



DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Guide to Climate Change Risk Assessment for NSW Local Government

2019 Revision



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Published by:

Environment, Energy and Science
Department of Planning, Industry and Environment
59 Goulburn Street, Sydney NSW 2000
PO Box A290, Sydney South NSW 1232
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment, Energy and Science enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.environment.nsw.gov.au

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Introduction

This guide helps councils assess the risks of climate change.

The climate of New South Wales, and the rest of the world, is changing. Average temperatures have been steadily rising since the 1960s while the decade from 2008 to 2017 was the hottest on record. As the average temperature rises and long-term weather patterns change, the occurrence of extreme weather increases. This means that the assumptions on which cities, towns and regions are planned and run must be reassessed. As time passes new information will come to light improving our understanding of the expected changes in climate and how they will affect us, reinforcing the need to regularly reassess the risks these changes pose.

The NSW Government is committed to assisting local government to take effective action on climate change. The NSW Climate Change Policy Framework aims to maximise the economic, social and environmental wellbeing of New South Wales in the context of a changing climate, current and emerging international and national policy settings, and actions to address climate change.

Decisions on environmental policies, building design, engineering, amenity and asset management have traditionally been based on historic climate data and experience. However, the changing climate means that last century's data and solutions may no longer be appropriate to guide decision-making this century.

Implications of this can include:

- built assets such as roads, stormwater drains and buildings may not be able to withstand increased frequency or intensity of extreme events such as flooding, fire and storms
- land-use patterns can change, impacting zoning and planning decisions
- a possible increased demand for council services, utilities and support for vulnerable populations.

Local government is often at the forefront of addressing climate impacts and communities will increasingly look to their council to provide solutions to adapt to, manage, transfer or share the risks associated with climate change impacts (Baker & McKenzie 2011¹).

This guide sets out a process for climate change risk assessment to assist councils as they address the uncertainty presented by the changing climate.

A climate change risk assessment aims to ensure council systems are resilient, by working through an analytical process that:

- identifies and assesses the risks that climate change poses to council assets and services
- prioritises actions for decision-making, adaptation planning, budgeting and community engagement.

It is important to note that this guide is focused on assessing the risks to council operations rather than wider community risks. Councils should also carry out a process to consider these broader risks, in consultation with the community. This could be done as part of the community strategic planning process or as a further stage of the risk assessment process. Refer to the vulnerability assessment in Step 11 for further information on community climate change risk assessment.

This guide outlines a qualitative approach to risk assessment, a method consistent with the level of climate change data currently available at a council scale.

The risk assessment should be reviewed every five years to capture updated climate science and to incorporate best practice in adaptation planning into council's strategic planning and operational delivery. Council can of course review the climate change risk assessment earlier if new data becomes available that materially impacts the understanding of risks, or if events occur that trigger the need to reassess climate change risk management.

¹ Baker & McKenzie 2011, *Local Council Risk of Liability in the Face of Climate Change – Resolving Uncertainties*, report prepared for the Australian Local Government Association, Baker & McKenzie, Sydney.

Aim of a climate change risk assessment

The purpose of a climate change risk assessment is to:

- identify and assess the risks that climate change poses to local government operations (including staff, assets and services)
- prioritise risks that require further action as a basis for decision-making and planning, and
- familiarise council staff with the local climate change risks and normalise the concept of climate change adaptation across all areas of council decision-making.

Climate change risk assessments aim to ensure that council systems will be resilient. By working through the climate change risk assessment process, councils can establish a robust framework to analyse the risks posed by climate change and develop strategies to address them.

The concept of risk assessment is not new to local government. Most councils already have risk management systems in place and may even have an officer dedicated to risk assessment and management. A climate change risk assessment follows the established risk management standards and techniques.

A climate change risk assessment is vital due to the far-reaching implications of long-term changing weather patterns. It is iterative by nature, requiring monitoring, review and update, and is specific to each local government area, noting that there is no single correct outcome from the process.

Reducing liability: the legal case

Local councils are particularly exposed to the physical, transitional and liability risks posed by climate change. The Hutley legal opinion showed that directors who fail to consider the impact of foreseeable climate change risks on their business properly could be held personally liable for breaching the duty of due care and diligence they owe to their companies (Hutley & Harford-Davis 2016²).

Based on this, liability could be reduced by ensuring the:

- decision is within the decision-maker's power
- decision is based on the best available information
- decision-maker's legal liability for the decision is understood.

If there is high uncertainty under the law, there is a high risk that the decision could attract a legal challenge or result in legal liability. The organisation will need to judge whether the identified risk is acceptable.

For more information refer to [legal risk and adaptation](#) from CoastAdapt³.

Although this legal opinion applies to a commercial entity, key findings of a recent discussion paper released by the Australian Centre for Policy Development identified that '... public sector directors are now increasingly likely to be closely scrutinised and held to account for climate risk management...' (Dibley et al. 2019⁴).

