T.A 7.1 Understanding Operational Risk and **Resilience**

Technical Annex

September 2018

Version 1.0

Navigation: TA.1. – *Understanding Operational Risk and Resilience*

Purpose:

This technical appendix provides further background on our approach to operational risk and resilience assessment, it describes the systematic framework used to identify and assess risks and quantify to impact using best available data.

The table below summarises the Ofwat tests that are addressed by the evidence presented in this Annex.

Table: Relevant Ofwat tests

Ref	Ofwat test		Comment
Primary Focus Areas			
LR1	How well has the company used the best available evidence to objectively assess and prioritise the diverse range of risks and consequences of disruptions to its systems and services, and engaged effectively with customers on its assessment of these risks and consequences?	• The company will take an organisation-wide, integrated approach to identifying and appraising all the diverse risks to the resilience of services and interdependencies across different areas. • The company will provide clear evidence that they have objectively considered and assessed the full range of resilience management options. • The company will present strong evidence that it has used robust, ambitious and innovative approaches to assess and mitigate risks to long-term resilience in the round. These proposals will be supported by stretching commitments to customers.	We have a bottom up approach to risk and resilience planning, which ensures integration. We have developed and enhanced our processes and systems to support this. This Annex explains: • Our approach to HazRev, developed and supported by the DWI • Our Zonal Resilience Assessments and how they quantify consequence in a customer led manner • Our approach to smart water network management using best data to manage incidents.

Executive Summary

Our **operational risk management** builds on existing frameworks and enhancements being delivered through Water First and Environment+[1]. Enhanced asset resilience has either been incorporated within our transformational programmes, such as Networks 2030, or site-specific schemes[2].

While we already have a systematic approach to operational service (asset) risk assessment, we recognise the need to improve the depth and detail of the risk assessment and take the opportunity to make better use of innovative technology. We are further strengthening our in-house catchment risk management via in-sourcing of specialist skills such as agronomists, which are required to fully embed Catchment First.

The identification of risk drivers for each strategic risk identified enables us to consider the proactive control environment, often demonstrated to be the most cost-effective way of managing risk, focusing on the four R's. Having considered the control environment, we are able to determine the residual risk.

We are pursuing innovative techniques, such as zonal resilience assessments and smart water networks to ensure we have an accurate understanding of our risk position and the resilience threats to our services.

We continue to collaborate with stakeholders to improve and align our risk management systems and processes, so they meet their requirements and expectations.

Our approach to wholesale operational risk management

A critical component of both Water First and Environment+ is improving risk management. We build on best practice for Hazop (Hazard in Operation) analysis to ensure a more integrated approach to both our assets and the catchments they operate in. This means we can systematically undertake full resilience assessments at catchment level, building on the international J100 resilience framework.

We are also assessing our resilience maturity against international best practice and the British Standard BS65000:2014 Organisational resilience through annual assessments, aligned to the British Standard.

We have developed our risk methodology further in AMP6 and it is currently being applied across our asset base, through the development of our Water and Wastewater Risk Frameworks.

The purpose of the hazard review (HazRev for water) is to ensure that there is a fully integrated review of catchment and operational and asset based hazards at assets. In addition it improves

[1] Please refer to Wholesale Water and Wholesale Wastewater chapters where we explain these programmes in more detail.
[2] Business cases have been developed

- inter-team communication and collaborative working
- document control/site drawings
- our asset maintenance strategy and site specific maintenance criteria

