Drainage and wastewater management plan

Appendix D – DWMP resilience report

Wessex Water

30 June 2022 (draft)

Wessex Water
YTL GROUP

Wessex Water notes:

The following document has been produced by Mott Macdonald and has been edited by Wessex Water for security reasons. Many plans and appendices have been redacted.

MOTT MACDONALD

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Wessex Area

Drainage and Wastewater Management Plan (DWMP)

Resilience Assessment

June 2022

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Drainage and Wastewater Management Plan (DWMP)

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P01	17/12/21	YM	SYE	SYE	Draft to Wessex Water for review
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Executive summary

Mott MacDonald has been commissioned by Wessex Water Services Ltd. to conduct resilience assessments at 125 Wessex Water wastewater sites, including wastewater recycling centre (WRC) sites and sewage pumping station (SPS) sites.

The objective of this project was to:

1. undertake high level flood risk assessments for sites specified by Wessex Water, considering flood risk up to the 1 in 1000-year event and climate change impacts.

   The flood risk assessments can be summarised as follows:

Risk Category	Number of Sites assessed
Fluvial	74
Tidal	30
Surface Water	21

   The flood risk assessments will inform recommendations for a flood mitigation strategy and accompanying cost estimates to inform the DWMP and the PR24 Business Plan.

2. Undertake a review of Wessex Water's existing procedures and processes to manage risks regarding:

- power resilience;
- business resilience and response recovery;
- communication resilience;

3. Integrate the findings from a Wessex Water led review of the Environment Agency's Coastal Erosion and Shoreline Management Plans to identify and assess risks to assets on the shoreline.
   a. The coastal erosion assessment identified 2 No. sites at risk from coastal erosion in the next 10 years, 5 No. sites at risk from coastal erosion in the next 10-20 years, and 40 No. of sites at risk in 20+ years' time.

The resilience assessment identified 248 sites that require investment. The extrapolated results estimated that it will cost £55m to increase the resilience of the identified sites.

1 Scope of Work

Mott MacDonald has been commissioned by Wessex Water Services Ltd. to undertake a high-level evaluation of wider resilience issues as part of the DWMP Framework. The high-level assessment was required across all catchments irrespective of whether the more detailed baseline risk and vulnereability assessment was required.

The minimum criteria for the resilience assessment included:

- fluvial and / or coastal flooding of WwTW and major pumping stations
- power outage
- outages to remote communications
- response and recovery plans

In addition to the minimum criteria outlined in the DWMP, Wessex water included consideration of surface water flood risk and coastal erosion risk as part of their assessment.

In order to undertake the high-level assessment, Wessex Water had a large number of assets that needed to be assessed for flood risk from rivers, sea, and surface water. For assets identified as being at flood risk, flood resilience solutions and estimates of the costs for implementing them, where required. Collecting and analysing information for every asset would normally be a hugely resource-intensive, time-consuming, and expensive task. Mott MacDonald worked collaboratively with Wessex Water to develop and implement lean processes and digital innovations, including a suite of digital tools, such as a bespoke app for site survey and data collection, and a high level of automation toolkits for data screening and processing, option assessment and solution development.

A total of 125 asset sites were chosen as a representative sample of the asset base, which were surveyed using tablets with a bespoke data collection app to identify the location of critical elements and threshold values, including incoming power sources, control panels, chemical storage areas, communications equipment, and access roads.

Bespoke apps, innovative digital tools and robust processes were developed and used to streamline data collection, data processing, analysis, and assessment of flood risks from multiple sources. Each asset was assessed for different potential flood event levels / return periods and scored according to the level of risk for each critical asset. A cost estimated options for making the at-risk assets more resilient.

An additional 47 asset sites were added to the programme as part of Wessex Water's review of Shoreline Management Plans. These assets had been surveyed by Wessex Water professionals, but the outputs needed to be mapped and reported in the same manner as Mott MacDonald led 125 sites.

The high-level flood risk assessments for sites specified by Wessex Water, considering flood risk up to the 1 in 1000-year event and climate change impacts. The flood risk assessments will inform recommendations for a flood mitigation strategy and accompanying cost estimates to inform the PR24 Business Plan.

The work undertaken as part of the flood resilience assessment included:

- Phase 1: Flood Risk Mobilisation Stage – October 2020 to July 2021
  - Data collection and review
  - Gap analysis
  - Workshops with Wessex Water project team and site operators
  - Site visits to identify critical equipment at 49No. sites
  - Definition of way forward for sites where modelled data is available; Total 125 No. sites determined to be in scope for assessment.

- Phase 2: Flood Risk Assessment and Mitigation Strategy – July to December 2021
  - High level assessment of flooding at each of the 125 No. sites
  - Screening assessment based on modelled data available
  - Prepare Site Summary Sheets
  - Attend intermediate review meetings
  - Indicative site-specific flood risk assessments including:
    - Fluvial flood risk (1 in 100 year, 1 in 1000 year event, present day and climate change)
    - Tidal flood risk (1 in 200 year, 1 in 1000 year event, present day and climate change)
    - Surface water flood risk (1 in 30 year, 100 year and 1000 year event)
  - Assessment of site operation in time of flood
  - Recommendation for potential options to manage the flood risk for each site, with indicative cost
  - Preparation of Flood Risk Assessment Reports

- Additional elements that were also required as part of the assessment:
  - a summary of existing procedures and processes in place to manage resilience risks at the sites:
    - power resilience;
    - business resilience and response recovery;
    - communication resilience;
  - a summary of an assessment of coastal erosion risk according to Coastal Erosion and Shoreline Management Policies which had been undertaken by Wessex Water and appended to this report for completeness.

2 Summary of available data for resilience assessments

The table below summarises the data used in Phase 2 – Flood Risk Assessments.

Table 2-1: Data Used for this Assessment

Data Type	Source of Data	Comment
Site schematic	Wessex Water	Shows schematic operation of the site. Provided for 125No. sites in scope.
Critical Equipment Drawings	Wessex Water	Marked up plans from Wessex Water site operators indicating the location of critical equipment
LIDAR data	Environment Agency	Publicly available data on ground level information, available in 1 and 2m grid resolution. Downloaded to a radius of 1km from each site location where available.
Ordnance Survey 1:10,000 Mapping Tiles	Wessex Water	For background mapping
Flood Zone Mapping	Environment Agency	Publicly available
Data collected during site visits	Wessex Water	Location of critical equipment Photographs of critical equipment and surrounding site Historical flooding information
Risk of flooding from surface water	Environment Agency	https://flood-warning-information.service.gov.uk/long-term-flood-risk/
Hydraulic Flood Models	Environment Agency	Flood models or data outputs from flood models were available from the Environment Agency for 125 sites out of the 270 that were original proposed. Note: many of the model results files provided were outside the scope of this project, and therefore site specific assumptions and interpolations of data have been documented on a case-by-case basis.
Coastal Flood Boundary Data	Environment Agency	Used to inform flood risk for sites at risk of tidal flooding, in conjunction with appropriate hydraulic flood models where applicable.

Source: Mott MacDonald

3 Site Visits for the resilience assessments

3.1 Phase 1 Site Visits

Site visits were conducted by Mott MacDonald at 49 No. sites between 22 June and 9 July 2021. These sites were selected by Wessex Water. The purpose of the site visits was to:

- Accompany the site operator identifying critical equipment at the site
- Record location and photographs of critical equipment
- Measure height above ground (or threshold flood level) of critical equipment
- Collect other flood related information such as previous flooding history from the site operator
- Confirm recent or future works at the site

The resulting critical asset dataset produced during the site visits is summarised in each individual Site Summary Sheet.

A bespoke innovative App was specifically developed and used for data collection during site visits to improve efficiency.

3.2 Phase 2 Site Visits

Additional site visits were conducted by Wessex Water to inform marking up schematics which were fed back to Mott MacDonald to populate the critical asset database for the full complement of 125 No. sites in scope. These visits were completed throughout July and August 2021.

The hardcopy asset mark ups were subsequently converted to digital format and integrated into a coherent database and GIS system.

4 Risk Assessment for the resilience assessments

4.1 Flood Risk Assessment

4.1.1 Executive Summary

Wessex Water required a review of their assets to assess the likelihood of investment being required to provide resilience from fluvial, tidal, and surface water flood risk. The Flood Risk Assessment section of this report summarises the approach adopted, work completed to date, and flood risk identified for all the specified sites based on available EA data sets.

The initial criteria (September 2020) for 'critical assets' was all Water Recycling Centres (WRCs) and all Sewage Pumping Stations (SPSs) within the 1 in 1000 flood extents serving more than 2,000 population equivalent - but this created too many assets (circa 700 No.) to assess in the time and budget available for this first iteration of DWMP.