2 Hutley N and Hartford-Davis S 2016, *Memorandum of Opinion: Climate Change and Directors' Duties*, prepared for the Centre for Policy Development and the Future Business Council business roundtable, 21 October 2016, Melbourne, Minter Ellison Solicitors, Melbourne.

3 Bell-James J, Baker-Jones M and Barton E 2017, *Legal risk: A guide to legal decision making in the face of climate change for coastal decision makers*, CoastAdapt Information Manual 6, 2nd edition, National Climate Change Adaptation Research Facility, Gold Coast.

4 Dibley A, Hurley S and Sheppard J 2019, *Public authority directors' duties and climate change: Managing the latent financial and governance risk*, Discussion paper, Centre for Policy Development, Sydney.

Incorporating climate change risk into the IP&R framework

It is recommended councils embed the consideration and management of climate change risks and vulnerabilities into their Integrated Planning and Reporting (IP&R) framework, especially if there is consistency with their community strategic plan in the objectives, themes and priorities. Actions from climate change risk assessments and adaptation plans need to align with relevant delivery programs and annual operational plans, and have relevant resources allocated.

Council’s asset management plan should incorporate an assessment of climate risks associated with the assets involved and the

identification of strategies for the management of those risks; see Figure 1 below. The IP&R framework comprises a:

- community strategic plan, reviewed in a 10-year cycle
- resourcing strategy consisting of long-term financial and workforce management plans plus an asset management policy, strategy and plans
- delivery program, reviewed in a four-year cycle
- operational plan, updated annually.

These elements are informed by community engagement, asset management processes, service delivery and the ongoing monitoring and reporting of progress.

