



The 8th REA Symposium Embracing resilience: Scaling up and speeding up

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Resilience of UK Water and Wastewater Systems

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Presentation content

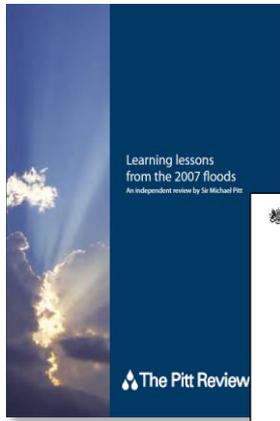
- How natural hazards have driven UK resilience policy
- The regulatory framework which has emerged
- How the UK water sector has responded
- How the sectors response has been received
- What more should the industry do

Natural hazards drive UK resilience agenda

2007 Floods

350,000 homes lose water supplies as flood misery grows

- Households face two-week wait for tap water
- Thames and Severn rivers set to rise further
- Emergency services battle to protect power supplies



CabinetOffice

Keeping the Country Running:
Natural Hazards and
Infrastructure

2011

Contact:
Civil Contingencies Secretariat,
Publication date: October 2011

A Guide to improving the resilience of critical
infrastructure and essential services



Resistance



Reliability



Redundancy



Response & Recovery

Big Freeze 2010-11



Water rationing as thousands left without in Northern Ireland



How resilient is the sector

Water Sector

Department for Environment, Food and Rural Affairs

Assessment of Existing Resilience

- Irrespective of the risk, water companies are required by law to plan to provide water by alternative means in the event of a failure of the mains supply.
- The piped water supply system is generally resilient to the loss of individual facilities, and there is a widespread ability to reroute supplies from other parts of networks.
- However disruption to electricity supplies or widespread flooding could result in the loss of mains water and affect the movement and treatment of sewage. Water companies have contingency plans in place which include the use of back-up generators.
- Emergency response is bolstered by industry-wide and local mutual aid agreements to enable the sharing of resources between companies.
- All companies maintain statutory plans to minimise the impact of a drought.
- Defra has well established mechanisms for engagement with the water sector and we have been working with them, across government and with the Devolved Administrations, to undertake contingency planning for a range of EU exit scenarios, including a no-deal scenario.

“An all-risks regulatory framework, effective mutual aid arrangements and high levels of investment continue to strengthen the resilience of the water industry to major disruptive events”.

Since first assessment in 2010 little substantive change in view of water sector resilience

Emerging regulatory framework



Water Act
2014

Water industry regulator
Ofwat statutory duty to
promote resilience
objective

The resilience objective is:

- (a) to secure the long-term resilience of water undertakers' supply systems and sewerage undertakers' sewerage systems as regards environmental pressures, population growth and changes in consumer behaviour, and
- (b) to secure that undertakers take steps for the purpose of enabling them to meet, in the long term, the need for the supply of water and the provision of sewerage services to consumers,

including by promoting–

- (i) appropriate long-term planning and investment by relevant undertakers, and
- (ii) the taking by them of a range of measures to manage water resources in sustainable ways, and to increase efficiency in the use of water and reduce demand for water so as to reduce pressure on water resources.

Resilience Task
& Finish Group

Water UK Task & Finish Group
Ofwat sponsored review

“Resilience is the ability to cope with, and recover from, disruption, and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future”.



“It is unclear as to whether the form of economic regulation encourages legitimate resilience investments to be made”

Emerging regulatory framework



ensure that companies assess **resilience** of their **systems and infrastructure** against the **full range of potential hazards** and threats and take proportionate steps to improve resilience where required

Where **residual risks** remain to long-term resilience, we expect companies to describe these **transparently** ...