A more focused approach, assessing sites where detailed flood models are available from the EA, was proposed and agreed as the preferred way forward. 124 No. sites have been assessed in detail on this basis (125 No. originally identified, 1 was descoped due to poor data availability), and the resulting feasibility stage solutions are to be scaled up as indicative for remaining at risk sites. Note: If the primary mechanism was found to be surface water flooding only, a mitigation option was not proposed or costed.

4.1.2 Summary of Flood Risk Assessment Approach

The flood risk assessment conducted at each site assessed the source of flooding from all potential sources for the following return periods where modelled data was available:

- Fluvial flood risk (1 in 100 year, 1 in 1000-year event, present day and climate change)
- Tidal flood risk (1 in 200 year, 1 in 1000-year event, present day and climate change)
- Surface water flood risk (1 in 30-year, 100 year and 1000-year event)

A more detailed description of the method applied is provided on page 3 of the Site Specific Summary Sheets for the 124 No. sites.

4.1.3 Assumptions and Limitations

The results from these high-level flood risk assessments are an indicative estimate only and are suitable to support the flood mitigation cost estimate for the PR24 Business Plan. The flood levels obtained in this assessment are not suitable for detailed design.

4.1.4 Health and Safety Implications of Flooding (electric shocks)

This assessment assumes that if assets (particularly electrical) are flooded they have been suitably designed such that they do not pose a health and safety hazard to persons on site i.e., assets are earthed / fail safe. This report focuses on the resilience of getting assets back online/keeping assets operational during a flood, not the consequential health and safety risks of assets flooding if they have not been designed or maintained safely.

4.1.5 Flooding due to surface water and ground water sources

A Wessex Water Mott MacDonald project team meeting held on 26 May 2021 agreed the following scope relating to flooding from surface water and ground water sources:

- **Surface Water Flooding:** Sites identified as being at risk due to surface water only should be kept in scope as flood risk is evident. Surface water flooding associated with a watercourses should be included, however, surface run off from a hill side should only be noted.
- **Groundwater flooding:** Sites identified as being at risk due to high groundwater are not to be included if flow is causing ingress to sewerage networks. If sites are at risk due to overland flow of ground water adjacent to a flood defence, or where fluvial or coastal flooding clearly affect the asset it should be noted.

  Lead local flood authorities (the unitary or County Council) are responsible for managing the risk of flooding from groundwater. They set out how they plan to do this in their local flood risk management strategies.

  Groundwater risk is a bespoke planning objective as part of the DWMP and has been assessed separately. Groundwater investigations determine weak points of the sewerage network where “watertightness” is compromised facilitating groundwater infiltration which impacts on asset performance.

4.1.6 Third Party Reliance

The following assumptions relating to third party assets/responsibilities were made:

- **Power:** Sites that are reliant on the flood resilience of third-party e.g., power substations for the site should be flagged where apparent on the site, but no works will be proposed to these third-party assets as these are to be made resilient by their owners as part of the National Infrastructure Resilience Plan.
- **Maintenance of screens/culverts:** Sites that are reliant on the maintenance of third-party assets e.g., culverts/bridges blocking up leading to Wessex Water sites flooding should be flagged where apparent, but no works should be proposed. Assume the assets continue to be maintained by others. Include site feedback if history has proven that maintenance is not done.
- **Existing flood defences:** Sites that are reliant on defences that appear to be working should be assessed based on the elevation of the defence provided assuming that the defence is well maintained/suitable for the purpose.
- **Breach risk:** this assessment is to assume that existing defences do not fail.

4.1.7 Site Specific Issues

The following assumptions relating to site specific issues and storage capacity resilience:

- **Site hydraulics issues:** Sites that are flooded due to manholes upstream being inundated should be flagged where apparent to be investigated by the appropriate team, they are not to be included as part of this project’s scope e.g., Ashton Avenue flooding should cross reference to the Rescue Project teamwork underway at the time of writing this report.
- **Hydraulic locking of overflows** is not to be considered within this assessment, i.e., if a gravity overflow cannot operate, the asset flooding caused by fluvial backwater effect or coastal tidal hydraulic locking is not considered. It should be noted where tidal locking is causing issues on sites, which may be exacerbated by climate change.
- **Standard Fuel Storage provision** is assumed to be sufficient to supply fuel for 72 hours for fixed generators as per Wessex Water operation standards.

- **Chemicals / Fuels** are assumed to be double bunded with 110% capacity, it is assumed that these are maintained, and the bunded areas are kept dry as per Wessex Water operation standards.

4.1.8 Flood Risk Assessment Method

The method for conducting the flood risk assessment at each site was a specifically tailored approach based on the data available for each site. A detailed summary of the method used is provided on page 3 of the Site Specific Summary Sheets.

The table below provides a high-level summary of the different categories of sites, and the methods used for each category.

Table 4-1: Summary of Flood Risk Assessment Method

Primary Source of Flood Risk	Preferred Assessment Method	No of Sites with this primary mechanism of flooding
Fluvial	Use existing modelling results (provided by Wessex Water or Environment Agency), extrapolate to account for climate change or other updates such as hydrology. Use results to estimate flood levels on site.	74
Tidal	2018 Coastal Flood Boundary data provided by the Environment Agency used to estimate extreme flood levels. Where required, an additional allowance for wave and tidal overtopping was applied as appropriate. Existing modelling results were also reviewed and used where available.	30
Surface water	Use existing Environment Agency Surface Water Flood Risk Mapping to estimate surface water flood risk. https://flood-warning-information.service.gov.uk/long-term-flood-risk/. Depth ranges have been quoted where there is a surface water flood risk, due to uncertainties associated with this assessment method.	21

Source: Mott MacDonald

4.1.9 Assessment of the impact of climate change

The base year for the flood risk assessment is set at 2025. The climate change horizon as defined by Wessex Water Ltd is 25 years from the base year (i.e., to 2050).

The impacts of climate change have been estimated using the latest Environment Agency guidelines, as provided in the National Planning Policy Framework Guidance (last updated 22 July 2020 using the UK Climate Change 2018 projections).

An assessment of the impact of climate change was made using conservative assumptions for climate change allowances that were assessed on a site-by-site basis (for surface water and fluvial risk sites). For sites with influence from the sea and/or estuaries upper bound Coastal Flood Boundary data has been used (higher central estimates).

4.1.10 Freeboard allowance

A Wessex Water Mott MacDonald project team meeting held on 4 August 2021 agreed that a 300mm allowance for freeboard be adopted for all resilience measures under consideration.

4.2 Coastal Erosion and Shoreline Management Plans

4.2.1 Executive Summary

Wessex Water undertook a review of their coastal assets to assess the likelihood of investment being required to provide resilience from coastal erosion risk. The Coastal Erosion and Shoreline Management Plans section of this report summarises the approach adopted, and work completed to date to identify and assess the risks for coastal assets at a high-level.

Wessex Water conducted a screening assessment to identify assets requiring a risk assessment along the coastline using insights from the Environment Agency (EA) Shoreline Management Plans (SMPs). 47 No. sites were identified, and site visits were carried out. Preliminary assessments of need were derived for each site, assessed to be at risk in the short, medium, and long-term.

4.2.2 Summary of Coastal Erosion and Shoreline Management Plans Approach

Wessex Water screened to identify assets requiring a risk assessment along the coastline using insights from the Environment Agency (EA) Shoreline Management Plans (SMPs). A methodology to determine which assets to include in scope was devised as follows:

- A buffer was drawn inland of the mean high water spring level boundary, the wastewater assets that fell within this region were selected. These included sewer lengths, outfalls, WRCs and SPSs.
- An initial 10m buffer was applied and assessed. It was identified that this buffer was too small as it did not capture assets known to be at risk from operational team feedback.
- Subsequently, a buffer of 20m was applied which aligned with the assets known to be at risk and thus was deemed acceptable.
- Based on the 20m buffer, 47No. Wessex Water sites were identified to be potentially “at risk” and required assessment.

Wessex Water staff developed a site checklist to inform site visits to each asset site and standardise reporting the susceptibility of each site to coastal erosion risk. This information has been reproduced as bespoke Site Specific Summary Sheets.

4.2.3 Assumptions and Limitations

The results from these high-level coastal erosion risk assessments are an indicative estimate only and are suitable to support the coastal erosion mitigation cost estimate for the PR24 Business Plan. Further details would need to be ascertained to inform design.

The following should be noted:

- Capital maintenance inspections are undertaken on a 3-yearly cycle. The focus of this risk assessment was to identify assets at high level risk of coastal erosion, not assets that require capital maintenance. For example, a rusty outfall that looks likely to fail soon was noted and reported to the relevant team for action, it was not required to be addressed as part of the proposed investment for coastal erosion resilience.
- Options are proposed for assets deemed to be at risk in the next 10 to 20 years only. Assets that are at risk in 20+ years’ time are not to be progressed at this time.
- No geological data has been reviewed; this assessment was based on EA SMP data and site visits only.

4.2.4 Reference documents informing this high-level assessment

Table 4-3 lists the key EA Shoreline Management Plan data sources used to inform the coastal erosion risk assessment section of this report.