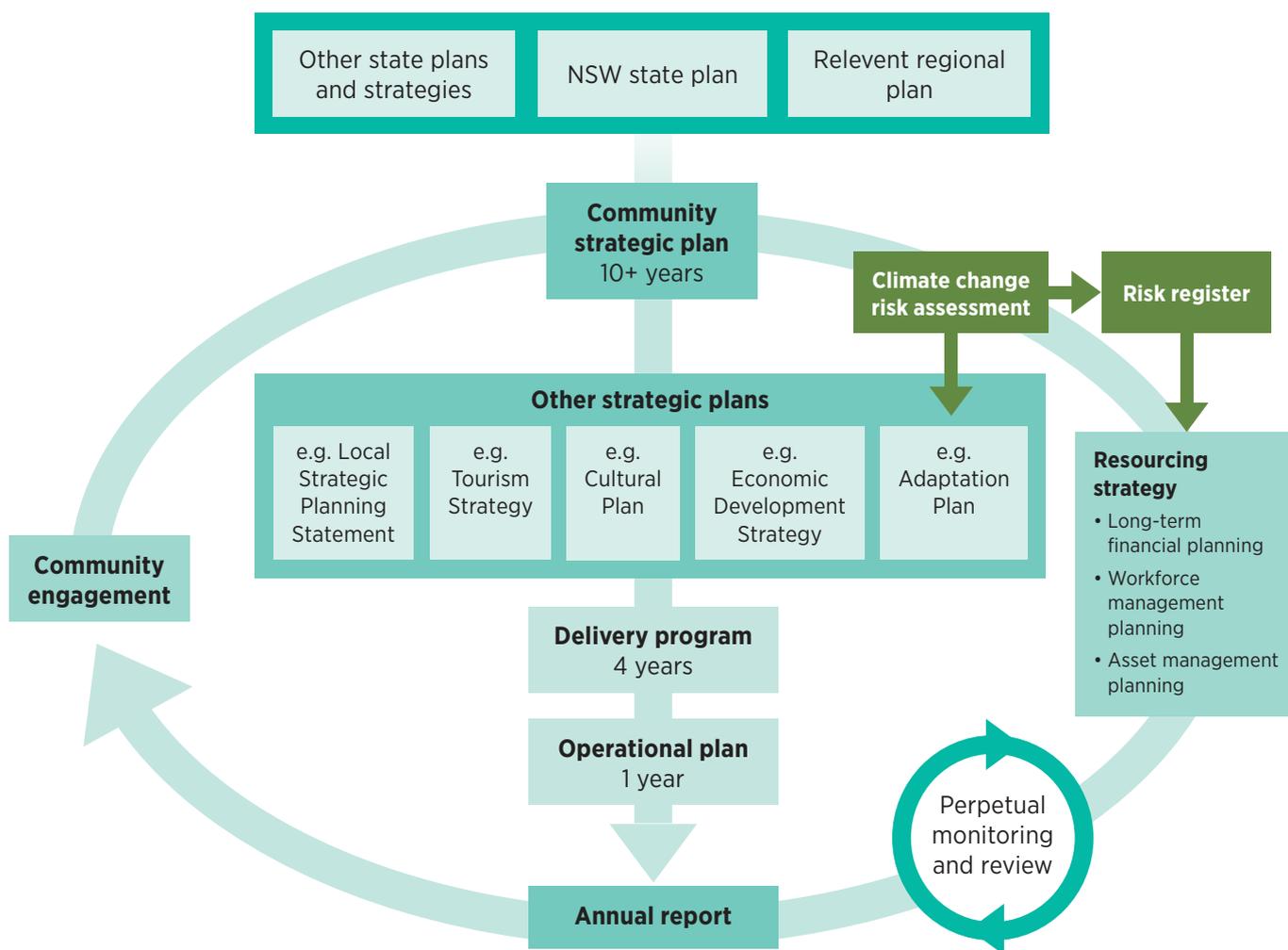


Figure 1 The Integrated Planning and Reporting (IP&R) framework – modified to integrate climate change risk assessment

Using this guide

This guide offers a step-by-step process to conduct or revise a climate change risk assessment. The guide helps councils to:

- undertake a climate change risk assessment using an approach based on standardised methods
- refine previous climate change risk assessments
- generate information that can be used to develop adaptation strategies and make decisions under conditions of risk and uncertainty.

This guide is based on [Climate Change Impacts and Risk Management: A guide for business and government \(AGO 2006\)](#)⁴ and [AS ISO 31000:2018 Risk management – Guidelines](#). Climate change information on the Adapt NSW website and other key resources that are adapted to the needs of local councils are also referenced. Throughout the guide you will find links to source data and other resources that will assist with the climate change risk assessment process and Attachment 3 contains links to many further resources.

Figure 2 summarises the key steps in the risk assessment process, the likely timeframes (elapsed time), who should be engaged in each step of the process, as well as suggested resources available to assist the assessment. The time it will take for each step will vary from council to council depending on the resources available. Who will manage and be involved in each step will also vary, so the nominated times and job titles are indicative, not prescriptive.

⁴ AGO 2006, *Climate Change Impacts & Risk Management – A Guide for Business and Government*, Australian Greenhouse Office, Department of the Environment and Heritage, Canberra.

PROCESS STEP	TIMEFRAME	WHO DOES IT?	RESOURCES TO ACCESS
PREPARING			
1. Establish why the assessment is being undertaken	1-4 weeks	Sustainability staff*, risk assessment team, LEMO and other relevant staff	AdaptNSW – climate change projections for New South Wales Sustainability Advantage – climate change modules
2. Assess resources needed	1-2 weeks	Sustainability staff*, risk manager	Local Government NSW – climate change risk resources
3. Form the project team	2 weeks	Sustainability staff*, risk assessment team, LEMO and other relevant staff	AS 5334:2013 Climate change adaptation for settlements and infrastructure – a risk based approach
4. Confirm executive support & communication strategy	1-3 months	CEO, General Manager, Executive Management Team	AS 31000:2018 Risk management guidelines NARCIIM
SETTING THE FRAMEWORK			
5. Determine the level of assessment	1 week	Sustainability staff*, risk assessment team, LEMO and other relevant staff	CSIRO – climate change information for Australia NCCARF Adaptation Library
6. Develop or adopt a climate change scenario	2 weeks	Sustainability staff*	NCCARF Local Government Portal
7. Identify existing datasets and gaps	2 weeks	Sustainability staff*	Australian Government, Department of the Environment and Energy: Climate change impact and risk management – A guide for business and government (formerly AGO Guide)
8. Identify scope and key elements of assessment	2-3 weeks	Sustainability staff* with risk manager	The Institute of Public Works Engineering Australasia Practice Note – Climate Change Impacts on the Useful Life of Infrastructure
9. Establish an evaluation framework & assessment tools	3 weeks	CEO, GM, Executive Manager	Latest IPCC reports UN Sustainable Development Goals (SDG) – Goal 13: Take urgent action to combat climate change and its impacts
CONDUCTING THE ASSESSMENT WORKSHOPS			
10. Key workshop activities: • Identify risks, opportunities • Identify interdependencies • Analyse the risks • Evaluate the risks	1-3 weeks	Project team with stakeholders across council	Coast Adapt – How to conduct a climate change risk assessment
ACTING ON THE RESULTS			
11. Develop risk treatments, write up & communicate results	1-2 weeks	Sustainability staff* with risk owners	Coast Adapt – Sea-level rise and future climate information for coastal councils
12. Embed risk treatments in: • Corporate risk register • Business continuity plan • Community strategic plan • Other decision-making and governance as applicable	3 months	All management staff	NSW Office of Local Government – Integrated Planning and Reporting framework

REVIEW CYCLE: EVERY 5 YEARS, UNLESS TRIGGERED EARLIER

Figure 2 Climate change risk assessment process for councils in New South Wales

* While 'sustainability staff' is used in this figure the role is flexible and should reflect the functional area in council that has primary responsibility for climate change.