... include a **robust, objective, comprehensive and quantitative** assessment of the **principal risks** they see to the resilience and delivery of the services. .. **publish** resilience assessments for greater **transparency**

Will consider extent to which they're supported by **global best practice** ... and third-party assurance



- **Operational resilience**
- **Corporate resilience**
- **Financial resilience**

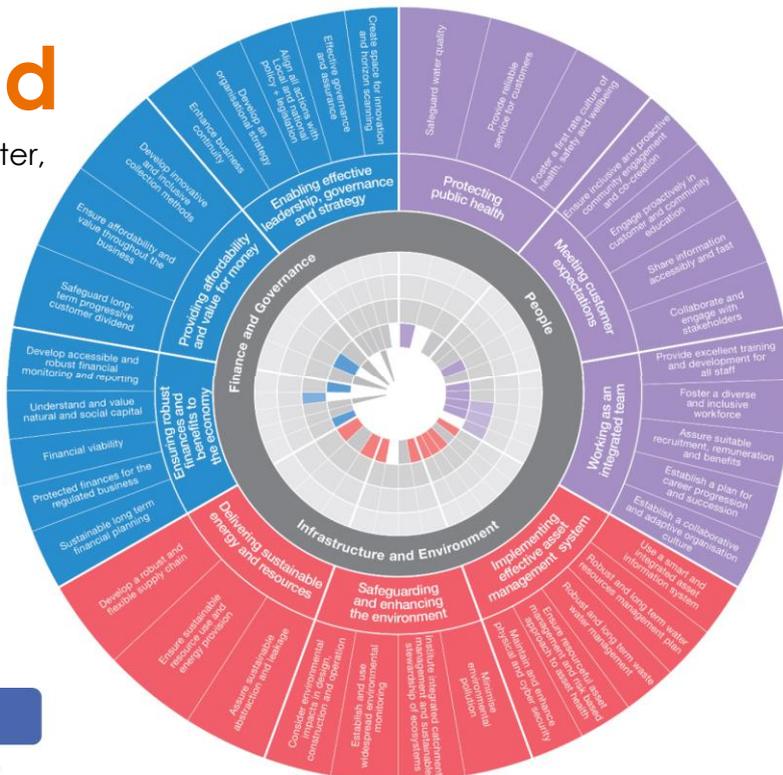
Systems Based Approach

It will be vital for companies to have a better understanding of the interrelationships and interdependencies across the systems underpinning their service delivery.

How the industry responded

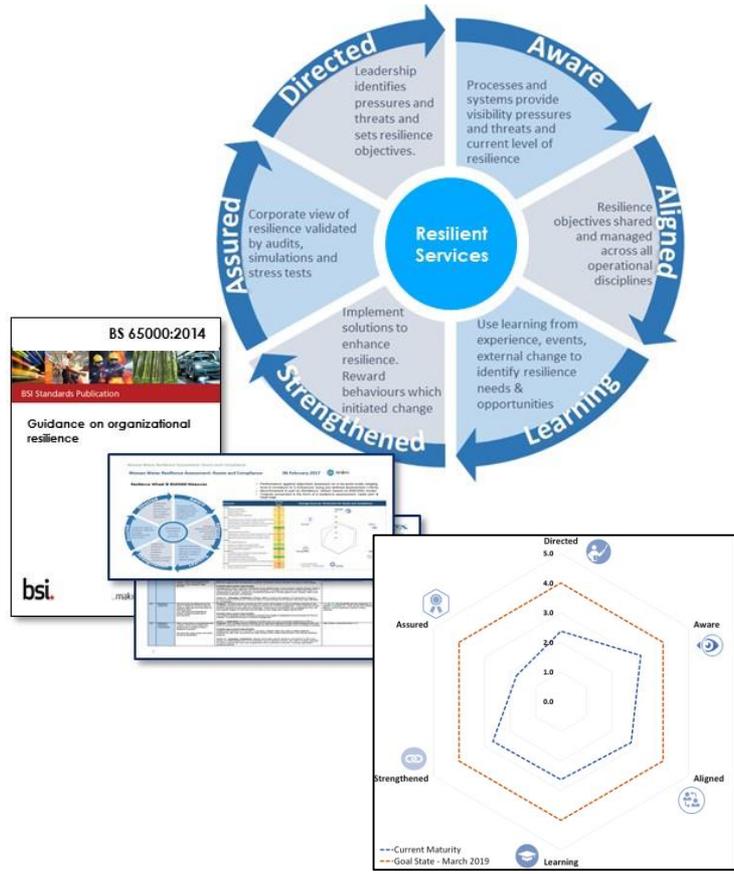
Dwr Cymru Welsh Water, "PR19 Operational Resilience", Sep 2018