Table 4-2: Key reference documents on the topic of coastal erosion risk

Reference title	Author
EA Shoreline management plans (SMPs) Policy Paper	EA
National Coastal Erosion Risk Mapping (NCERM) - National (2018 - 2021)	EA
Shoreline Management Plan Mapping	EA
SMP2 for the Severn Estuary	Severn Estuary Coastal Group
SMP2 North Devon and Somerset Shoreline Management Plan	South Devon and Dorset Coastal Authorities Group (SDADCAG)
SMP2 South Devon and Dorset Shoreline Management Plan	South Devon and Dorset Coastal Authorities Group (SDADCAG)
SMP2 Cornwall and Isles of Scilly Shoreline Management Plan	Cornwall Council

Shoreline Management Plan Policies

Naturally, a coastline changes over time due to erosion from wave action and weathering, sediment movement due to tides, currents and storms, and local geology. The four standard policies used to describe SMPs are summarised:

- **Advance the Line:** The coastline is built seawards of the current defence to reclaim land along the coast.
- **Hold the Line (HTL):** The current alignment of the defence is maintained with no movement seawards or landwards.
- **Managed Realignment (MR):** This allows the shoreline to move seawards or landwards naturally with management to control or limit movement.
- **No Active Intervention (NAI): Do Nothing** – No investment in coastal defences or operations.

4.2.5 Third Party Reliance

There is a risk that other stakeholders may have planned investment to resolve issues identified in this risk assessment. The data reviewed to date is limited to the EA SMP. Wessex Water has an awareness of other stakeholders' investment plans through awareness of projects on the Environment Agency's Medium Term Plan for potential partnership working.

4.2.6 Risk Assessment Method

Wessex Water checked the SMP that addressed each of the 47No. assets for assessment. The policies assumed for each asset aligned with the SMP for the asset.

Where an asset fell between or overlapped an adjacent SMP boundary the worst-case risk category was assigned. For example, the asset known as "Sandbanks No. 2" is located between a Hold the Line (HTL) and a Managed Retreat (MR) SMP classification, MR was assigned as a conservative approach. The findings of the site visit identified

- 2 sites at risk from coastal erosion in the next 10 years
- 5 sites at risk in the next 10-20 years
- 40 sites at risk in more than 20 years time.

4.3 Power Resilience

4.3.1 Executive Summary

Wessex Water is required to assess the resilience of their WRCs and major SPSs in the event of mains power failure. The Power Resilience section of this report summarises the Wessex Water Power Resilience approach, and work completed to date to identify issues and options to improve power resilience.

Wessex Water has assessed the existing power supplies (single, dual, generator, mobile generator hook-up) to ascertain if they are adequate based on supply provisions available to the sites, mains power, single / dual mains supply, generators and fuel storage, site criticality, and hierarchy of need. Options to improve power resilience are proposed where issues are identified.

4.3.2 Wessex Water reference documents and data provided

A summary of power resilience for each site is documented in the Site Specific Summary Sheets based on information gathered from site visits and operational team mark-ups of site plans. It was noted that Wessex Water employ an in-house generator maintenance team to keep generators in good condition, ready to deploy when required.

Table 4-3 lists the key Wessex Water reference documents provided for review to form the basis of this section of the report.

Table 4-3: Key Wessex Water reference documents on the topic of power resilience

Reference title	Date
BCIRP01 – Business Continuity Incident Response Plan – Widespread less of power response plan	June 2021
DS331 – Risk based decision framework for assessing need for standby power	October 2018
AMPOL003 – Risk Management Policy	September 2020
Sewage Pumping Station power failure strategy. (Outage Assessment)	May 2020
Water Recycling Centre power failure strategy. Also known as the Outage Assessment	TBC
Aggreko contingency plan project and report Provision of generators to specific sites – to be bound into this report to help inform availability assessment/ criticality of sites/procurement etc.	2022

A data set was provided as part of the Wessex Water Sewage Pumping Station power failure strategy report May 2020, refer to Table 4-4. This was filtered to identify pumping stations in scope for this assessment to provide an indication of typical back up power required Vs coverage available.

Table 4-4: Sewage PS power failure strategy data identifying generators provided at sites

Region	Total No. of Sites in scope	Permit requires back up power plan	Fixed generator on site	% with fixed generator
North	9	3	2	22%
South	18	11	9	50%
West	41	24	21	51%
Total	68	38	32	47%

Outside the scope of this report, a matrix of acceptability is being developed by Wessex Water to review current design standards and agree thresholds for sites to have back-up power supplies. Advances in technology such as 30-minute battery packs may be considered more valuable for smaller sites where outages are usually of very short duration.

4.3.3 BCIRP01 – Business Continuity Incident Response Plan – Widespread less of power response plan

This document sets out the response plan for an incident when local or widespread loss of primary power supplies on Wessex Water sites has occurred. The operations department have been identified as the business area that would be most affected, and they will be responsible for the initial management of this type of incident.

Operations response and recovery during a loss of power incident will be focused to:

- Identify work priorities and work planning adjustments;
- Manage generator requirements including location of mobile generators and fuel;
- Manage fixed and mobile generators;
- Maintain inter-departmental liaison for resource assistance i.e., with fleet services;
- Ensure the appropriate technical support is in place.

The following triggers are deemed relevant to assess and escalate the response:

- Notification is received from a power company of a Category 2 or 3 incident where predicted restoration times are more than 24 hours in one or more areas;
- Notification is received from a power company of a Category 2 or 3 incident where predicted restoration times are unable to be given in one of more areas;
- Widespread mains power failure affecting multiple water supply and/or wastewater sites not supported by fixed standby generators and 50% of mobile generators have been deployed.

Table 4-5 provides definitions of the outage categories to assess their relative impacts.

Table 4-5: Distribution Network Operator (DNO) categories of outage and definitions

Category of outage	Definition
Category 1 (medium events)	Lightening events - when a distributor experiences at least 8 times the normal amount of faults in 1 day – supplies will be restored within 24 hours.
	Non-lightening events - when a distributor experiences 8 or more but fewer than 13 times the normal amount of faults in 1 day – supplies will be restored within 24 hours.
Category 2 (large events)	Non-lightening events - when a distributor experiences at least 13 times the normal amount of faults in 1 day – supplies will be restored within 48 hours.
Category 3 (very large events)	Any severe weather events where at least 35% of exposed customers are affected – supplies will be restored within a period as calculated using a formula based on the number of customers affected as set out in the Regulations.

Escalation procedures, activation, and power incident management team activities are defined. To manage the impact on the organisation the Emergency Planning Tactical Group (EPTG) will be activated.

Roles and responsibilities are defined for the management team at Mitigation and Response/Recovery stages including liaison with third parties, allocation of generators, hire and management of standby generators, procurement and management of generator fuel and re-filling timetable.

4.3.4 DS331 – Risk based decision framework for assessing need for standby power

This document sets out the factors to be considered, and information required when assessing the impact of local or widespread loss of primary power supplies on Wessex Water sites and the

need for standby power supplies to maintain resilient services to customers and protect the environment.

Risk Assessment Framework Steps:

1. Understand the severity of the impact of power loss at a site and the time for the failure to impact. Unless a requirement for a standby power is specifically required by the discharge permit or operating permit, the severity and impact of the loss of primary power supply should be considered with respect to:

- Safety of employees or the public, e.g., loss of safety critical protective equipment.
- Unacceptable environmental performance, e.g., flooding, pollution, or compliance.
- Loss of operational capability, e.g., loss of production, unacceptable customer service.

2. Establish the extent of process plant or equipment requiring continued operation to sustain safe and resilient services, together with an understanding of the time to impact.

A systematic review of the site's function and its interdependencies with connected sites, customers, and the environment, together with a review of the design, capacity and reliability of the existing power supply infrastructure will help inform decisions on whether new or augmented standby power suppliers are required, or whether alternative risk mitigation options are acceptable.

A flowchart of the process is appended to DS331 – Risk based decision framework for assessing need for standby power, reproduced in this report as Figure 4-1 for ease of reference.

