

**Climate Change Adaptation
Good Practice - Case Study**

**AdaptWater™ online
climate change analysis tool**



About Adaptation Good Practice

Adapting to climate change is a relatively new concept to many. It is important to learn from practitioners who are undertaking adaptation activities that are beginning to have tangible outcomes. Documenting examples of good practice and identifying the criteria that makes them work, enables those interested in adaptation to learn about how to take action.

There are expectations that Adaptation Good Practice (AGP) includes a definite start and finish to a project. However climate change practitioners' experiences show that adaptation projects are often steps in longer learning journeys. There are no golden rules on how to adapt and often practitioners across Australia are inventing the wheel that drives future AGP.

The AdaptWater™ case study is part of a series of 16 Case Studies that recognise exemplars for AGP in Australia. Through the development of these stories of successful adaptation it was refreshing to see an emergence of similar experiences and challenges regardless of the project or location. Australian climate change practitioners may experience physical isolation from their peers but they are rarely alone in facing adaptation challenges.

Following the Snapshot there is a more in depth narrative of the experiences, learnings and network links from this project to stimulate further engagements and knowledge sharing among the growing community of adaptation practitioners.

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Case study snapshot

Quantifying the Cost of Climate Change Impacts

The project journey

The AdaptWater™ project, began with a highly innovative and challenging goal to develop an online tool to meet this challenge. The outcome is a user friendly software program to quantify the climate change risks to multiple assets, assess adaptation options and provide economic modelling for investment decisions. The default settings for the tool's data fields could be readily adapted to apply to other kinds of utilities and infrastructure owners including roads, railways, ports, airports, electricity, gas suppliers and irrigators.

Important lessons were learnt from this journey.

→ Lesson learnt:

Setting realistic expectations around the timeframes required to develop complex, cutting edge tools such as AdaptWater™.

This project required far more iterative development of the methodology and software, through pilots in five states, than was initially envisaged.

→ Lesson learnt:

Allow adequate time to access interstate and national data, and anticipate the likelihood of incurring delays.

Project partners and funders must consider what data are readily available, the protocols for access, and time involved in accessing the data.

The third key learning is important for any collaborative adaptation projects that depend on good teamwork.

→ Lesson learnt:

Early on, identify and engage the 'make it happen people' in each partner organisation who excel at building cross-organisational relationships and stakeholder networks, gain quick access to data, and provide reviews of project outputs and milestones in quick turn around times.

The ability to meet tight timelines and deliver complex project outcomes is highly dependent on trusted relationships.

Risks and impacts addressed

AdaptWater™'s database has been developed to address multiple risks, specifically these six climate hazards across five States:

- Salt water ingress
- Coastal inundation
- Riverine flooding
- Heat wave
- Bushfire
- Extreme wind.

Drivers for adaptation action

Water Services Association of Australia (WSAA) members, led by Sydney Water, required a cutting edge decision support tool to:

- Identify risk-based justifications for protecting vulnerable infrastructure assets
- Develop a suite of quantified investment responses to manage risks.



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Figure 1: Iterative piloting in partnerships with major urban water utilities in Sydney, Melbourne, Brisbane, Adelaide and Perth.

The outcome is a user friendly software program to quantify the climate change risks to multiple assets, assess adaptation options and provide economic modelling for investment decisions.

→ Adaptation action

AdaptWater™ is a cutting edge project that integrates climate hazard information into an online quantification tool for the Australian water industry, to quickly assess impacts on many thousands of assets.

WSAA sees significant financial and governance benefits for all water utilities. Adam Lovell, Executive Director of WSAA, said 'WSAA members operate around 260,000 km of pipeline and hundreds of water and wastewater treatment facilities. The AdaptWater™ tool will ensure these assets perform reliably under a range of climate change scenarios.'*

Outcomes achieved

- **Input** of spatial data sets for six hazards in five states to a 160 gigabyte database
- Adaptive user interface – for example utilities can apply different costs to provide Net Present Value (NPV) and compare costs
- **Output** data include tables, graphs and heat maps of risk cost of climate change to hazards, tables and graphs of financial and non-financial key performance indicators (KPI), including risk cost, NPV, dry weather overflows (sewage spills), customer supply disruption and water quality
- Reports to compare adaptation options against financial and non-financial KPIs

