# Yorkshire Water Flood Resilience Planning

## implementing the service risk framework to increase asset resilience

by Paul Conroy & James Webber

In order to implement the 2008 Ofwat Service Risk Framework (SRF) for assessing flood risk to assets, Yorkshire Water Services (YWS) commissioned a project to provide a process to support delivery of AMP5 resilience planning targets and to inform the PR14 business plan of future investment requirements to achieve asset resilience to the standard of 1 in 200 year fluvial flood event. YWS appointed CH2M HILL to deliver the project, commencing in 2011 and is due for completion in the autumn 2013.

*Severe flooding example 1 - Courtesy of CH2M HILL*

### What were the outputs?

The project has delivered a planning methodology that will support delivery of an iterative resilience planning process and a comprehensive resilience assessment of Yorkshire Water's vulnerable assets.

The project has produced a detailed process, developed from the Ofwat SRF (2008), which supports asset resilience investment planning. The process has developed and trialed a series of resilience planning tools which support investment planning, identification of potentially vulnerable assets and detailed resilience assessments.

Specifically, the outputs have been a resilience planning tool and reporting process, a screening process for a large asset base, individual site resilience assessments for over 170 assets, intervention option analysis for vulnerable sites and a technical approach, designed to be submitted as part of justifying asset investment to Ofwat.

The following table summarises outputs from the screening process and detailed analysis:

| Asset type | Total number screened | Number subject to detailed analysis |
|---|---|---|
| SPS | 1,816 | 86 |
| WPS | 523 | 10 |
| RPS | 44 | 11 |
| STW | 623 | 42 |
| WTW | 60 | 8 |
| STF | 63 | 14 |
| **Totals** | **3,129** | **171** |

*Table 1: Asset types and numbers*

### Project need

YWS recognises that flooding is one of a number of hazards that may compromise the resilience of the asset infrastructure. Flooding is one of the priorities because of the severe service disruption that has occurred in recent years to extreme rainfall events.


Severe flooding example 2 - Courtesy of CH2M HILL.


Severe flooding example 3 - Courtesy of CH2M HILL

This project was a development and implementation of the Ofwat 2008 SRF, currently recognised as industry best practice for assessing flood resilience. Undertaking this work is a key component of the business planning process, and is required to facilitate an understanding of the risks to assets and potential disruption of service during a low probability, high magnitude event. This understanding is then used in order to inform and evidence the investment required in order to minimise these risks.

### Objectives and benefits

The objectives of this project were:

- Develop process and supporting documentation to support delivery of a good practice, risk based and outcomes focused on resilience planning and management.
- Undertake a flood hazard screening process to identify and create a risk based prioritisation of assets potentially vulnerable to flooding.
- Produce detailed assessment of sites ranked highly in the prioritisation process and iteratively refine priorities based on findings to identify sites where intervention is required.
- Scope and cost intervention options to generate a list of schemes to be taken forward into AMP6.
- Implement the '4 Rs' of resilience planning (as laid out within the Cabinet Office document, *Keeping the Country Running – 2011*. See Figure 1 below).

The expected benefits of implementing this resilience planning process were:

- A forward-looking and consistent risk-based process to improve understanding of assets and support better prioritisation and investment decisions.
- Identification of investment needs and risk-based prioritisation of implementation.
- Establish an iterative resilience assessment process.
- Identification of a broad range of intervention options to increase asset resilience, based on the '4 Rs'.

### Project approach

This project has been broadly split into two phases of work:

- Phase 1: A large scale study to trial, develop and apply the 2008 Ofwat SRF.
- Phase 2: This approach was subsequently rolled-out for all of the Yorkshire Water treatment and pumping assets.