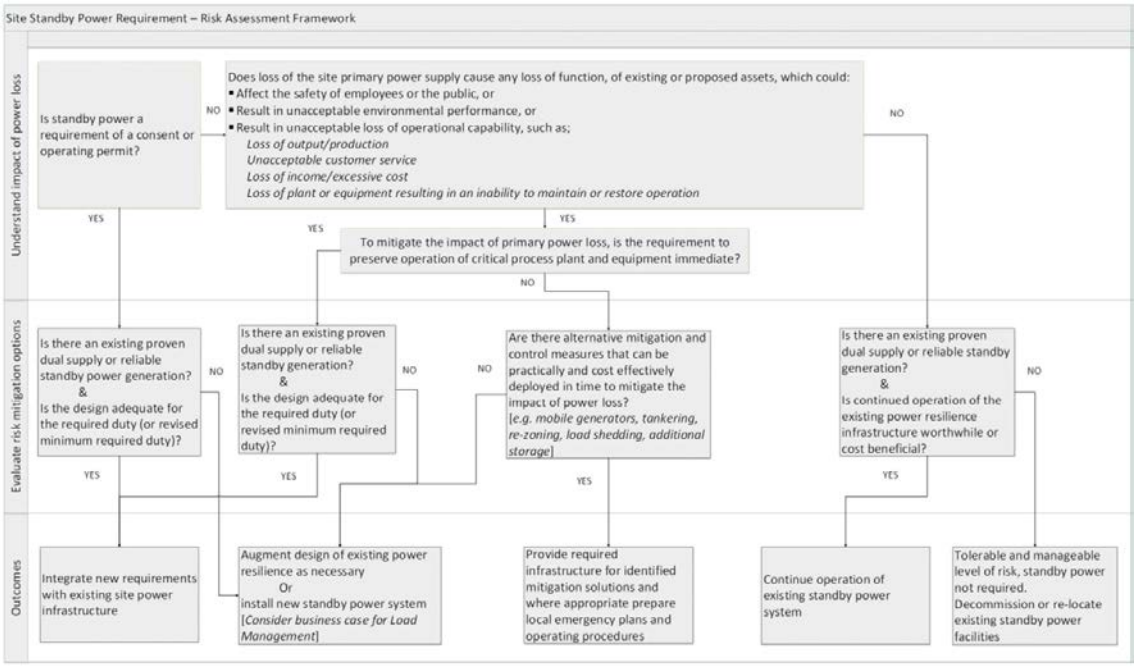


Figure 4-1: Site Standby Power Requirement – Risk Assessment Framework

4.3.5 AMPOL003 – Risk Management Policy

This document sets out Wessex Water's policy and objectives to manage risk. Risk is defined as any event that can impede Wessex Water's ability to achieve its objectives. The company's aims are:

- To provide our customers and communities with excellent service and value for money.
- To protect and improve the environment.
- To provide our people with the opportunity for personal development and a satisfying career.
- To provide our investors with a fair return for their investment.

The document defines the roles and responsibilities of risk management held by the Wessex Water Service Board, the Audit and Risk Committee, the Risk Management Group (RMG), the Risk and Investment Team (within the Finance and Regulation directorate), Management, and Employees and Contractors.

Risk Management Systems are in place to be complied with and internal audits are carried out to monitor adherence and continually improve the system as required.

4.3.6 Sewage Pumping Station power failure strategy

This document is a status report on the provision of generators where deemed required for Wessex Water Pumping Stations. It is also known as the "Outage Assessment" completed in May 2020 with the following key observations:

- There are 2,131 Sewage Pumping Stations, 560 of these have consents to discharge.
- Permit clauses obligating power failure mitigation be provided impact 486 of the sites.
- Historically most outages are under 30 minutes in duration (seconds to 29 minutes) with potentially minimal likelihood of pollution under DWF conditions.
- Power outage data for a 6-year period found failures greater than 0.5hrs were most likely to last between 0.5hrs and 2hrs and a very small number lasted more than 6hrs.

The document sets out a mitigation approach to be implemented based on the maximum power requirements of the pumping stations, the logistics of removing sewage via tanker if required, and their proximity to a mobile generator dispatch fleet.

4.4 Communication Resilience

4.4.1 Executive Summary

The Communication Resilience section of this report summarises the resilience measures Wessex Water have in place and work ongoing to improve their telemetry and control communication channels to meet with the requirements of modernising technology.

Most sites are controlled by local telemetry and thus are vulnerable in the event of a communication systems failure. Some sites have intelligent real time control systems to optimise system performance. A review of critical sites, using company expert and local knowledge, is being undertaken to ensure resilient i.e., fail safe shall be the default position to maintain levels of service.

Wessex Water are also considering further investment to improve the resilience of communication with their sites, including using roaming SIM cards and upgrading legacy systems.

4.4.2 Wessex Water reference documents provided

Wessex Water have recognised the risks associated with the cessation of Public Switched Telephone Network (PSTN) in 2025 to senior levels through the Executive Leadership Team.

- Driven by the need for greater broadband coverage and the upgrade of legacy systems, the overhaul of UK hardwired and cellular communications presents the water industry with additional resilience challenges.
- OpenReach will be ceasing operation of their analogue, copper line, public switched telephone network (PSTN) from 2025. Communications providers have also proposed the end (sunset) of 2G and 3G services. The 3G sunset is already underway and it has been indicated that the 2G sunset will occur around 2028.
- Wessex Water utilise 2G/3G cellular devices at c6000 sites such as leakage meters, storm overflow monitors, many sewage pumping stations (transferred in 2016) and consumption monitoring.

4.4.3 Status quo – business as usual

The current resilience position, i.e., if sites lose communication links, is that sites will continue to operate on a stand-alone basis, data is stored and uploaded once communication has been re-established.

Wessex Water have completed a project to replace BT Private Wires on circa 250 sites. The next phase is to replace PSTN lines. Proposals include replacement with DSL Link & Cellular / Satellite / Radio. Critical sites will receive dual communication pathways. This project is due to be completed by October 2024.

4.4.4 Wessex Water are currently updating their DS300 guidance on the requirements for communication on sites Future risks to communication resilience

The PSTN and 2G/3G switch-off represents a significant reduction in the resilience of communications networks and presents new risks such as:

- Wessex Water's ability to meet regulatory requirements due to the potential for monitoring and reporting data loss. Note, at present in the event of communication loss data is stored on the site and transmitted when communication is restored. The only time data may be permanently lost is if the onsite battery backup fails, which is very unlikely.
- Downtime and communications gaps resulting in assets working outside of normal parameters without the operational teams being alerted e.g. storm overflow discharges
- Increased cyber threat vulnerability requiring significant investment in resilience to meet regulations.

- The all-IP transition will have a significant financial impact

4.4.5 Planned mitigation to reduce communication resilience risk

WaterUK, with the support of Defra, will continue to lobby Ofcom and the Department for Culture, Media, and Sport on the following key areas:

- alongside the energy industry, a call for more stringent resilience expectations on communications providers, including under Ofcom regulations.
- access to the reasonable worst-case scenario for a communications failure and a guaranteed survival time in event of a power failure.
- a call for an extension of the 2G switch off from 2028 to 2040.
- a call for options to enable an extension of the PSTN switch off.

4.4.6 Progress to date to reduce communication resilience risk

PSTN lines – circa 2,800 telemetry sites impacted

- a programme manager and project team are leading on the PSTN transformation and are in the process of appointing a contractor to support delivery.
- a PSTN working group is in place to account for any business risks and raise any concerns.
- Wessex Water are working with suppliers to identify an alternative device to replace the existing analogue telemetry equipment:
  - an interim budget has been authorised to procure this equipment and to ensure there are no delays, an order is being placed
  - the new equipment is not a straightforward swap and will require configuration and testing – to ensure migration is seamless and business risk is not increased.

To test the migration of devices we have chosen seven sites to run as a trial to test the capability of transferring existing signals, alarms, and monitors from the old device to the new model. This trial is currently underway, programmed for completion ahead of the 2025 deadline.

Cellular 2G/3G communications – circa 6,000 devices reliant on 2G impacted

- Wessex Water are moving to Narrow Band Internet of Things (NBIT) batteries to make use of Low Powered Wide Area Networks (LPWAN). This migration is a step change to give greater longevity of batteries and aid moving away from the 2G network that is being discontinued.

4.5 Business Resilience and Response/Recovery

4.5.1 Executive Summary

The Business Resilience and Response/Recovery section of this report summarises the business resilience measures Wessex Water have in place and work completed to improve their response/recovery. Wessex Water champion industry leading recovery practices including C-Mex, levels of service, and targets to attend site. Each regional team has developed bespoke Local Emergency Plans (LEPs), operational mitigation plans and other planned emergency controls and measures.

4.5.2 Wessex Water reference documents provided

Table 4-6 lists the key Wessex Water reference documents provided for review in this section of the report. These documents are reviewed periodically and updated, for example, BCA03 is currently under review as SunGuard is no longer the proposed recovery centre.

Table 4-6: Key Wessex Water reference documents on the topic of business resilience

Wessex Water Resilience Action Plan (RAP)
BCA03 – Business continuity arrangement for loss of the operations centre
BCA07 – Business continuity arrangement for loss of a critical operational site Advice and guidance to departments on the activities they must undertake to ensure continuity at certain sites
BCA08 – Business continuity arrangement for loss of a critical non-operational site
BCA10 – Business continuity arrangement for adverse weather
BCPOL01 – Management of Business Resilience in Wessex Water
GENG002 – Procedure for Emergency Documents
GENG010 – Emergency Planning Guidance – Integrated Emergency Management Guidance
GENG012 – Emergency Planning Guidance – Management of an Incident in Operations
Consequence Management Plans (CMP) – brief explanations incl.:
CMP001 – CMP: Emergency Relocation of the Control Room (Claverton Down)
CMP014 – CMP: Significant Broad Area Power Supply Failures
CMP018 – CMP: Major Oil / Fuel Pollution Incident Response

The Wessex Water intranet “Source” has a dedicated section for Business Resilience with hyperlinks to further guidance where required, including all the references listed in Table 4-6. Six of the ten business continuity arrangements are exercised in a three yearly plan as presented in Table 4-7. A further suite of exercises is carried out as agreed by the Emergency Planning Implementation Group (EPIG).