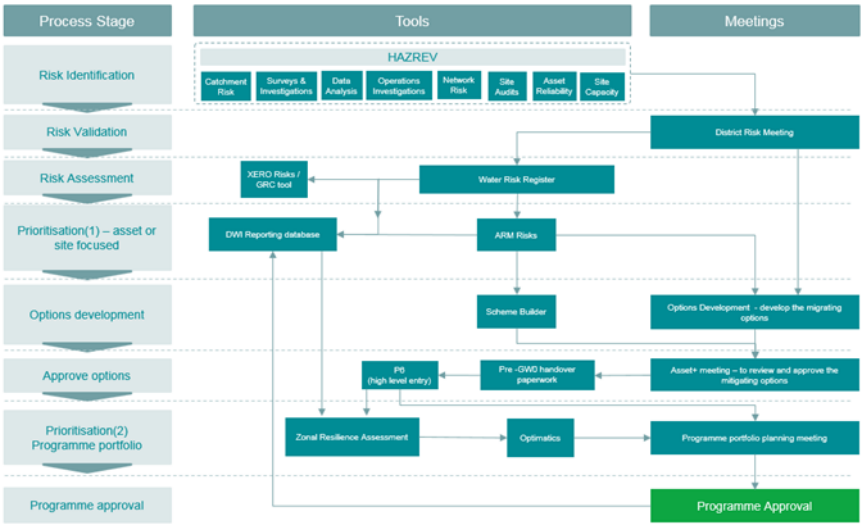


Figure 1 - Water Risk Framework

In water, we have shared our methodology and example results with the DWI. It has been recognised as good practise and is being referred to other companies as a methodology to improve risk management. Our Hazrev review outputs are a key input into our catchment risk assessments. This enables us to gain a true understanding of the catchment resilience by identifying, for example, single points of failure in sites and network – enhancing our ability to understand and prioritise interventions.

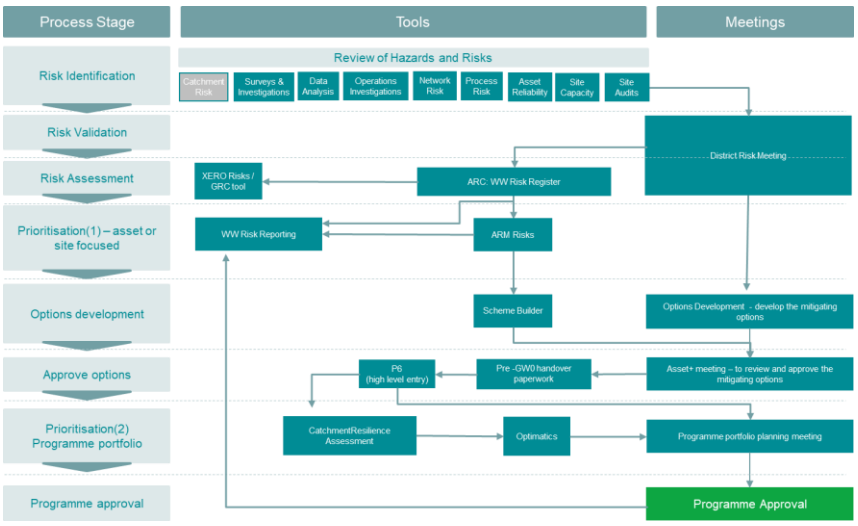


Figure 2 – Wastewater Risk Framework

Our Hazard Review approach improves the co-ordination of activities that feed the hazards in our water and wastewater risk frameworks, shown in Figure 1 and Figure 2. This utilises a variety of tools and techniques, including:

- FMECA – Failure Mode & Effect and Criticality Analysis
- Operational Performance Dashboards

- CAR (Compliance and Asset Resilience) Site Audits
- Process Headroom Investigations and Studies

In order to identify risks across a number of broad categories, such as:

1. Asset Health and Reliability
2. Performance Compliance
3. Growth and Demand
4. Efficiency and Effectiveness
5. Asset Deterioration

The Frameworks were developed by our Planning and Resilience team, putting them at the heart of the planning process to ensure a truly integrated system assessment. We achieve this by;

- Having clear line of sight from these operational risk registers, to Xero Risk our Enterprise Risk Management System
- Ensuring commonality between our ARM Risks and DWI reporting database
- Including these bottom up risks as part of our Resilience Assessment, which we are in the process of rolling out.