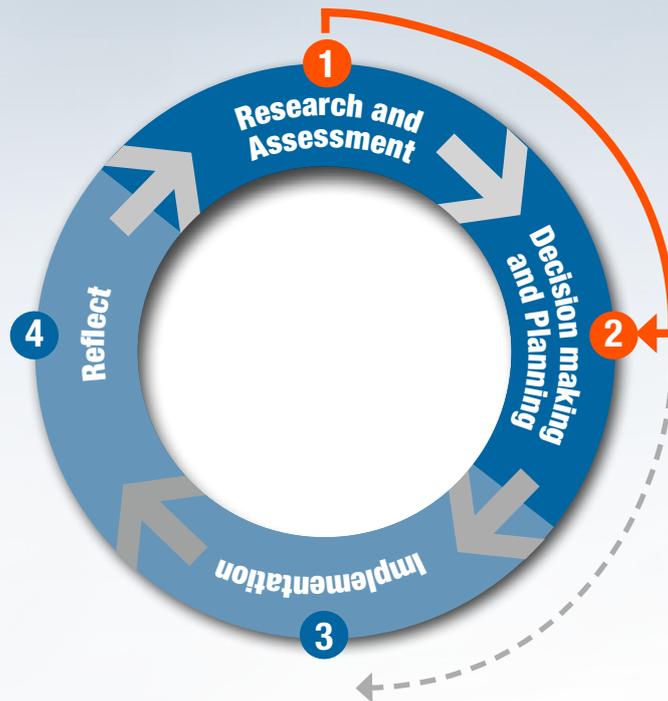


Figure 2: AdaptWater™ Adaptation Good Practice phase.

- Pilot tool development involving Sydney Water and WSAA and partner utilities (Melbourne Water, SA Water, QLD Urban Utilities, City West Water, Water Corp).

Emerging outcomes

- Opportunity for other industries to use this tool.

*Source: Sydney Water Annual Report 2012. Annual Report 2012

The project



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Figure 3: Flooding of Sydney Water assets in the Illawarra

Key objectives of the AdaptWater™ project included:

1. Developing an online tool that integrates multiple sources of scientific data on climate hazards with cost benefit analyses (CBAs) to quickly and systematically assess the effects of climate change on hundreds of thousands of complex assets, each with individual specifications.
2. Establishing a robust business case for reducing risks to vulnerable, long-lived infrastructure assets, to acceptable levels within the licence conditions for operation e.g. service levels, avoidance of pollution.
3. Gaining independent economic regulator's support for risk-based investment in adaptation decisions.

The primary research partners driving the AdaptWater™ project have been WSAA, Sydney Water, and Climate Risk Pty Ltd. They have been supported by these project participant utilities: Melbourne Water, SA Water, Queensland Urban Utilities, City West Water and Water Corporation (Western Australia). This project received co-funding from the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE) as part of its Coastal Adaptation Decision Pathways (CAP) program.

Early instigation stemmed from Sydney Water's concern that it has too many individual infrastructure assets to assess manually. It needed a tool to assist in establishing robust, quantified CBAs and

a business case for undertaking major capital works.

Greg Allen, Sydney Water's Science and Technology Manager, recalls,*

‘We started this project because we were seeking to compare emerging climate change risks and what they mean for our business and customers. The tool allows us to test options and put in place the most cost-effective responses to ensure customer needs are met.’

*Sydney Water Annual Report 2012.

Risks and impacts addressed

Urban water and sewerage assets vary in size and function, as well as location (buried or above ground). Risks posed by climate change to Australian water utilities include:

- Potential reduction in fresh water supplies
- Changes to customer demand for water
- Increased risk of pipe corrosion and odours
- More extreme storms that test the capacity of sewage treatment plants and networks
- Rising sea levels and storm surges that pose a flood risk to low-lying coastal and remote assets, and lead to pollution risks and license breaches
- More intense and extreme riverine and drainage floods which can inundate and damage infrastructure and lead to pollution and licence breaches
- More extreme hot days and exacerbated bushfire risk that could pose a threat to worker safety and productivity
- Changes in soil conditions that could lead to greater risk of pipe failure
- Disruption to electricity supplies leading to service failure due to inability to pump water and sewage
- Change in water quality due to increased temperature and changes in catchment vegetation and bushfire frequency.

Sectoral impacts include multiple climate risks and hazards impact on all water utilities. For example, Melbourne Water and City West Water are already undertaking works to remediate saltwater intrusion on infrastructure assets.