Table 4-7: Exercise plan to test business continuity arrangements

Year	Business Continuity arrangement test	BCA ref no.
2018 - 2019	Loss of staff, pandemic influenza	BCA05
	Loss of information systems	BCA06
2019 - 2020	Widespread loss of power	BCA01
	Significant constraint on fuel supplies	BCA04
2020 - 2021	Adverse weather	BCA10
	Loss of a critical supplier	BCA02
Exercised when appropriate	Business continuity arrangement for loss of a critical operational site	BCA07
	Consequence management plans and local emergency plans	
Annually at recovery centre	Business continuity arrangement for loss of the operations centre	BCA03

4.5.3 Wessex Water Resilience Action Plan (RAP)

This document is Wessex Water's annual update of their Action Plan for the continuing development and implementation of a systems-based approach to resilience that underpins operations and future planning. It summarises progress to date, next steps, and case studies to demonstrate how the integrated resilience framework will develop further in the coming years.

The document was first developed in response to Ofwat's initial assessment of the PR19 Business Plan requiring Wessex Water to show "a line of sight between risks to resilience, planned mitigations, package of outcomes, and corporate governance". Figure 4-2 extracted from the RAP illustrates this approach in a flowchart.

The key elements of the framework are incorporated into corporate governance:

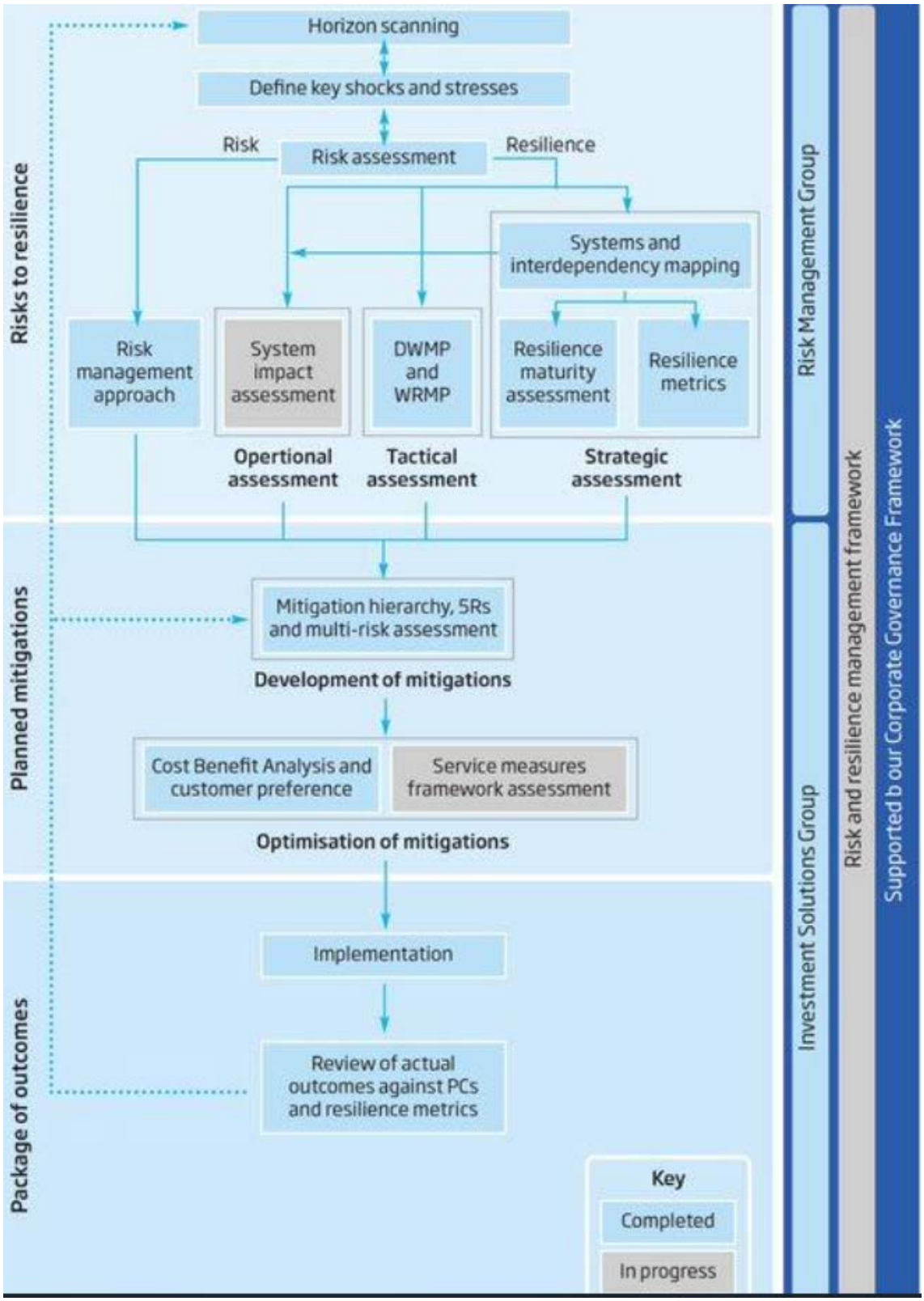
1. Risk to resilience at strategic, tactical, and operational level
2. Planned mitigations to tolerate risk, improve operations, collaborate to address root causes, optimise existing assets, and/or build smarter solutions.
3. Package of outcomes delivering mitigation investments and evaluating their success to continuously learn and improve.

This Drainage Wastewater Management Plan (DWMP) report is one of the seven actions identified in the RAP informing investment to improve the resilience of assets. Actions in progress are summarised in Table 4-8.

Table 4-8: Actions in Progress extracted from the Resilience Action Plan

Actions in progress		
1	Developing system impact assessment approach	We have developed our approach to defining critical sites
2	Drainage and Wastewater Management Plan delivery	We are making good progress in developing our Drainage and Wastewater Management Plans (DWMP) and are on track to draft our DWMP by June 2022.
3	Strategic water resource planning	We are now undertaking work to revise our supply demand balance for the next WRMP and other plans.
4	Extending our resilience assessment to all our systems	We have completed our initial resilience maturity assessments. We have a defined approach for determining what a level Resilience Maturity would look like for each shock and stress. We will then determine requirement for gap analysis to raise needs.
5	Develop resilience metrics	We have defined out initial resilience metrics and will be undertaking a period of review before implementing in to BAU.
6	Develop a capitals-based Service Measure Framework	We have completed the process of compiling our service measures (financial, natural, social, human). We are currently plan to start integrating the use of the service measure framework into intervention selection/decision making.
7	Develop risk and resilience management framework	We have committed to a service provider for a digital GRC tool and are developing the system to roll out across the business. As part of this framework we are working to embed this framework into our BAU activities.

Figure 4-2: Wessex Water's system-based resilience framework



4.5.4 BCA03 – Business continuity arrangement for loss of the operations centre

This document provides advice and guidance for an emergency when critical activities may not be able to be carried out at the operations centre in Bath. In these circumstances it will be necessary to relocate activities to an alternative office site in Bristol. A business continuity incident will be triggered if:

- The building is destroyed or rendered unusable through either a natural disaster or another type of incident such as fire, a white powder incident, or a bomb threat.
- The building remains intact and usable but becomes inaccessible due to an incident in the wider area that prevents access to the site.
- The building is intact and usable but a catastrophic failure of IT and/or communications systems means critical activities cannot be carried out in the operations centre.

Escalation procedures, activation, and IT business continuity plans are defined. Details of the alternative office spaces to be used are provided.

Roles and responsibilities are clearly defined for each team at Mitigation and Response/Recovery stages.

4.5.5 BCA07 – Business continuity arrangement for loss of a critical operational site

This document defines the trigger that constitutes a business continuity incident as “an incident that affects the core function of one or more critical operational sites and is likely to last more than 24 hours.”

Wessex Water operational teams have identified critical sites by assessing the vulnerability of all sites. Where a site is identified as critical, a risk assessment must take place. This determines the sites impact on the continuation of business-critical activities.

Where a risk is identified as site specific, the decision will be made to produce a Local Emergency Plan (LEP). If there is evidence that the risk is generic to other sites, an existing Consequence Management Plan (CMP) may be referred to or a new CMP will be produced.