Hazard Review – HazRev in detail

An example of how we apply Hazard Review to comprehensively identify, assess and determine the optimum control measure in our Wholesale Water business is set out in this section. Our HazRev is multi-facated, utilising a range of approaches to identify and capture risk. These include – catchment risk assessments, surveys and investigations, performance data analysis, asset or process capacity assessments, operational inspections, network risk, site audits and asset reliability analysis. **Figure *3*** provides a high level summary of the Hazrev risk assessment scope which covers catchment, asset criticality, operation and maintenance, site pipework, hazard containment on site, sampling and monitoring, contingency planning and manufacturer materials.

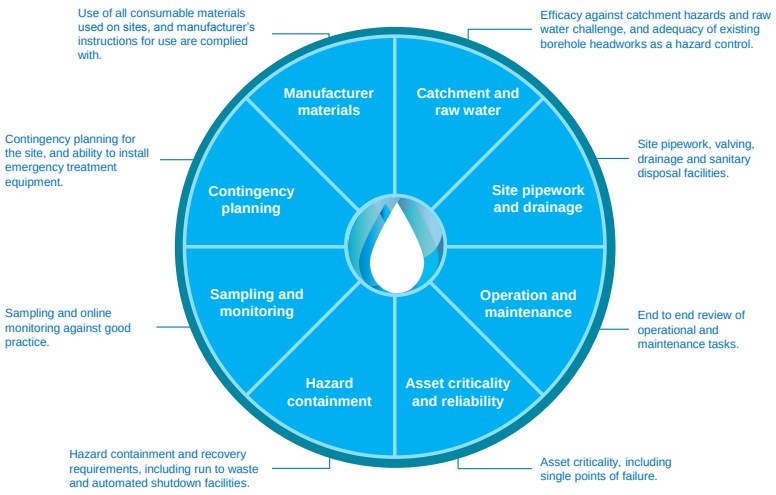


Figure 3 - HazRev Process

Hazard review elements	No. Q's
Catchment and raw water	32
Site pipework and drainage	4
Operation and maintenance	684
Asset criticality and reliability	184
Hazard containment	25
Sampling and monitoring	21
Contingency planning	1
Manufacturer materials	16
Total	**967**

- All questions are segmented by **hazard review elements** from which to assign business owners and remove potential duplication between teams / groups

Asset process elements	No. Q's
Abstraction	58
Holding	17
Inlet and screening	21
Clarification	182
Filtration	100
Water treatment	189
Sludge treatment	11
Conditioning	25
Disinfection	203
Distribution	82
Facility support	38
General	41
Total	**967**

- All questions are segmented by **asset process elements** from which to drill into the relevant details for that specific process.

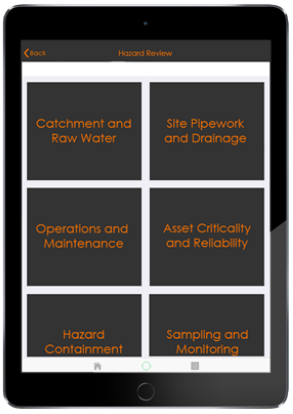
Response driver elements	No. Q's
Design	140
Operation	255
Maintenance	572
Total	**967**

- All questions are segmented by **response driver** i.e. the type of action required to control the hazard, with the intent to reported on rolling basis.

Figure 4 - Overview of HazRev Question Bank

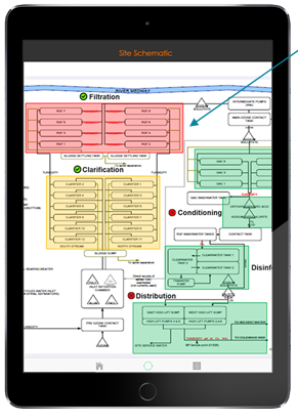
To undertake a systematic assessment of risks affecting the water supply and quality we use a question bank – Figure 4 explains how circa 1000 questions interrogate both the hazard review elements and the asset process elements. The questions are then segmented by the response driver – design, operation or maintenance. We have worked collaboratively with the DWI to create this framework. Recognising the need to ensure the information used is as current, reliable, accurate and complete as possible, we are investing in collecting it at source. **Figure *5*** illustrates the use of mobile devices, in addition to paper based records, which support the systematic and structured approach to hazard reviews.

