. Invariably some repair will be required (or amendment to a process). Finally, we carry out a post-incident investigation to establish the cause. Note, that there is also a feedback loop from each step, back to the prevention stage.

Causal Analysis is appropriate to the four key steps (bordered in red) in Figure 3-1:

- Prevention activity – all proactive activity that helps prevent pollution (e.g. maintenance).
- Detection and verification – how did the pollution get detected (e.g. alarm, member of public) and how did it get verified (e.g. correlation of data sources or other).
- Response – attendance on site to attempt to resolve and to collect evidence.
- Recovery/repair – performance of service recovery.

This Causal Analysis approach has been incorporated into our enhanced Pollution Investigation Report System (PIRS+) process and is an essential part of our programme.

3.3. Areas for priority interventions

Identifying high environmental consequence locations

We have historically ranked all of our WPS in terms of subjective risk of failure. We have reviewed and enhanced this ranking process to include the environmental consequences of a pollution from them, irrespective of the likelihood of a spill occurring. We have initially prioritised our pollution prevention work at the 350 WPS with the highest environmental consequence (HEC).

We have carried out health checks at these top 350 HEC sites to assess the state of the assets. Faulty equipment identified in the health checks has been addressed by raising work orders to rectify those problems. Progress on closing out actions is tracked in weekly calls.

A key risk factor relevant to addressing risk of pollution is the time between a fault occurring and the system spilling. This is known as the Time to Spill (TTS). As part of the Health checks, the data to calculate TTS was checked and TTS data updated. We compared these data with where pollutions occur; unsurprisingly there is a strong correlation between pollutions and those sites that at the top of the HEC ranking with a short TTS.

Having assessed the highest risk pumping stations, we have started the same process for wastewater treatment works (WTW). We are also in the process of extending this to the rest of our WPS.

Power resilience

Guided by the analysis of the 2018 and 2019 pollutions data, and using CAST, the reliability of electrical equipment at WPS was identified as an area needing further investigation. Short power cuts (known as 'brown-outs'[6]) can cause pumps to stop and, while pump stations are equipped to restart after a substantial power cut, different equipment is needed if the power cut is only for a few seconds. We have piloted automatic restart technology to resolve this. We believe this will prevent a significant number of pollution incidents and we are now in the process of a roll-out of auto restart technology to the first 350 Sites.

We are also in the process of surveying and rectifying any faults in the air circuit breakers at over 200 sites, which are critical in switching over from the mains supply to generators in the event of a power cut.

In the event of longer term power cuts or interruptions to supply, the role of generators – which we have at around 400 sites – aids the smooth transition to keep essential equipment operating. Our analysis of previous pollutions showed a need to consolidate and enhance generator reliability. This is also being addressed as part of our improvement programme. Similarly, uninterruptible power supplies – which are used to maintain power to critical low power consumption units – are being checked.

Our health checks also revealed that in some cases the control set points for pump operation were sub-optimal. As part of the PIRP we have therefore initiated a programme to improve set point governance for pumps.

[6] Up to 6,000 mains failures per month

Blockage hotspots

A significant number of pollutions also occur from our foul sewers (FS) due to blockages. On average, a pollution occurs on every 500 blockages in our FS network. Analysis indicates that a large proportion of these are influenced by customer behaviour – flushing the wrong things down the sink or toilet.

To help identify the hotspot locations to focus on, we have used state-of-the-art machine learning techniques to understand the probability of every mapped network asset at risk of blocking. This work considered a variety of both characteristics of the asset (e.g. age, material type, velocity) and environmental/demographic attributes (ACORN category of connected properties, soil type, surrounding housing type) to create a comprehensive view of blockage risk. Alongside this analysis, we have adopted a 'rolling ball' method, where a height grid has been used to better understand the direction of pollution spills. These pathways of overland flow have been combined with our manhole asset data and intersected with rivers and other water bodies.

By combining the analyses of network blockage risk, point of exit of sewerage from the network, the pathway of overland sewerage flow and correlating with the receptive water courses, we are able to understand the relative environmental risks of different spill locations. Similar to the ranking of WPS and WTW by environmental consequence, manholes (MHs) have been ranked to identify those at highest risk of pollution. But for the MHs, the historic location of blockages has been incorporated into the analysis.