Escalation procedures, activation, management, and notification plans in the event of an incident are defined. Details of managing and escalating an incident are given in the integrated emergency management guidance. (GENG010).

Roles and responsibilities are clearly defined for each team at Mitigation and Response/Recovery stages.

4.5.6 BCA08 – Business continuity arrangement for loss of a critical non-operational site

This document provides advice and guidance to departments on the activities they must undertake to be prepared for loss of a critical non-operational site and the company’s reaction to such an incident. It also states how a response to loss of a critical non-operational site incident will be activated. A site is deemed critical if:

- over 50 staff members are based at the office location.
- there is no alternative location in Wessex Water.
- if business critical activities are conducted on site.

Local Emergency Plans (LEPs) and Business Continuity Plans (BCPs) are referenced for the ten offices in scope. The relevant LEP will be triggered if an incident affects one of the identified sites, and is likely to last more than 24 hours, including:

- The building is destroyed or rendered unusable through either a natural disaster or another type of incident such as fire, a white powder incident, or a bomb threat.
- The building remains intact and usable but becomes inaccessible due to an incident in the wider area that prevents access to the site.
- The building is intact and usable but a catastrophic failure of IS and/or communications systems means critical activities cannot be carried out at the site/office.

A business continuity incident for loss of a critical non-operational site will be triggered when:

- Two or more LEPs for loss of a critical non-operational site are invoked.
- The management capabilities of the operational incident management team are exceeded.

Escalation procedures, activation and LEPs are referenced for further guidance. Roles and responsibilities are clearly defined for each team at Mitigation and Response/Recovery stages.

4.5.7 BCA10 – Business continuity arrangement for adverse weather

This document provides advice and guidance to departments on the activities they should undertake to be prepared for adverse weather and the company's reaction to such an incident. It also states how a response to an adverse weather business continuity event will be activated.

The document advises that plans should be made for the impact of government assessed weather risks categorised as:

- storms and gales with damaging wind speeds and possible lightning
- low (sub-zero) temperatures and heavy snow for prolonged periods
- heatwaves with high temperatures lasting several weeks, harming peoples' health

Drought is addressed separately under the Wessex Water drought plan. The Wessex Water approach to mitigation is summarised as follows:

- Emergency Planning Tactical Group (EPTG) who meet quarterly to implement measures to ensure that the company can cope with extremes of weather and raise employee awareness
- The provision of weather warnings from the National Severe Weather Warning Service (NSWWS) cascaded down from regional level to specific staff for awareness and action
- Provision of 4x4 vehicles where required
- Salt and grit supplies including back up stock
- Homeworking arrangements in line with departmental business continuity plans

The document also sets out the roles and responsibilities for each responsible person for the response to adverse weather and recovery post event.

4.5.8 BCPOL01 – Management of Business Resilience in Wessex Water

This document references the Wessex Water "Business Plan to 2020" to define resilient services as "assets and working practices that continue to deliver high quality, reliable services in the face of unusual events (such as flooding or droughts)".

The policy applies to all Wessex Water group activities and subsidiary companies. It sets out the business resilience policy and objectives to ensure preparation for emergencies and restore business as usual in the quickest possible time. This is interpreted to be the capacity of the business to deliver its key services which are aligned to statutory, regulatory, and contractual duties, performance indicators, and the interests of key stakeholders.
Key services are defined as:

- The provision of clean wholesome drinking water.
- Protecting public health; and
- The provision of sewerage and sewage treatment services all without a detrimental impact on the environment.

The policy explains the use of Business Continuity Management (BCM) by Wessex Water to analyse, design, implement, and validate processes to provide service resilience. Emergency Planning aims where possible to prevent incidents occurring, and when they do occur, good planning should reduce, control, or mitigate the effects of the emergency. It is a systematic and ongoing process which should evolve as lessons are learnt and circumstances change.

The Group Engineering and Safety Director is the nominated Director for business resilience and is responsible to the Wessex Water Board for development, monitoring, implementation, compliance, and reporting. The Director will act as the “champion” for business resilience and facilitate its implementation across the company.

The policy also sets out the roles and responsibilities of the Risk Management Group (RMG), the Emergency Planning Implementation Group (EPIG), the Head of Group Health, Safety and Security, Directors, Group Heads, the Business Resilience Advisor, the Security and Business Resilience co-ordinator, Department Heads, Managers, and all Employees.

The policy explains the use of:

- Business Continuity Incident Response Plans (BCIRP)
- Business Continuity Plan (BCP)
- Consequence Management Plans (CMP) and Local Emergency Plan (LEP)
- Debrief guidance and procedures (GENG008)
- Business continuity coordinators guidance (GENG009)
- Integrated emergency management plan (GENG010)
- Communication process (GENG013)
- Business resilience competency requirements (GENG014)

4.5.9 GENG002 – Procedure for Emergency Documents

This document details the procedure to be followed in the production and management of regional Consequence Management Plans (CMP); site-specific Local Emergency Plans (LEP); and associated general support documents (GEN).

The minimum requirements for a CMP or LEP are as follows:

- Purpose and scope
- Associated documents
- Trigger conditions
- Notification
- Plan detail to ensure the recovery process is successful
- Stand-down
- Review and document control
- Appendices

Existing plans should be reviewed annually as per the manager’s programme on Wessex Water’s intranet.

4.5.10 GENG010 – Emergency Planning Guidance – Integrated Emergency Management Guidance

This document provides guidance for integrated emergency management with three levels of response:

- Operational – “hands on” work required to resolve the situation
- Tactical – ensures actions taken at operational level are managed
- Strategic – the wider context to determine long term and wider impacts and risks.

The document outlines the core requirements for managing an incident:

1. Appoint an incident manager and appropriate incident management team
2. Notify the business and other stakeholders
3. Use a suitable location to manage an incident
4. Consider local management at ground level
5. Adopt good practice incident management including record keeping.

Further emergency planning guidance is recommended and referenced including the pre-populated Consequence Management Plans (CMP), Local Emergency Plans (LEP) and Business Continuity Plans (BCP).

The appendices of the guide detail the triggers defined for each level of response, task cards for each key lead, notification record template, incident room set up form, “incident in progress” notice for the door, summary of CMPs and BCPs, standing agenda for incident team meetings, personal incident log template, incident attendance register, and a handover form template.

4.5.11 GENG012 – Emergency Planning Guidance – Management of an Incident in Operations

This document provides guidance for the management of an incident in operations intended for use in conjunction with:

- GENG010 Integrated Emergency Management Manual
- GENG016 Emergency planning arrangements
- Relevant departmental procedures and instructions.

It includes a flowchart to show how an incident is escalated, replicated in Figure 4-3 and a cascade diagram to illustrate how information about the incident should reach various concerned parties in a controlled manner, replicated in Figure 4-4.