Burham hazard review elements



- This screen shows the hazard review elements that are configured for the selected site.
- Click on the elements to drill drown into the list of assets at the site.

Burham process flow diagram



- This screen shows the processes with green dots indicating surveys have been completed and red dots for surveys still pending.
- Click on the process to start the survey (colour denotes hazard grading).

Filtration process questions (sample)

HazRev Element	Category	Question
Catchment and raw water	Membranes	Is feed water quality subject to sudden changes?
Operation and maintenance	Rapid gravity filter	Is the RGF free of biofilm or algae growth
Asset criticality and reliability	Membranes	Is there duty/standby arrangement for the pump?
Hazard containment	Rapid gravity filter	Is it possible to recycle or run to waste a filter following backwash?

- This table shows a sample of filtration process questions by category (or asset type) and hazard review element.

Figure 5 - Risk Assessment enhanced by mobile data

Further enhancements to improve the assessment of operational service resilience

Key to planning for operational resilience is understanding the impact resilience hazards can have across the system. To systematically assess this, we have developed, and are rolling out, Resilience Assessments across Water and Wastewater, building on the international J100 resilience framework. These are the key systematic assessments for determining the best value options to deliver outcomes for customers. We have started using them to identify threats and to optimise mitigations. For water we will publish the results of these assessments to give greater transparency to stakeholders of our short, medium and long-term resilience initiatives, through our Water supply resilience Performance Commitment. For Wastewater we will monitor our progress and determine how best to make this information visible to stakeholders, building on the approach recommended in the Drainage Strategy Framework.

Our methodology is implemented in four key stages. The first step is to identify and define the sites, systems and hazards relevant across the board. These sites and systems are assessed against each hazard using the four risk elements. Corresponding control factors are applied, producing a subsequent output resilience score.

The assessments are providing new insight and enabling us to compare resilience levels across different zones. Our methodology is a consequence-led approach that quantifies resilience by “households at risk” for water and Controlled risk ‘£’ score for wastewater. We consider systematically quantifying risk in this manner ensures a customer and stakeholder focused approach to our planning and operational activities, as illustrated in **Figure** .

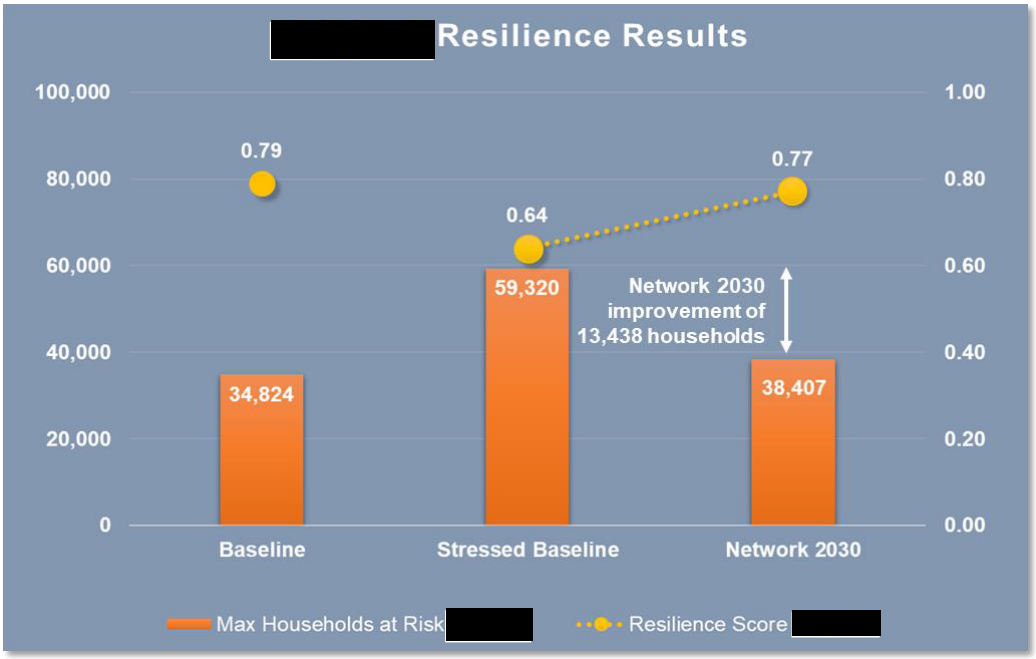


Figure 6 - Output from [redacted] Resilience Assessment

Figure shows an assessment undertaken for our [redacted] Zone and illustrates our resilience levels under current average conditions and during drought[3], ensuring we are consider long-term resilience in the round and integrate Water Resource Management Planning and Drinking Water Safety Plans into the assessment process.