An example of where Southern Water has used this data set is to identify 'blockage hotspots' in the Havant and Hayling Island catchments where a pilot customer engagement programme is being run.

3.4. Conclusion from the evidence base

The key conclusions from the analysis of the evidence base can be summarised as:

- WPS and WTW pollutions have increased since 2017.
- Self-reporting has increased dramatically in WTW and WPS and improvements in self-reporting correlate with increases in the number of pollution events.
- Awareness campaigns and recent legal investigations have improved awareness and changed the culture, resulting in increased reporting of pollutions, near misses and hazards (non-pollutions).
- Causes linked to electrical and power issues increased in 2018 and more noticeably in 2019.
- Pump issues at WTW and WPS are statistically significant causes.
- Blockages dominate FS pollutions and a large proportion are driven by customer behaviour.
- There is a need to improve pollution prevention activity. Difficulties in the ability to 'detect and verify' a pollution is also a noteworthy factor. Often the response to a pollution is acceptable.
- Outside core hours, reporting to the Environment Agency takes 50% longer than in core hours.
- The environmental consequence modelling has proven to be very reliable and correlates well with the data for WPS.
- Category1–3 WPS pollutions frequently occur at the top 10% or 350 sites (Category 1 high environmental consequence sites).

- Category 1 environmental consequence sites with spill times of less than one hour have the highest proportion of pollutions.
- Sites with more than an hour of storage have far fewer pollutions.
- Category 3 pollution faults tend to be less systematic than Category 1 to 2 pollutions.
- Systematic improvements in ‘detect and verify’ and ‘response and recovery’ processes have been seen between 2018 and 2019, corresponding with the introduction of the new incident management structure.
- Serious pollutions are more likely to occur at the weekend or outside core hours.
- Serious pollutions are more likely in the summer – for example, a serious pollution is 10 times more likely to occur in July than in December.
- Category 1 high environmental consequence WPS sites are statistically more likely to have a serious pollution.
- Sites with more than an hour of storage have far fewer serious pollutions.

In summary the conclusions from the evidence base justifies the following activities and principles in the pollution reduction programme:

1. Focus on WPS and WTW initially.
2. Continue to enhance awareness, capability and training to identify, report and resolve pollutions and pollution risk.
3. Design and implement activities to consolidate and enhance site resilience to power failure and electrical faults.
4. Design and implement activities to enhance the reliability of pumps.
5. Target activities at sites with highest environmental consequence and short spill times.
6. Research and design customer behavioural change programme to reduce blockages caused by sewer misuse.
7. Enhance the resilience of the regional control centre outside core hours – a dedicated waste 24x7 shift point – who would also inform the Environment Agency more promptly.
8. Enhance detection systems, in particular a focus on ‘alarm transformation’.
9. Continue to investigate pollutions and near misses with enhanced processes and systematic techniques to learn lessons faster and apply learnings region-wide.
10. Implement improvements at key risk sites before the summer to minimise the risk of serious pollutions.

4. The programme

4.1. Summary

Southern Water's dedicated function Pollutions team is implementing this PIRP through a comprehensive programme of activity, which is built around the four swim lanes and eight critical success factors (discussed previously). These are designed to ensure that we attain our forecasted glidepath (see Figure 2-3) in pollutions reduction and address the issues summarised in Section 3.1 by effectively delivering a programme of activities as detailed in Sections 4.2 and 4.3 and summarised in Table 4-1.

Table 4-1: Programme Activity Summary (position on 29th May 2020)

Swim-lane	Activity description	AMP6 progress to 1 April 2020	AMP7 year 1 target
Staff and customer participation	Think Pollution training (no. of people trained)	650	Supply chain and new starters. Key office staff.
	Customer participation – Havant and Hayling Island blockage reduction pilot	Deliver the plan for pilot	Complete the pilot catchment and two more catchments
	Site Continuity Plans WPS (no. verified)	175	350
	Site Continuity Plans WTW (no. verified)	14	364
Improving resilience of assets and processes	Health checks (no. of sites – WPS and WTW)	350 (WPS) 50 (WTW)	200 WPS
	Immediate and High Pollution Action closure (% closed \ target)	88.7%	90%
	WPS auto resets (sites with completed installs)	200	550
	Generator resilience (mains failure test, load test and enhanced service)	160	440
	Standby system checks (no. of sites)	79	Maintain
	Air circuit breakers checks (no. of sites)	200	Maintain
	Top 10 WTW repeat sites with Action Plans in place	-	10
Trusted monitoring and analysis	Alarm transformation (no. of WPS sites)	10	300
	Underload alarms for screw pumps and aerators (no. installed)	100	Maintain
	Condition Based Monitoring on critical sites monitored centrally	-	650 sites
	New spills system (ASPIRE)	Operational	Maintain