1. High level strategic frameworks and policies
2. Organisational maturity assessments
3. Asset system resilience assessments
4. Development of resilience metrics and scorecards



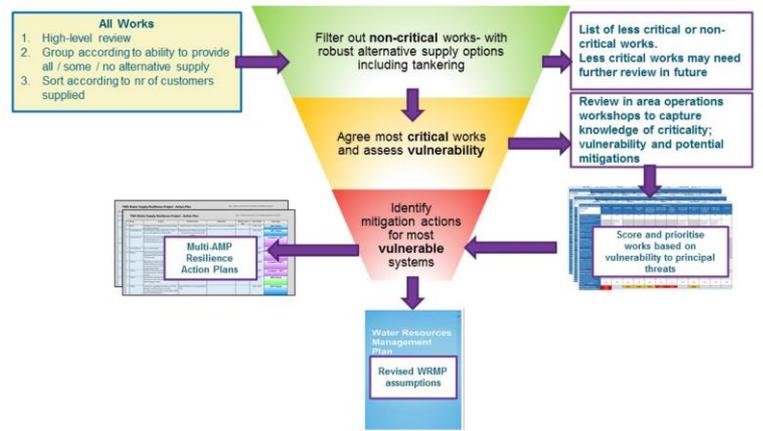
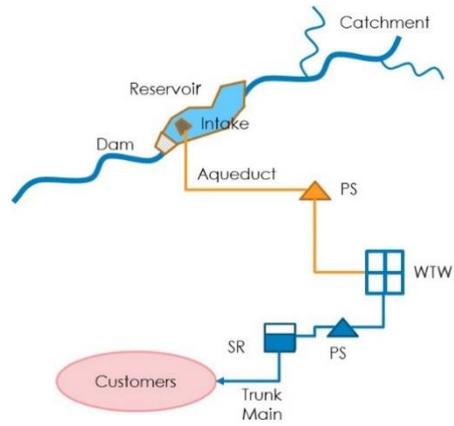
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Risk = C (consequence) x V (vulnerability) x T (threat likelihood)

Resilience = R (risk) x 4Rs (control factor)



United Utilities, "Measuring Resilience in the Water Industry", June 2017

Risk Boundaries per Hazard High: 50,000 Mid: 10,000 Low: 0	Risk Boundaries per System High: 300,000 Mid: 50,000 Low: 0	Assumptions Data not available = max score Hazard not relevant = 0	Total Company Score 416,100	No. of Properties 1,000,000	Normalised Score 0.416
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System Name	Flood	Critical Asset Failure	Infiltration	Raw Water Loss	Malicious Damage	Telemetry Failure	Total System	Risk Category	Confidence
WTW 1	2,400	6,341	7,540	3,759	1,133	2,113	21,173	Low	91%
WTW 2	5,846	1,446	Data not available	3,943	1,481	2,151	78,036	Moderate	71%
WTW 3	139	260	Data not available	3,187	0	3,187	97,186	Moderate	73%
WTW 4	13,033	2,385	5,145	14,307	7,894	0	42,744	Low	87%
WTW 5	0	81,431	18,179	Hazard not relevant	0	0	99,630	Moderate	90%
WTW 6	0	Hazard not relevant	1,893	0	180	0	4,185	Low	90%
WTW 7	6,439	12,106	7,377	Data not available	0	Hazard not relevant	49,203	Low	82%
WTW 8	600	6,364	Data not available	Hazard not relevant	0	Hazard not relevant	23,963	Low	82%