The first column shows our assessment of the current number of households at risk and the zone's resilience score during normal circumstances. The other columns show our forecast for homes at risk and resilience scores during drought – one under a stressed baseline, where we adopt traditional approaches, and one where we have implemented Networks 2030.

This assessment demonstrates that by adopting our Networks 2030 approach of improving the resistance/reliability of our assets (rationalisation and centralisation), improving redundancy (adding additional connectivity) and improving our ability to respond (monitoring and control), our asset base becomes significantly more resilient – ensuring we are delivering best value for customers.

In **Figure** we provide details of how our assessment considers a number of scenarios and the assumptions we build into our analysis. By considering a range of scenarios, we enhance our ability to plan for the long-term and consider possible sensitivities which may influence the best value, helping us identify adaptive interventions.

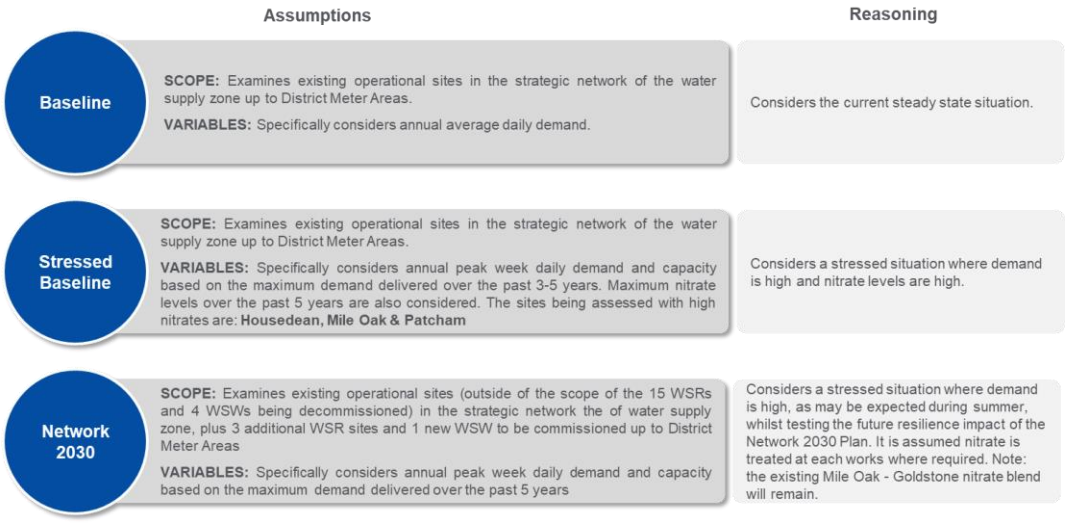


Figure 7 – Assessment Scenarios

The assessment we undertake, ensures we are exploring and testing a full range of failure points and potential hazards, including those which are non-asset and out of our boundary. Working in close collaboration with relevant stakeholders, a list of key hazards and sites were identified and agreed. The definitions of each of these hazards can be found below, with ***Figure 7*** highlighting the applicability of these hazards to each site type.