Smart networks / fast and effective responses	Recruit, train and new Waste Network Coordinator Shift	Seven day cover and 24hr cover as required	24 x 7 shift
	High pollution risk manholes targeted	1,650	8,250

4.2. Programme activity description

Staff and customer participation (CSF 1 and CSF 8)

Enabling behaviours that help meet our pollution targets (CSF 1) and aim to enhance, deliver and embed organisational capability. Many of the enabling milestones (not detailed within the table above) for this CSF have already been met. The main activities being delivered are:

- Think Pollution training – a full-day training course for first responders to raise awareness of pollution, ensure evidence is captured and appropriate escalation is made following an event. We trained 650 people before COVID-19 restricted classroom-based training. In AMP7 we aim to continue with the programme by training the supply chain, new starters and key office based staff, but this will now be via an e-learning tool until COVID-19 restrictions have changed.
- WPS continuity plans – these have historically only been written following a pollution incident for a site, so we engaged with our data team and auto generated continuity plans for all WPS sites, which could be used in an emergency scenario. We are now manually verifying the continuity plans for high consequence sites which will be complete in 2020.
- WTW continuity plans – WTW have better coverage but we are enhancing these to include additional information to help mitigate and reduce the impact of a pollution event on a WTW. All enhanced WTW continuity plans will be complete in 2020.
- Blockage reduction campaign – building on our successes in AMP6 with our award-winning[7] FOG and Unflushables team, we are trialling a different approach to stimulate customer participation to reduce blockages in a problematic catchment with high pollution related blockages (Havant and Hayling Island). If successful, this approach will be rolled out to two further catchments in 2020.

Improving resilience of assets and process (CSF 2 and 6)

One of the first steps was to refresh and enhance modelling to better identify waterbodies at which there would be a high environmental consequence if a pollution occurred. This information has been used to prioritise many of our activities, such as ‘health checks’ and asset resilience work. The main activities being delivered are:

- Health Checks – proactive health checks on high consequence WPS sites to identify improvements to mitigate pollution risk. 350 health checks were completed at WPS sites in 2019. A further 200 sites will be checked in 2020.

[7] southernwater.co.uk/the-news-room/the-media-centre/2019/may/southern-water-team-wins-top-award

- Health Checks – proactive health checks on high consequence WTW sites to identify improvements to mitigate pollution risk associated with the inlet, storm management and outfall systems. We health-checked 50 sites in AMP6. The benefit will be reviewed before progressing any further WTW checks in 2020.
- Immediate and High Pollution Action closure – the actions identified have and are being tracked. Those deemed as immediate and high priority will be completed first and a 90% completion rate is the target.
- WPS auto resets – these reset devices will automatically reset a site following an electrical disturbance or nuisance pump trip and mitigate pollution risk by avoiding the delay from a manual reset requiring physical attendance on site. Installations to date have been very successful. We aim to complete 550 site installs by the end of 2020.
- Generator resilience – our standby generators are receiving enhanced mains failure testing, load testing and servicing to improve reliability following trend analysis of events. 160 generators on high risk sites have received enhanced testing to date. All fixed and mobile generators will be completed in 2020.
- Standby system checks – essential standby systems were identified as a common issue following trend analysis. Batteries, control systems software back-up and uninterruptable power supplies (UPS) are being checked and mitigations put in place where required. 79 high risk sites have been checked (March 2020).
- Air circuit breakers checks – critical low voltage air circuit breakers required during changeover from generators and mains power have had additional resilience checks by a specialist following trend analysis. 200 sites have been completed (March 2020).
- Site based Action Plans – for 10 sites by the end of 2020.