Information and knowledge gaps

This project required Climate Risk Pty Ltd to bridge many gaps in order to combine climate change science with predictive asset risk analysis. However, there are further gaps that could be filled by extensions of this project, including detailed research and development for quantifying CBAs.



Adaptation actions can be selected from a library within the tool or created by the user. This shows a comparison of adaptation options applied. Blue line shows the baseline (combined bushfire and riverine flooding risk over time). Red = Option A = Heatproof civil and electrical components of those bushfire risk assets in 2025, and raise assets at risk of flood 0.5 m in 2035. Green = Option B = Raise flooding risk assets 0.5m in 2030. Orange = Option C = Heatproof elec (2060) and raise asset 0.1 m (2070)

Figure 4: Image of application of adaptation options



© Sydney Water Corporation

Figure 5: Burst water main

Response strategy

After five prototypes, AdaptWater™ has been successfully piloted for the partner utilities, to meet the following specifications:

- Risk based
- Asset driven
- Geospatial
- Utility specific
- Provide user flexibility
- Assess operational impacts
- Compare adaptation options for robust decision-making.

The most significant outcome is the ability of AdaptWater™ to quantify impacts on assets and compare adaptation options.

Implementation phases

The scoping for this project began with Sydney Water's qualitative assessment of climate risks, in 2010. However, a quantitative analysis was also required.

Research started in June 2011. It entailed the ground-up development of a completely new type of content management system, using world's first methods supported by research documentation.

Project aims have been achieved through five phases of prototype tool development, applied in five case studies: 2 desktop; 1 online HTML; and 2 online python C++ phases. After iteratively piloting the prototype tool in the final case study, a highly intuitive and user-focused tool has emerged.

AdaptWater™ is now a very large but user-friendly online information and analysis system. The data systems underpinning the tool have been expanded to cope with hundreds of

thousands of assets, and currently incorporate 160 gigabytes of spatial data. As such, AdaptWater™ provides crucial support for decision-making and planning.

Ongoing challenges to AdaptWater™'s implementation include considerable in-kind and financial resourcing required to maintain the upkeep of information on large numbers of assets, in a complex online tool, and to incorporate emerging and future spatial information.

To assist in meeting these challenges, future work is proposed to further develop an inbuilt intuitive process to automatically transfer new content among databases. This will reduce maintenance costs.

Outcomes achieved

A key intended outcome achieved was to successfully pilot the AdaptWater™ tool with multiple major water utilities. Specific achieved outcomes after piloting include:

- Input of spatial data sets for six hazards in five states
- 390,000 individual assets in databases
- Six utility users (each can only gain access to, and use their own assets)
- Adaptive user interface - utilities can apply costs to adaptation options allowing the estimation of NPV and comparison of adaptation costs
- Systems analysis of interdependency of assets
- Executes probabilistic analysis
- Output data include tables, graphs and heat maps of risk cost of climate change to hazards, tables and graphs of financial and non-financial key KPIs,