7.2.1 Incident escalation diagram

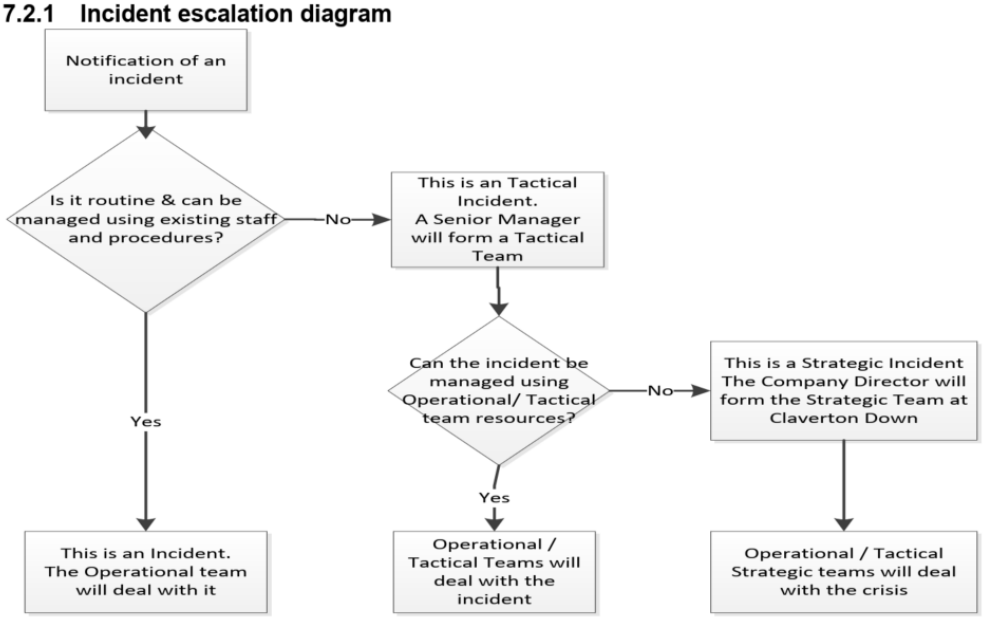


Figure 4-3: Incident escalation diagram extracted from GENG012

8.6 Information cascade tree

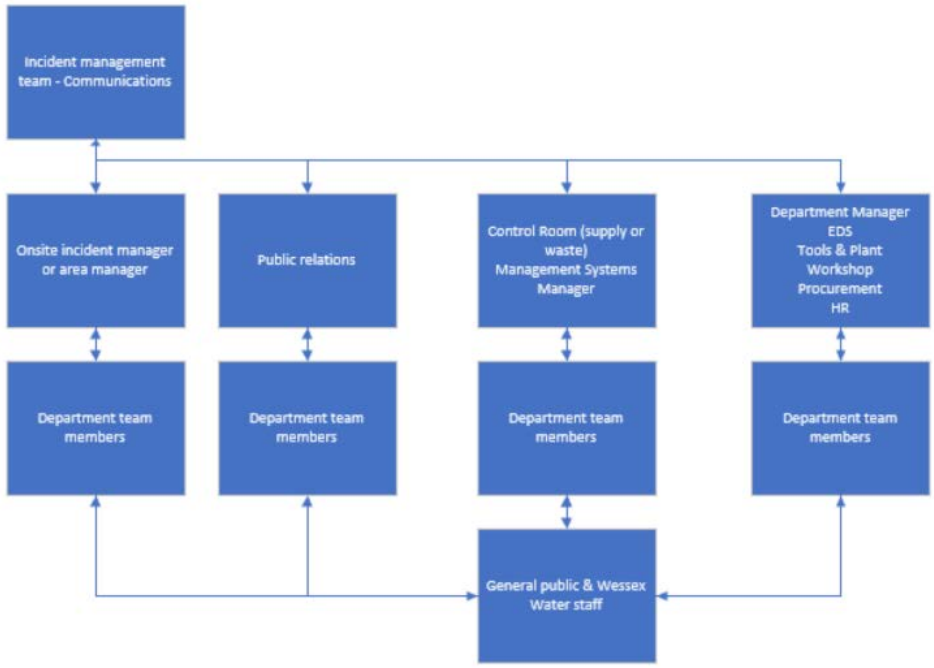


Figure 4-4: Information cascade tree extracted from GENG012

Appendix 1 of the document sets out the operations incident team roles and responsibilities. Appendix 2 is a checklist template for organising a letter/card drop to customers.

4.5.12 Consequence Management Plans (CMP) – brief explanations

GENG010 – Emergency Planning Guidance – Integrated Emergency Management Guidance Appendix F provides a summary of the Consequence Management Plans (CMPs) in place following the procedure set out in GENG002.

CMP001 – Emergency relocation of the ROC

Emergency Relocation of the Control Room (Claverton Down). This document details the plan to facilitate a rapid relocation of the Control Room to a pre-defined alternative location following the procedure set out in GENG002.

- Evacuation of the ROC
- Operations centre rendered unavailable for any reason
- Facilities within Operations centre rendered unavailable for any reason
- A significant communications failure of telemetry data to the ROC, provided that the information is available at the Bunker.

CMP002 – Pollution of a designated bathing beach or recreational water

- How Wessex Water may be made aware of a major compliance failure
- Possible causes of that failure
- Remedial action which must be taken.

CMP003 – Failure of a major pumping station or critical sewer

- The action necessary to deal with a major disruption to the pumping station/sewerage system
- who to notify
- what should be done when the situation has returned to normal.

CMP004 – Response to a chemical release into the sewerage system or treatment works

- Action to be taken once notification of the major release of a harmful material is received
- Who should be contacted
- What to do on cessation of the emergency.

CMP005 – Inundation of an STW or SPS by a major flood event

- Actions to be taken in the event of a major flooding incident severely affecting the normal performance of a sewage works or pumping station. This could also be induced by a severe blockage to an outfall causing the normal discharge to flood back into the sewage works
- Who should be contacted
- Actions to be taken when the situation has returned to normal.

CMP006 – Major failure of bulk storage tanks on an STW

- Actions to be taken in the event of a catastrophic or rapid release of material from a bulk storage tank
- Who should be contacted
- Actions to be taken when the situation has returned to normal.

CMP007 – Response to an animal disease outbreak affecting sludge disposal

- Actions to be taken in the event of a major animal disease outbreak affecting sludge disposal
- Who should be contacted
- Actions to be taken when the situation has returned to normal.

CMP009 – Supply customer bulk notification

The purpose of this procedure is to notify each customer who will be affected by a widespread water supply contamination or unplanned disruption to supply.

CMP010 Deployment of alternative water supplies

- Tanker deployment
- Pillow tank deployment
- Static tank deployment
- Mobile bowser deployment
- Bottled water

CMP011 Loss of supply

- Treatment failure
- Third part intervention
- Malicious acts
- Failed internal hygiene control
- Inadequate chemical control
- Transfer via bulk import

CMP014 – Significant broad area power failure

This plan ensures some key deliverables are maintained during an extended, broad based, power supply failure.

CMP015 – Inability to attend wastewater site due to external constraints

This plan aims to reduce or eliminate the consequences of the inability to attend a wastewater site caused by external constraints by adopting a risk-based approach and employing alternative treatments.

CMP016 Extraordinary failure of critical plant on an STW

- actions to be taken in response to a major failure of critical plant
- who should be contacted
- Action to be taken when the situation has returned to normal.

Other consequence management plans include:

- CMP017 – Loss of UV site or major reduction in capacity
- CMP018 – Major oil fuel pollution incident response
- CMP019 – Wet weather recovery plan
- CMP020 – Hinkley Point nuclear power station offsite emergency water supply response plan
- CMP021 – Loss of chlorine gas and or sodium hypochlorite
- CMP022 – Dry weather action plan
- CMP023 – Response to potable water ingress into gas mains
- CMP024 – Urban hub and distribution point information.

5 Proposed Flood Mitigation Measures and Cost Estimate

5.1 General Approach

Based on the flood levels derived, a flood defence mitigation measure or measures have been proposed at each site to protect the site assets from extreme events up to and including the 1 in 1000-year return period event, under climate change conditions to 2050.

In several instances, the estimated depth of flooding on site is so extreme that it would be difficult or extremely costly to defend the site to this standard of protection. In this instance, alternative measures have been proposed. Please see individual site summary sheets for more detail.

Given the high-level nature of this project and lack of site-specific data, the proposed mitigation options were filtered to a range of potential mitigation options that could be considered plausible for use to protect the sites. The cost of the most likely approach to be adopted has been derived based on available EA datasets described in this section of the report.

5.2 Derivation of Flood Defence Crest Level

As agreed with Wessex Water, the flood defence threshold level of the proposed mitigation measure was determined from using the 1 in 1000-year return period event under climate change conditions to 2050 (High Central), plus an additional 300mm freeboard allowance.

5.3 Choice of Flood Mitigation Measures

An assessment of existing flood risk was conducted at each site to determine the target level of defence required. A sequential approach was used to identify and develop suitable flood resilience measures, with the aim of minimising costs overall and impacts to third parties:

- Can the site be relocated away from flood risk?
- Can the existing equipment be raised above flood levels?
- Can the existing equipment and key apparatus be protected locally?
- If a flood defence is built to protect the site, can it be designed with a minimised footprint?

A tiered approach to determine a cost-effective solution was used to determine the preferred solution or combination of solutions with the following options:

A. Option A: Raise Equipment:

   Raise control panel / kiosk / other equipment

B. Option B: Seal Building / Kiosk:

   Waterproofing treatment to existing assets/buildings incl. flood doors, air bricks etc.

C. Option C: Wall / bund (localised) and

D. Option D: Wall / Bund (Site-wide)

   Wall or bund in defence height ranges (< 1.2m, 1.2 to 2.1m, 2.1 to 5.3m, > 5.3m)

E. Option E: Relocate equipment

   No sites fell into this category at this stage. Subsequent design stages may determine that this option is more cost effective as design details are developed.

5.4 Cost Estimate for Flood Defences

CIRIA C790 Guidance on the Code of Practice for Property Flood Resilience (2020) advises: *"Guidance costs for packages of PFR measures should be prepared and presented to the client. Resources such as guidance produced by the Environment Agency (2015) can help to identify these costs."*

The EA Cost estimation for household flood resistance and resilience measures – summary of evidence Report – SC080039/R11 (2015) and the Environment Agency Unit Cost Database (capital costs) Report – SC080039/R2 (2015) draws on key datasets including:

- Defra resilience grant documentation
- Defra report on flood resistance and resilience solutions
- Defra research report on flood resilience
- ABI report on flood resilience measures and cost

"For initial estimates it is suggested that a complete house solution consisting of door gates and air bricks to protect against flood levels up to 900 mm could cost in the region of £2,000 to £4,000. A more secure approach involving the former options with the addition of anti-flood valves and external wall treatments would be in the region of £10,000 to £14,000 (ABI 2009)."