Trusted monitoring and analysis (CSF 3 and 5)

Trusted and effective monitoring systems for improved decision-making (CSF 3) recognises the need to improve the effectiveness of our monitoring systems and analysis for reporting and improved decision-making (CSF5). The main activities being delivered are:

- Alarm transformation – a programme to improve the alarm quality, consistency and volume to allow controllers in and out of hours to prioritise resources and activity appropriately. Seven WPS pilot sites have been tested with new alarm logic; in 2020 this will be rolled out to either 300 WPS high alarm noise or high environmental consequence sites.
- Underload alarms for screw pumps and aerators – additional alarms are being fitted to aid early detection of failure and to avoid the pollution occurring. All assets with this risk have had new alarms fitted (March 2020).
- New spills system (ASPIRE) – a robust and reliable tool, designed to permit effective reporting of spills from multiple data sources to ensure our pollution reporting is compliant and can be confidently used for evidence-based decision-making in future. The new system has been operational since December 2019.
- Condition Based Monitoring installed, commissioned and monitored centrally – we aim to ensure high risk WPS sites have sufficient monitoring to provide early warning of asset performance deterioration and prompt early proactive action.

Smart networks and effective responses (CSF 4 and 7)

Fast and effective emergency response for reducing environmental impact (CSF4) combines three key activities to deliver the necessary capabilities to enhance our emergency response to incidents. Out of hours resource rotas have been already been revised, with new standby rotas for emergency planning implemented. A key activity was to provide a new wastewater network management controller role created to manage them. This role provides critical support to the existing operational control room by promoting more in-depth interrogation of available data to spot issues before they happen. We have recruited the shift and it is in place seven days a week.

Predictive analytics and smart networks (CSF7) is in the early stages of development. The objective is to utilise predictive analytics and smart networks to achieve pollution prevention through pre-warning. We have piloted an assessment of historical blockages using a rolling ball analysis to locate high pollution risk manholes. The initial programme of cover lifting lifted 1,650 by April 2020 and the plan is to continue this programme and the target for April 2021 is 8,250.

4.3. Programme implementation

Historically, this programme has been supported by a number of external contractors to provide strategic, technical and project support. We have recently made changes to embed the resources into a permanent Pollution and Flooding Resilience function within wastewater operations. The new function will deliver flooding and pollution reduction across the business.

The Pollution and Flooding Resilience function will:

- be accountable for all direct and indirect flooding and pollution activity and performance
- design, optimise and deliver the reduction programmes which deliver the right balance between penalty, TotEx and service to the customer.
- provide and enhance pollution and flooding reporting
- manage key stakeholders with a vested interest in pollution and flooding reduction.

4.4. Forecast benefits

Our forecast shows that current activities could reduce pollutions from 427 to 276 in 2021, assuming similar environmental conditions seen in 2019. We are forecasting a 2020 outturn of 390, taking account of actual pollutions to date, the challenges and our forecast benefits profile from pollution reduction activity. The very wet weather at the start of 2020 has masked some of the benefits from pollution reduction activity.