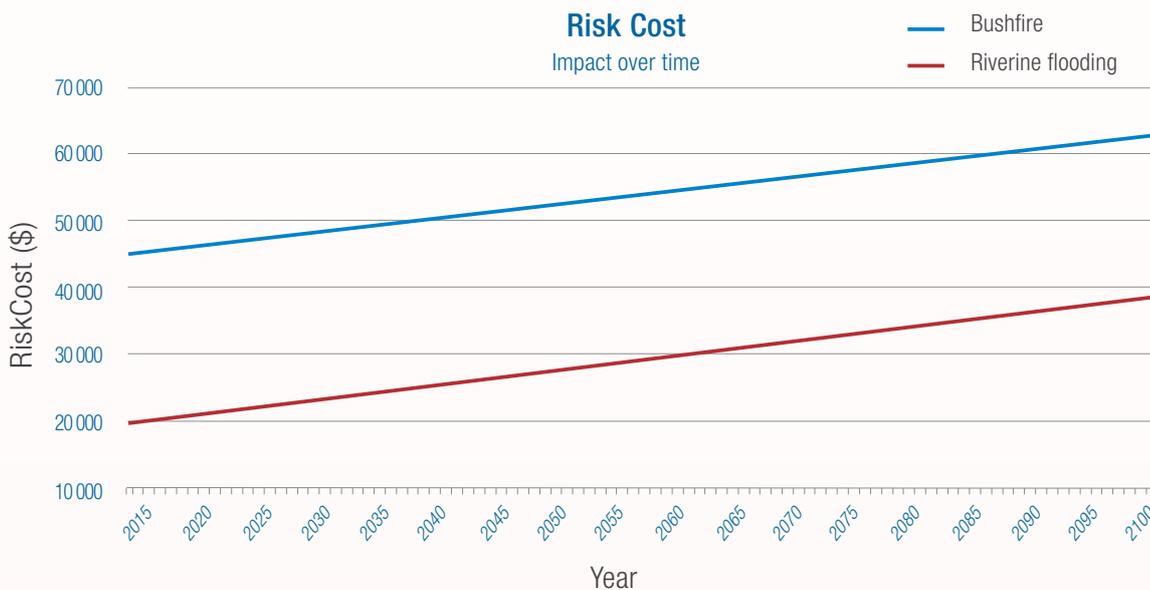


Figure 6: Risk cost of bushfire and riverine flooding for a set of example assets

Note: How much would it cost to insure the asset in a given year (in the analysis time series) based on the risk to the asset and the replacement cost of the damaged element/s [expressed in \$].

including risk cost, NPV, dry weather overflows (sewage spills), customer supply disruption and water quality

- Reports to compare adaptation options against financial and non-financial KPIs
- Reports on annual impacts of 1-in-100-year hazard events.

Data tables, charts and reports are all available to the online user. Users can create different adaptation actions for one or more assets, apply flexible costs and years of implementation, and combine these into adaptation options. Adaptation options can be compared using the NPV and other financial and non-financial KPIs of these options to select the most appropriate option for investment.

Emerging outcomes

Five potential key areas for further iterative development of AdaptWater™ are identified:

1. Extending it to assess other climate change hazards including analysis of drought induced soil shrinkage / contraction, and salt deposition and corrosion in concrete structures.
2. Additional cost and benefits data could be incorporated into available adaptation actions to further improve the quantification of costs and benefits.
3. Further measures to protect asset confidentiality.
4. Updating the underlying climate change science and data sets when the Intergovernmental Panel on Climate Change's (IPCC) fifth assessment reports (AR5) are

released in 2014, and correlating updated climate projections from Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM), Geoscience Australia data on soils, and so forth.

5. Inclusion of completed fine-scale output data from the NSW and ACT Climate Modelling (NARCLiM) research project being undertaken by the Climate Change Research Centre at the University of New South Wales (UNSW). Some emerging data was provided through links with Sydney Water but in the main the NARCLiM data was not ready for inclusion during the piloting phases.

The key point to note is that all future data updates can be uploaded at a central point, ensuring there is no data variability. All users access the same software, similar to cloud computing.

Critical success factors

AGP analysis of the project

Success of this approach has been driven by strong leadership, excellent connectivity between all stakeholders and a sustainable vision.

This project is strong in:

- **Leadership**
- **Connectivity**
- **Sustainability**

Leadership

The biggest critical success factor in developing AdaptWater™ has been the sectoral leadership shown by WSAA, which has made a major contribution towards effective governance of assets in WSAA's partner utilities, and its members, in particular Sydney Water.

Senior management support from climate change and asset management teams in the major utilities has been another critical success factor during the tool's development and piloting. They have pooled their resources to match DIICCSRTE's co-funding on a 50-50 basis, to achieve more effective governance of their assets – more so than could be achieved by go-it-alone approaches.

→ Leadership lesson learnt:

Senior management support leads to success.

Engagement

The project has involved very close engagement with WSAA's CEO and project manager; with representatives of Australia's largest water utilities.

AdaptWater™ is designed to augment risk management by identifying the emergence of current and future risks to multi-decadal assets, leading to preparation of longer-term implementation strategies

Research and piloting of AdaptWater™ has also involved partnerships with specialist data providers, Australian Government agencies, State Government agencies for water, climate change and environmental management including NSW Office of Environment and Heritage (OEH) and Department of Sustainability and the Environment (DSE) in Victoria.

→ Engagement lesson learnt:

Close engagement with representatives of Australia's largest water utilities and with important players in State Government provided clear project aims.

Connectivity

AdaptWater™ is designed to augment risk management by identifying the emergence of current and future risks to multi-decadal assets, leading to preparation of longer-term implementation strategies.