Site Name and Capacity (Ml/d)	Anytown	50 Ml/d	Equivalent Properties Supplied / Average Output	111,550	47.7 Ml/d average output	Typical Availability average % of max capacity which is actually deployable	93%	Slightly Low	Resilience risk score at Anytown relative to total risk (for all 17 sites reviewed)
Disruption from 'Principal Threats' how many would cause significant disruption if outage > survival time	1 out of 10 considered	62 % of customers	Properties at Risk / Deficit Equivalent nr of props without alternative supply / shortfall in supply	41,000	17.7 Ml/d deficit	System Redundancy (% of customers which can be supplied from elsewhere)	63%	Appreciable Shortfall	
"Survival" Time time supplies can be maintained using storage and rezoning (hrs)	36	Marginal	Estimated likelihood of outage exceeding "Survival" time (during next 10 years)	Very High	> 90 %	Customer minutes lost impact (per hour if outage duration exceeds "Survival" time by > 3hrs)	1.2	Serious Concern	
Reliability Unplanned shutdowns / year and quartile for production hrs lost	32.5 shutdowns / yr	Lower Quartile	Safe Restart Is site able to run to waste to allow safe restart	Yes	Overall Resilience Risk Ranking (within the 17 sites reviewed)	7th Highest Resilience Risk			

How the industry responded - insights



No overarching resilience framework or defined standards



Latent vulnerabilities to internal threats e.g. single points of failure



Erosion of headroom and redundancy 'Response and Recovery' dominant



Lack of visibility of operational 'near misses'



Limited engagement with third parties



Limited / static view of operational resilience

Absence of major service disruption is not evidence of resilience

The regulatory response

Ofwat's initial response to companies plans – April 2019

X Must do better - see me!

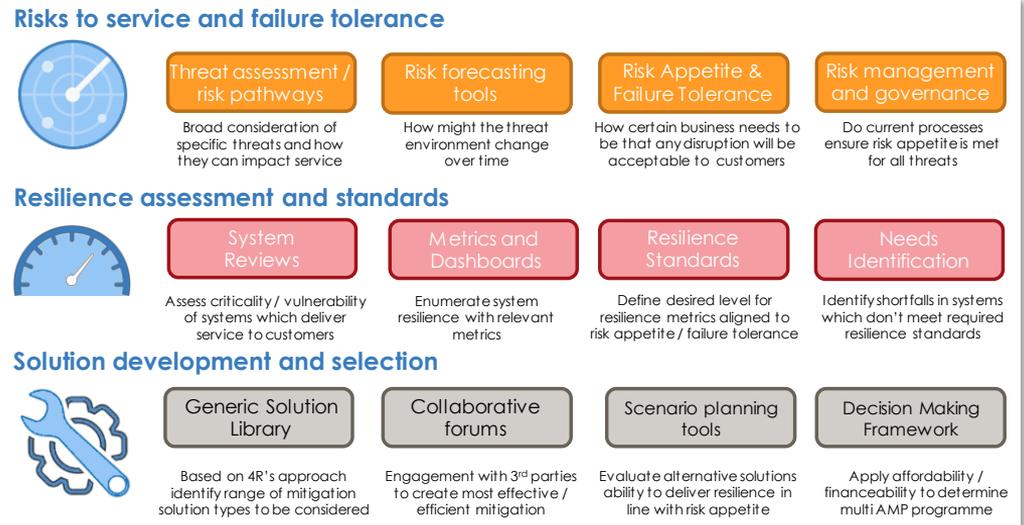
IAP Test Results	United Utilities	Severn Trent	South West	Anglian	Dŵr Cymru	Northumbrian	Wessex	Yorkshire	Southern	Thames
Securing long-term resilience	B	C	B	C	C	C	C	C	D	D

Ofwat challenge – by August 2019 submit an action plan to develop ...

...a **systems based** approach to resilience and ensure that the company can demonstrate in the future an **integrated resilience framework** that underpins the company's **operations and future plans** showing a **line of sight** between **risk** to resilience, planned **mitigations**, package of **outcomes** and corporate **governance**.