On this basis a cost was developed for each of the flood mitigation options to be applied to individual critical assets on each site. This approach was agreed as appropriate for use for this stage of the assessment. A factor is to be applied to these estimates to allow for planning, consultancy fees and other services that would likely increase the overall capital cost estimate and inflation that has occurred in construction since the EA dataset was published in 2015.

Table 5-1: Costing approach for assets based on 2015 interpolated data

Opt	Measure	Basis	Explanation	Cost assumed
A	Raise Equipment	Per asset	To raise asset plinth to be higher in the flood plain, provide steps and handrail for access.	£15k
B	Seal Building / Kiosk	Per asset	Flood proof door installation/raising of control panels internally.	£10k
C	Wall / Bund (Localised)	Per linear metre		
D	Wall / Bund (Site-wide)	Per linear metre		
E	Relocate Equipment	Per asset	More costly than the above options, not in scope for this stage of the assessment.	£20k

Table 1.1 Environment Agency Unit Cost Database wall raising and wall construction mean costs per m length

Height band	Wall raising (£/m)	All wall types (£/m)
<1.2m	1,029	1,419
1.2–2.1m	2,177	2,905
2.1–5.3m	–	3,577
>5.3m	–	11,168
All heights	1,526	2,984

Note: If the primary mechanism was found to be surface water flooding only, a mitigation option was not proposed or costed.

5.5 Carbon Estimate for Flood Defences

R&D Technical Report FD2622/TR by the Joint DEFRA/EA Flood and Coastal Erosion Risk Management (FCERM) R&D Programme (2010) “Understanding the Impact of Flood and Coastal Erosion Risk Management on the Causes of Climate Change” investigates the effectiveness of FCERM measures versus the carbon impact of their implementation.

“Drawing together the findings of the research, the key themes that emerge are:

- *Current FCERM activities result in net emissions of GHGs but, in general, these emissions are lower than the counterfactual level of GHG emissions that would arise in the short-term in their absence as a result of flood and coastal erosion damages (i.e. the policy-off scenario and no active intervention);*
- *Compared to the net emissions from other sectors, the role of FCERM policies is relatively minor (current UK GHG emissions are in the region of 630 Mt CO2e per year), not withstanding unquantified emissions and data limitations.”*

The Report advises that increased use of the Construction Carbon Calculator should improve quantifying carbon footprints of designs from feasibility, through option selection, construction, and handover stages.

In 2022, the EA announced the rollout of a new carbon and cost tool for all EA construction projects to help meet its 2030 net zero ambitions. It is recommended that this tool (or similar) is accessed and utilised to inform the most carbon and cost-effective designs for flood mitigation proposals at design stage.

5.6 Anticipated Impact on Flood Risk to Third Parties due to Proposed Flood Defences

When permanent defences are proposed within a floodplain, it is possible that there are obstructions to flow and reduction of floodplain storage due to the proposed defences may have a significant or even detrimental impact on flood risk elsewhere.

It is not possible to quantify the potential impact to adjacent areas/third parties without detailed modelling. This should be investigated and assessed at the next phase of design. If impacts to third parties are expected, mitigation measures such as compensation flood storage may be necessary to satisfy regulatory requirements.

6 Summary and Conclusion

6.1 Summary and Conclusion

Based on the results from the Flood Risk Assessments of 124 No. sites, and Coastal Erosion and Shoreline Management Plans review of 47 No. sites. Indicative cost for resilience measures has been developed where appropriate. These indicative costs will feed into the Wessex Water Services Ltd DWMP and Price Review Business Plan.

The assessment into resilience identified 248 No. sites that are potentially at risk of flooding from an extreme rainfall event (1 in 1000 years environment Agency flood extents of flooding from rivers and sea). We appraised 124 No. of these to estimate the mitigation costs. The results were extrapolated to 248 No. sites and estimated that this will cost £55m. The results from the resilience assessment are summarised in the Figure 6-1 below.

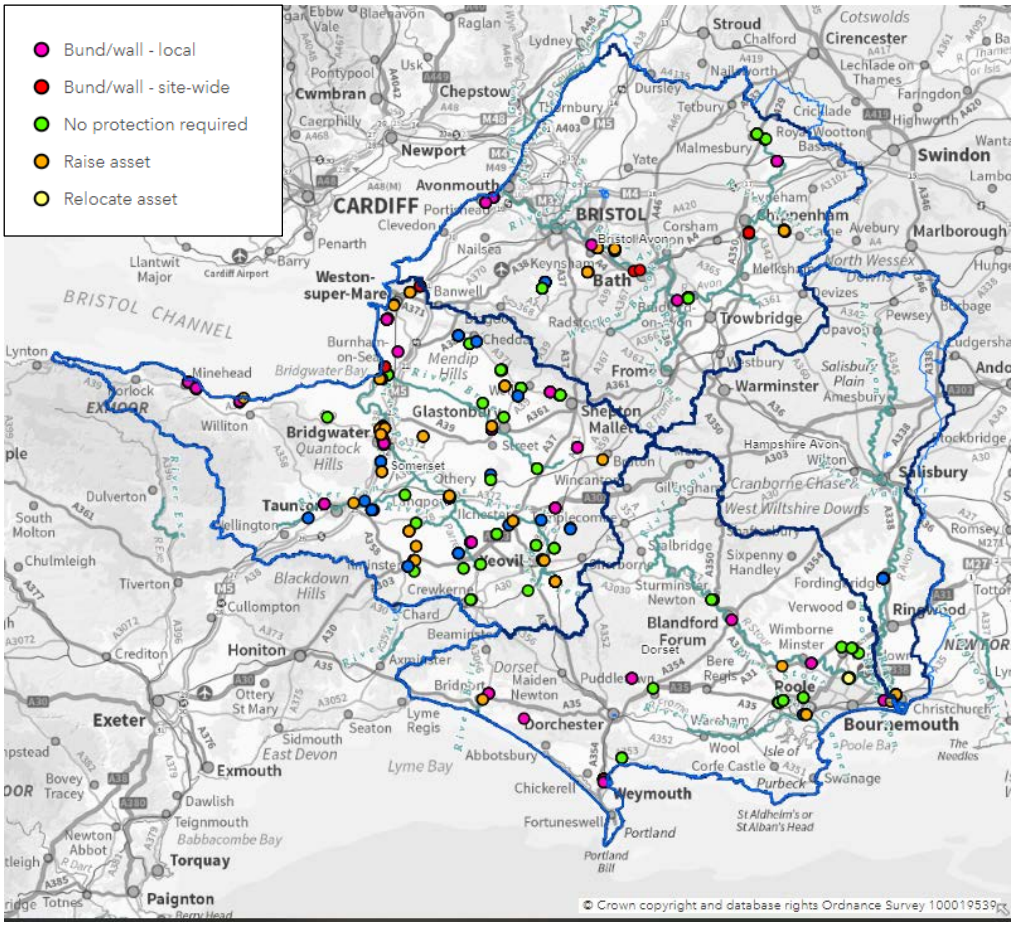


Figure 6-1: Resilience options required

The programme of these will be spread out over several AMPs, choosing the highest priority sites first.

6.2 Recommendations for Future Work

The flood levels estimated for each site will need to be refined to inform detailed design stage. The following additional work may be required:

- Topographical survey of the site and surrounding area to confirm critical levels
- Watercourse survey to inform detailed hydraulic modelling
- Detailed hydrological analysis and hydraulic modelling
- Quantitative assessment of impact to third parties to ensure proposed mitigation measures have no detrimental impact on flood risk outside the site
- Options appraisal and cost benefit analysis of potential flood mitigation solutions
- Review of risks following the SMP refresh progressing in 2022

6.3 Assumptions and Limitations

- Identification of critical equipment on site was made by Wessex Water Ltd site operators. Height of critical equipment above ground was estimated during site visits. The ground level at critical equipment was estimated from LIDAR data.
- Flood level estimates are based on high-level flood risk assessments using publicly available data and engineering judgement. The results from this assessment are not suitable for detailed design.
- Unit costs are capital costs informed by EA datasets 2015, these need to be factored up to account for associated services, environmental impacts to be mitigated, design time, licencing, groundworks, temporary works, interaction with other services/assets risk/need for diversions, contamination, and inflation.
- No information was available regarding ground conditions. An assumption of 1m foundation depth has been made for flood walls.
- It is assumed that suitable access is available to all the areas needed to carry out the works and no confined space or hazardous working conditions are present
- No allowance has been made for any restrictions placed on the works due to adverse weather conditions
- Proposed flood defences may require additional costs to mitigate impact on flood risk to third parties due to the construction of proposed defences. This is not included in the cost estimate.
- Proposed flood defences have been assumed to be within the site boundary as defined by Wessex Water. Additional costs for land purchase have not been included in the cost estimate.
- In the event of inundation of open tanks, clean-up operations may be required. No allowance has been made for the cost of clean-up.
- If the primary mechanism was found to be surface water flooding only, a mitigation option was not proposed or costed.

7 External References

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