Management of the piloted tool in the case study utilities has tended to migrate/transfer from the climate change/sustainability managers to the asset managers.

The methodology and design parameters that underpin AdaptWater™ can be applied to achieve cost savings to other highly networked, complex infrastructure assets such as energy, road, rail and irrigation systems.

AdaptWater™ is a very innovative national research and development initiative – it breaks new ground. It has been developed and piloted with major urban water utilities. There is scope for broad application to other metropolitan, regional and local government utilities.

AdaptWater™ lends itself to whole-of-organisation utilisation, by hard wiring climate science into asset management, corporate planning, environmental management and customer relations/community engagement.

At NSW state level, the project has involved good collaboration between WSAA, Sydney Water, Climate Risk Pty Ltd, and OEH; similar relationships between State and Local Government existed in other state; at the national level, collaborations have included DIICCSRTE as co-funder, Geoscience Australia regarding extreme wind hazards, CSIRO and BoM regarding climate projections, and the Critical Infrastructure Program for Modelling and Analysis (CIPMA) data from the Attorney-General's Department.

→ Connectivity lesson learnt:

The tool will assist planning across a major corporation. Connecting with key local, state and commonwealth government organisations enables integrated outcomes to be achieved.

AdaptWater™ improves asset portfolios by enabling consideration of ‘real options’ and timely, better informed decisions on future upgrades based on cheaper and/or more efficient, innovative technologies

Sustainability

A key sustainability issue that the project addresses is how to ensure that new infrastructure investments will remain appropriate for future generations; given that water infrastructure assets can have lifetimes in excess of 80 years. Customers continue to utilise 100+ year-old water infrastructure in Sydney and Melbourne. Protection of multi-decadal assets carries benefits forward to future generations.

AdaptWater™ is designed for WSAA member utilities, largely state and local government owned, to improve their governance processes. In addition, it improves the risk position of State Treasuries, and will inform independent economic regulator’s decisions on pricing and capital works, for the benefit of the economy, taxpayers and customers.

AdaptWater™ improves asset portfolios by enabling consideration of ‘real options’ and timely, better informed decisions on future upgrades based on cheaper and/or more efficient, innovative technologies.

Highly flexible, multi-action adaptation strategies can be developed in the tool and compared in terms of risks and costs. AdaptWater™ can also indicate the suitable timing of actions, allowing decision-making to be deferred where possible, in expectation that new information becomes available and/or

new technologies emerge. The tool also identifies where deferral would lead to increased costs or where poor decisions would have adverse financial outcomes. AdaptWater™ identifies different options which can be assessed against scenarios, to scope no-regret pathways in asset adaptation choices.

→ Sustainability lesson learnt:

Infrastructure investments in the water sector are made for the long-term. Using the right tools and forming the right partnerships, help to ensure that the infrastructure will remain viable long into the future and that investments will not be lost.

Cost

Shorter-term cost benefits analysis (CBA) for adaptation options can be compared using risk, cost, cash flow and NPVs. As part of the prototype testing, case studies covering CBAs for each of the five partner locations were undertaken.

Anticipated longer-term cost needs were addressed as AdaptWater™ has identified longer-term costs in the pilot case studies, and this is now a strong feature and key outcome of the project.

Follow-on funding has been negotiated.

Conclusion

For professional staff in water

utilities: AdaptWater™ enables targeted responses to climate change hazards and impacts on assets and infrastructure.

Using the tool can assist with wise investments which last long into the future.

→ **Lesson learnt:**

For adaptive learning: ensure that access is gained to all known good climate data from key sources e.g. Geosciences Australia, CSIRO and BoM.

Gaps and future challenges

AdpatWater™ identifies risk-based justifications for investments in vulnerable infrastructure assets to allow effective climate change adaptation. Further gaps could be filled by extensions of this project, including detailed research and development of quantifying cost-benefit analyses.

This project required Climate Risk Pty Ltd to bridge many gaps in order to combine climate change science with predictive asset risk analysis. However, there are further gaps that could be filled by extensions of this project, including detailed research and development for quantifying CBAs.

Links to more information and projects

For further information about AdaptWater™ and the Australian water industry's approach to climate change adaptation please contact:

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Sydney Water Annual Report 2012

www.sydneywater.com.au/annualreport/sw_ar12_pg_72.html



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