[3] 1 in 200-year drought

Key Hazards	Water Supply Works	Service Reservoir	Booster Pumping Stations	Trunk Mains
Flooding Sites are located in flood risk locations and hence are exposed to fluvial, coastal or surface water flood risks. The effects of climate change are expected to increase the risk to our sites from environmental flooding.	✓	✓	✓	×
Critical Asset Failure This is used where the failure of a single critical asset could lead to the loss of supply. This assesses the potential of an unprompted asset failure, i.e. a failure not caused by any other hazard, occurring to critical assets within a site.	✓	✓	✓	✓
Contamination This assesses the risk of contamination of clean water caused by infiltration of contaminants into the water process or network (downstream from the source). This will include events such as service reservoir infiltration from pollutants.	×	✓	×	✓
Raw Water Loss This assesses the unavailability of raw water delivered to the treatment works through the source water being untreatable (i.e. either due to quality or quantity issues). Typically this will include aspects such as river contamination, impounding reservoir algal blooms and elevated nitrates.	✓	×	×	×
Malicious Damage This assesses the expected risk from third party malicious damage. Malicious damage typically looks at a targeted attack on critical assets that would cause a loss of supply.	✓	✓	✓	×
Cyber Security Incident This assesses the risk of any malicious or accidental cyber event that disrupts the operation or appropriate use of any systems, physical infrastructure, software, information and data that is essential to the reliable operation of a site.	✓	✓	✓	×

Figure 7 - Key Hazards and the assets we have considered.

We have applied this assessment to our three highest priority water supply zones (WSZ) and one wastewater catchment, and are now rolling it out across all our WSZs and wastewater catchments. We will continue using our Water and Wastewater Risk Framework to identify, assess and prioritise control options and investment.

Operational Risk Assessment Outputs

Having completed our Risk Assessment activities we ensure that risks are captured in ARM (Asset Risk Management) System (ultimately as can be seen in **Figure *1*** & **Figure *2*** this informs XeroRisk our Enterprise Risk Management System), this allows for the comprehensive and consistent capture of risks against known customer prioritises and consequences, by weighting the importance that they place on them, informed by our customer engagement.

In Figure 6 we provide as an example the 17 high priority, significant investments for Wastewater Treatment Works included in our plan (TA12WW01 Wastewater Treatment) and the ARM risk score. We also show how our risk management activity is ongoing, by illustrating how both our current programme and future plans will mitigate and address risks we have identified. In this summarised extract, we also differentiate between the capital maintenance interventions we intend to make and where we reduce risk as a secondary benefit of investment driven by growth or enhancement.

Site	Sum of Weighted Asset Risk Score	No. of identified risks	Planned risk mitigation through named AMP7 capital maintenance scheme	Planned risk mitigation in AMP6	Planned risk mitigation through alternative AMP7 mechanism
[redacted]	33405	2	Y		
[redacted]	16474	4	Y		Y
[redacted]	13852	1	Y		
[redacted]	12455	3	Y		
[redacted]	9086	2	Y		
[redacted]	5988	2		Y	
[redacted]	5362	3		Y	
[redacted]	4016	1	Y		
[redacted]	3655	1		Y	
[redacted]	3564	1		Y	
[redacted]	3493	2	Y		
[redacted]	3393	2			Y
[redacted]	2992	1			Y
[redacted]	2861	4	Y		
[redacted]	1998	2		Y	Y
[redacted]	1505	1		Y	
[redacted]	1279	1	Y		
[redacted]	1024	2			Y
[redacted]	1001	1	Y		
[redacted]	998	1		Y	
[redacted]	998	1	Y		
[redacted]	988	1		Y	
[redacted]	834	1		Y	
[redacted]	770	1			Y
[redacted]	748	1		Y	

[redacted]	616	1			Y
[redacted]	482	1			Y
[redacted]	400	1	Y		
[redacted]	374	1		Y	
[redacted]	249	1	Y		

Figure 8 - Extract of Wastewater Risk Register

Within the Wholesale Water business we align The Drinking Water Safety Plan (DWSP) methodology which focuses on delivering a practical risk management tool which minimises risks by taking a preventative approach, with our Resilience Assessment and ARM. Where risks are identified we ensure that they are managed and understand so suitable action is taken in a cost effective and timely manner.

provides the top 20 risks extracted from our DWSP, showing line of sight to both the ARM risk register and the business cases which outline our proposed mitigations.