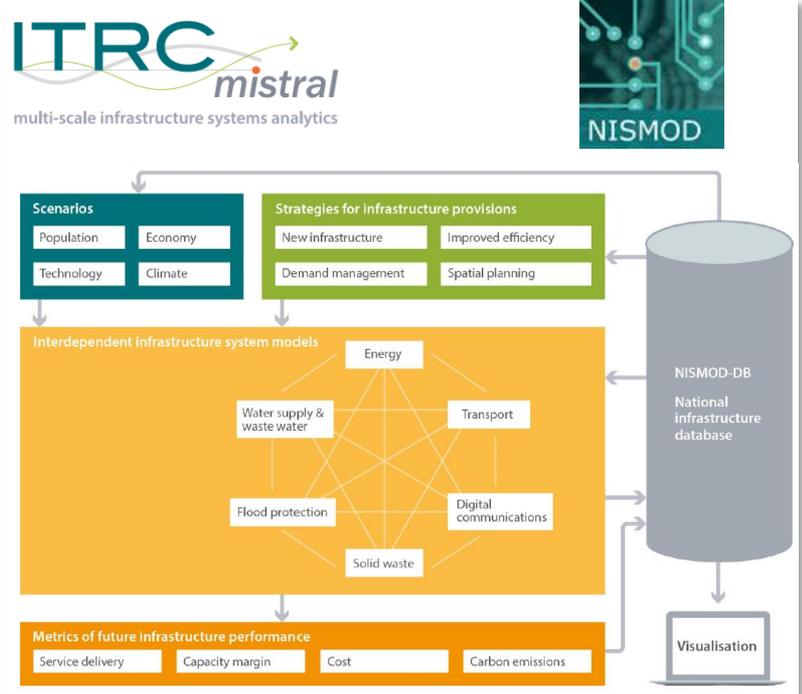
What more could the industry do?

Common Resilience Management Framework



Decision-making in complex policy areas needs innovation in associated methodologies and tools

Complex System-of-Systems Modelling

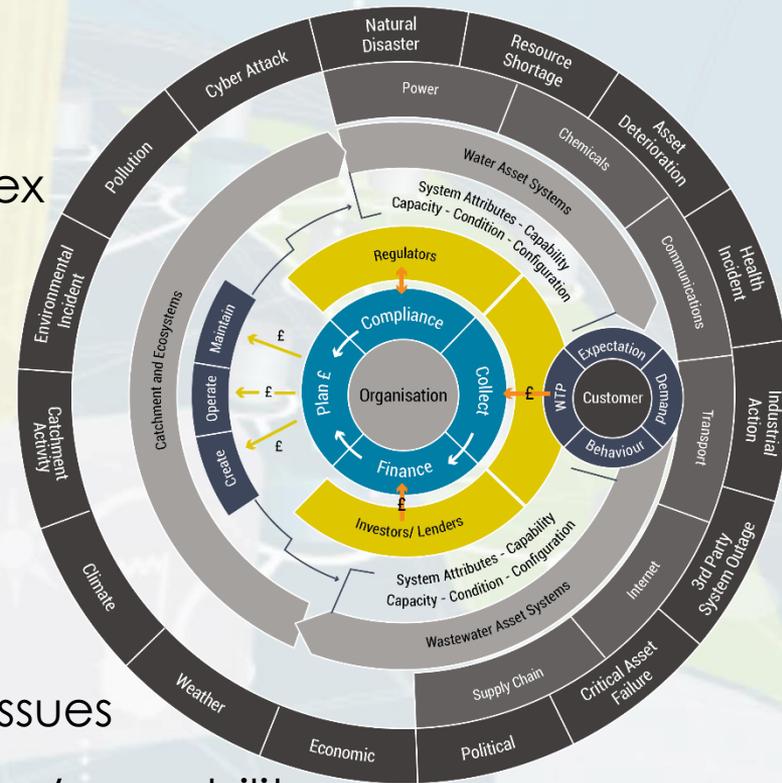


"Strategic analysis of the future of national infrastructure"; Civil Engineering; 7 July 2016; Hall et al



Conclusions

- Water and wastewater systems are complex
- Dynamic and evolving threat environment
- Many latent vulnerabilities
- Digital future - complexity will increase
- Better scenario planning tools are needed
- Tools alone won't address the challenge
- Need the right business processes to elicit issues
- Need resilience standards to drive capacity / capability
- Address the risks we can't anticipate



As we get smarter we need to be wiser to the challenge



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