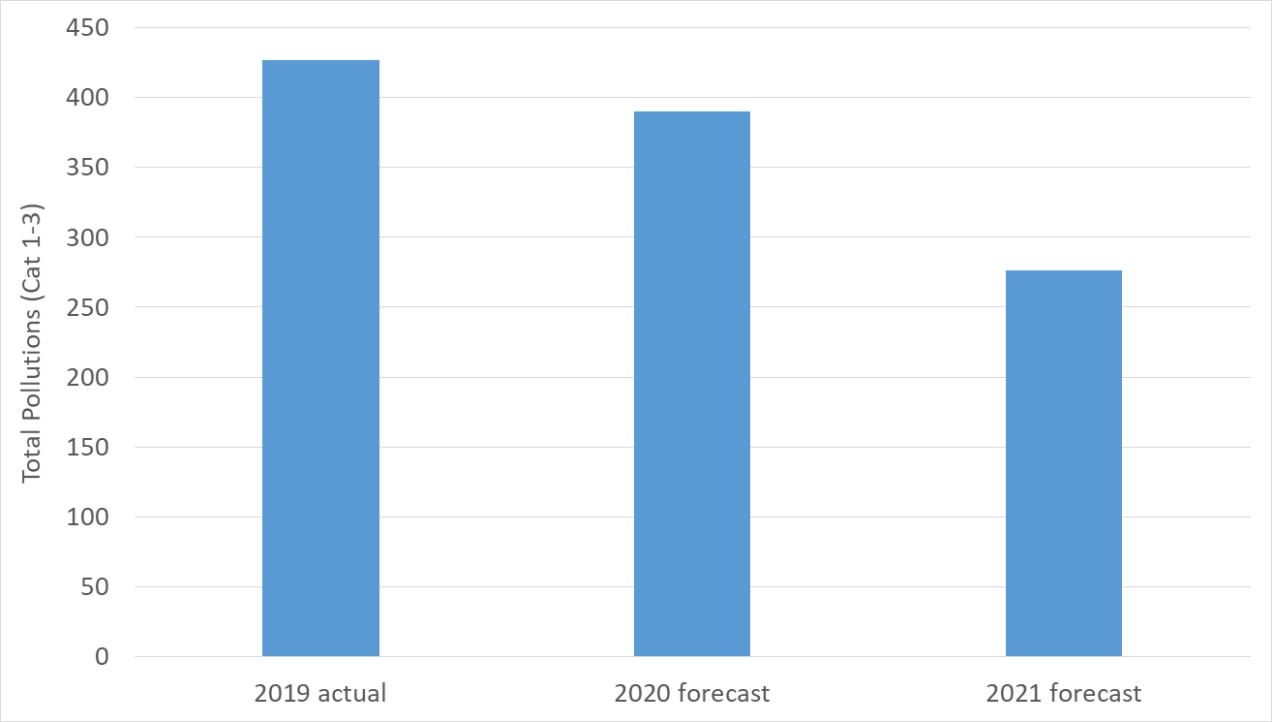

Figure 2: Forecast benefit profile

This analysis of benefits reveals that our current activity does not provide sufficient reduction to reach the ODI and EPA targets and additional activities will be developed to close the gap as discussed in Section 2.

5. Conclusions

There is a clear commitment from the most senior levels at Southern Water to deliver an effective glidepath in reduction of pollution, to reach zero incidents by 2040. Our positive culture of accountability, the desire to ‘do the right thing’ and protect the environment is apparent in our increased levels of self-reported pollution incidents.

The creation of the Pollution Reduction Programme, together with a dedicated functional Pollutions team to deliver the programme, means that we are supporting these desires with real action and strong governance; the programme is under close scrutiny by both our Board and our Chief Executive.

The Pollution Reduction Programme is already delivering real benefits through early identification of essential critical success factors. We have analysed the evidence base of historical incidents, to identify clear areas of focus for us to prioritise the most effective ways to reduce pollution.

We are developing and building on some of the best practices in the water industry, using detailed root cause analysis and thorough heath checks of our assets to deliver a transformation project that will ultimately see us with a resilient infrastructure.

The anticipated long term benefits in overall reduction in pollution incident numbers will take time to realise, but reductions in pollution incidents are already being seen in some areas and we expect the pace of incident reduction to pick up as our programme matures and is iteratively enhanced to ensure maximum value is enhanced within the TotEx envelope of AMP7.

6. Glossary

Acronym	Definition
CAST	Causal Assessment based on Systems Theory
Cat1	CICS Category 1 Pollution Incident
Cat2	CICS Category 2 Pollution Incident
Cat3	CICS Category 3 Pollution Incident
Cat4	CICS Category 4 Pollution Incident
CBM	Condition based monitoring
CICS	Common Incident Classification Scheme
CSF	Critical success factor
FOG	Fat, oil and grease
FS	Foul sewer
HEC	High environmental consequence
NMC	Network management centre
MH	Manhole
OFWAT	The Water Services Regulation Authority
PIRP	Pollution Incident Reduction Plan
PIRS+	Enhanced Pollution Investigation Report System
PR19	Ofwat's Price Review 2019
PIRP	Pollution Reduction Programme
RCA	Root cause analysis
SR	Self-reported incident
TTS	Time to spill
Unflushables	Items which should be disposed of in the bin, not the toilet.
WaSC	Water and Sewerage Companies
WPS	Wastewater pumping station
WTW	Wastewater treatment works