System Name	Hazard Category	DWI Risk Cat	ARM risk	Control Measure	Verified DWSP Risk	Relevant PR19 Technical Annex
[redacted]	Insufficient water supply - >12 h outage	E	6371	Mains renewals, proactive leakage detection and resolution, response to mains bursts	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	8141	storage in bank side reservoir, contact tank, clear water tank	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	58	storage in bank side reservoir, contact tank, clear water tank	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	2172	Mains renewals, proactive leakage detection and resolution, response to mains bursts	100	[redacted]

[redacted]	Insufficient water supply - >12 h outage	E	422	Alternative supplies.	100	[redacted]
[redacted]	Pathogenic bacteria (e.g. E Coli & Enterococci)	E	7351	Groundwater directive (80/68/EEC). Groundwater regulations 1998. Water Framework Directive 2000/60/ECThe Waste Management (England and Wales) Regulations 2006. Waste Management Licensing Regulations 1994.	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	2169	Mains renewals, proactive leakage detection and resolution, response to mains bursts	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	1069	Mains renewals, proactive leakage detection and resolution, response to mains bursts	100	[redacted]
[redacted]	Pathogenic bacteria (e.g. E Coli & Enterococci)	D	9177	Groundwater directive (80/68/EEC). Groundwater regulations 1998. Water Framework Directive 2000/60/ECThe Waste Management (England and Wales) Regulations 2006. Waste Management Licensing Regulations 1994.	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	x	Resevoir Integrity	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	8135	Alternative supplies from Hardham WSW.	100	[redacted]

[redacted]	Insufficient water supply - >12 h outage	E	7388	Reservoir storage	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	7791	EA control and monitor sources of hazardous event in the catchment. Wastewater teams control and monitor sources of hazardous event in the catchment and are regulated under Urban Wastewater Treatment Directive 91/271/EEC.	100	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	2018	Mains renewals, proactive leakage detection and resolution, response to mains bursts	50	[redacted]
[redacted]	Insufficient water supply - 6-12 h outage	E	998	Mains renewals, proactive leakage detection and resolution, response to mains bursts	50	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	x	Alternative supplies.	50	[redacted]
[redacted]	Insufficient water supply - >12 h outage	E	5703	Storage in WSR, zone transfers	50	[redacted]
[redacted]	Insufficient water supply - 6-12 h outage	E	56	storage in bank side reservoir, contact tank, clear water tank	50	[redacted]
[redacted]	Pathogenic bacteria (e.g. E Coli & Enterococci)	D	9171	Groundwater directive (80/68/EEC). Groundwater regulations 1998. Water Framework Directive 2000/60/ECThe Waste Management (England and Wales) Regulations 2006. Waste Management Licensing Regulations 1994.	50	[redacted]

[redacted]	Pathogenic bacteria (e.g. E Coli & Enterococci)	D	7160	Groundwater directive (80/68/EEC). Groundwater regulations 1998. Water Framework Directive 2000/60/ECThe Waste Management (England and Wales) Regulations 2006. Waste Management Licensing Regulations 1994.	50	[redacted]

Figure 9 - DWSP Extract

Both of these are provided as examples of how we make use of our operational risk management systems to capture an accurate and consistent understanding of risk and appraising all the diverse risks to the resilience of services.

How we will continue to improve

We recognise the importance of learning from and benefitting from best practice and international standards, this can be seen in our example above where we learn and adapt the J100 resilience framework from the US and apply it to our business. We have also sought to understand where our strengths and opportunities for improvement exist. We have done this in a structured way, following the BS65000 framework set out by BSI, this framework provides quantitative insight on Organisational Resilience across a suite of core elements. We are undertaking annual assessments, aligned to the British Standard, to measure our progress and highlight areas for further improvement.

We undertook a resilience self-assessment in May 2017 to determine where we needed to strengthen our capability, this assessment informed the development of our Modern Compliance Framework (TA7.2) and the development of the resilience assessment described above. We will undertake an annual review of our developing capabilities against the framework and refine and enhance our plans so that we have a structured approach to continuous improvement of our Operational Risk and Resilience capabilities.