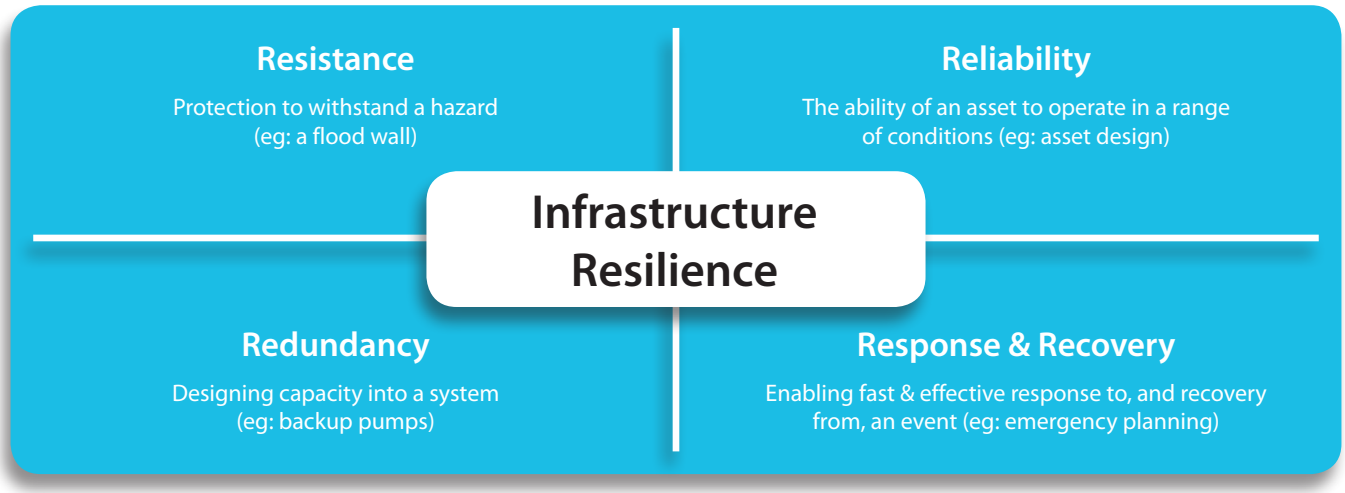
The approach was based on the methodology tested and developed within the Phase 1 pilot study and has been informed by Ofwat's SRF and more recent guidance for flood resilience planning in the water industry *(UKWIR RG06 Resilience: Making a business case 2013)*. This methodology is divided into three distinct stages, which are designed to facilitate the development of an investment strategy, informed and shaped by risk analysis and supported by a comprehensive, auditable evidence base.

### Stage 1: Risk screening

The purpose of this stage was to conduct an initial high level risk screening, based on the best readily available data, and develop this into a risk-based asset ranking. This was then refined through stakeholder and operations staff engagement during workshop based validation and a shortlist of vulnerable assets is generated.

### Stage 2: Risk analysis

This consisted of a detailed risk analysis for those assets and risks given a high priority at Stage 1. This involved a detailed topographic survey at each site, identifying critical levels of assets and defences, and capturing anecdotal evidence from experienced operational staff. A comprehensive hazard analysis using best available modelled data was then undertaken, and consideration



given to climate change and uncertainty in order to develop a quantification of site resilience. Sites were subsequently ranked by resilience in order to identify those which require investment.

### Stage 3: Risk management

The risk management stage involved identifying cost beneficial interventions, including both operational and capital solutions. The approach was underpinned by the four box model for resilience planning as set out in the 2011 Cabinet Office document '*Keeping the Country Running*' (Figure 1). Multiple solutions were developed and a cost benefit analysis (CBA) was carried out in order to identify the optimum solution at each asset to increase resilience.

### Project outcomes

There were several key outcomes from this approach:

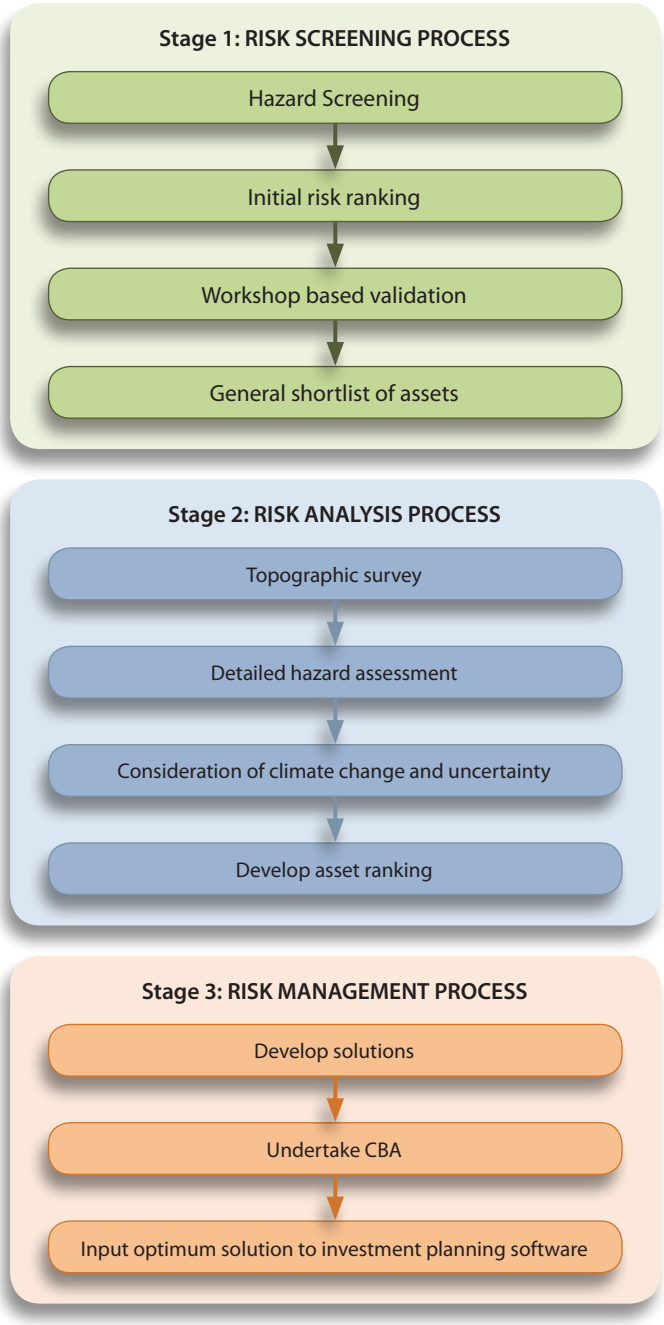
- Successfully trialed and demonstrated a methodology for identifying resilience investment requirements for a large asset base.
- Developed an adaptable and dynamic iterative process for utilising a combination of best available data to produce a risk-based asset prioritisation, strongly evidenced by utilising a range of data sources.
- Produced, refined and successfully applied a number of resilience assessment tools to quantify resilience at assets.
- Identified vulnerable sites where investment was required, and scoped a series of cost beneficial solutions to increase resilience for these assets.
- Created a strong evidence base with which to inform, shape and justify a comprehensive investment case.

### Lessons learnt

The approach developed represents current best practice for resilience planning within the UK water industry and this forms the basis for the PR14 investment plan for flood resilience. The area of resilience planning is very dynamic and it is important to remain informed and promote innovative methodologies and solutions to solve identified problems and manage future risk.

Several key considerations should be taken forward into future iterations of this project:

- Further develop relationships and solutions by working with other stakeholders.
- Continue ongoing dialogue and review of climate change implications.
- Link flood resilience at local level to system level risks and issues. Specifically, identify the relationship between the resilience of an individual asset and the performance of the service system within which it is located (e.g. if WPS is damaged, can water be pumped to customers via another part of the network).
- Expand the method by considering the spatial effect of flood events in assessing system connectivity and redundancy (i.e. no good relying on another WPS if it too has been damaged by the same event).
- Move existing methodology further towards an 'all hazards' resilience planning approach, including working to develop the understanding of pluvial and combined pluvial/fluvial hazards.
- Continue to monitor and develop current methodology and apply process iteratively to asset base.
- Encourage innovative solutions to encompass more of a mix of the '4 Rs' of resilience planning.
- When investing for other drivers, resilience should be built into solution where it is cost beneficial to do so; it is recommended that a system for keeping track of this is implemented in order to facilitate a pragmatic and efficient installation of resilience measures where a hazard has been identified.




### What will this mean for companies like Yorkshire Water Services?

The implications resulting from this work include:

- Identified need to implement an iterative risk-based asset investment prioritisation process, which is aimed at achieving asset resilience to low frequency, high magnitude events and can be broadened to move towards an 'all hazards' approach.
- This work provides an effective methodology to facilitate understanding of asset resilience and the potential impacts of flooding to levels of service.
- There is a need to continue to develop good working relationships with stakeholders.
- Best available data needs to be drawn together to evidence pragmatic, outcome based intervention options, based on the '4 Rs' of resilience; *Resistance, Reliability, Redundancy* and *Response & Recovery.*

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