Preparing for a climate change risk assessment

Step 1: Establish why the assessment is being undertaken or reviewed

Establishing why a climate change risk assessment is needed helps determine its objectives and the level of assessment required. Reasons for undertaking a climate change risk assessment include, to:

- meet insurance obligations
- reduce liability
- mitigate costs
- plan budgets
- comply with regulations and program guidelines
- update existing plans and risk ratings
- work with other councils, government agencies and private providers
- clarify the nature of an identified risk
- submit grant and other funding applications
- address community concerns
- update a previous climate change risk assessment.

Step 2: Assess resources needed

Climate change risk assessments can be undertaken by internal staff, consultants and in partnership with other councils and external agencies. All require a commitment from the executive and general staff as well as human and financial resources.

An internal climate change risk assessment will need:

- one staff member to drive the process and document outcomes (project manager)
- representatives from different operational areas within council to inform the process
- resources to undertake workshops, host forums, and coordinate peer reviews and advisory groups.

An internally run assessment can help councils build on existing internal knowledge and also develop new expertise, which will be vital as climate change impacts increase. Staff with a sound knowledge of the local area, environmental conditions, council assets and operations, and risk assessment methodology are best suited to this project.

Some councils will choose to resource the risk assessment process internally, while others will engage external consultants. For those planning to use internal staff, there are many resources available to assist in building internal capability; for example, Local Government NSW has [examples of climate change adaptation planning](#), including climate change risk assessments.

For councils wishing to engage external consultants, the guidelines for [working with consultants](#) from CoastAdapt will be helpful and include advice on verifying their expertise and ensuring the project scope is clearly documented and agreed to by both parties.

Collaborating with other councils to develop joint climate change risk assessments, share information and resources, especially those with similar climates, population and land, can be cost-effective and help to ensure a more equitable, coordinated and consistent response across regions. Collaboration can also help identify and treat interdependency risks.

TIP: Building internal capability with consultants

Consultants can provide valuable assistance when undertaking a climate change risk assessment. By bringing best practice process and content, currency with the latest research and literature, up-to-date industry experience and case studies, a specialist consultant can bring a voice of authority to help councils tackle this complex challenge.

However, one of the key objectives of running this process is to ensure your council builds its own capability to assess, evaluate and address climate change risks. So, it is important to ensure the consultant facilitates knowledge transfer to the internal team and can mentor those likely to retain ongoing responsibility for the process. It may be worth including this teaching and mentoring capability in the request for quotation as part of the project scope.

Step 3: Form the project team

The climate change risk project team can be involved in a range of activities ranging from data provision and interpretation to identifying and evaluating risks.

Ideally, the project team will include representatives from all areas of the organisation including:

- executives
- planners and policy advisers
- asset and facilities managers
- operations managers (roads, water, sewer and parks)
- community service managers
- finance, IT and risk managers
- local emergency management officer (LEMO)
- legal counsel
- procurement
- service delivery managers
- parks managers

- environmental managers
- communication and engagement specialists
- indigenous engagement
- homelessness engagement
- education officers
- frontline customer services.

Recruiting a mix of long-serving and less experienced staff to the team can help ensure succession and knowledge management strategies are successfully implemented, as well as engender wider support.

The project team can also be guided by a steering committee or advisory group, and include external stakeholders such as first responders, the chamber of commerce, traditional owners, resident action groups, subject matter experts, neighbouring councils, social service providers and representatives of agencies responsible for critical infrastructure in the area. Infrastructure representatives are particularly important when seeking to understand interdependencies such as water utilities, electricity utilities, Roads and Maritime Services.

Ideally, team members will be able to influence council decisions or be in a position to make decisions, supporting the implementation of climate change adaptations, based on their capacity to apply their expertise to the process.

Step 4: Confirm executive support and communication strategy

Any organisation undertaking a major project is significantly more likely to succeed when it has a senior *champion* to give authority to the person or team responsible for its delivery. The champion is like the project's ambassador. They will promote its benefits and help manage hurdles should they arise. This is especially applicable when addressing climate change due to the complexity and timeframe of the risks, and the potentially politically sensitive nature of the topic. Local government climate change adaptation surveys show that general manager and other executive support is a top-rated enabler for developing climate change responses.

Climate change potentially affects all aspects of council business and ideally, managing associated

risks is part of everyday business processes via the IP&R framework (Figure 1), as well as staff and community engagement.

Once approved by senior management, a climate change risk assessment can be communicated more broadly through internal and external channels such as workshops, emails, mainstream and social media, newsletters and consultations. This communication is an important component of the overall process to ensure that senior managers and key staff understand what is being done and why. This will help make sure they are 'on board' when it comes time to invite them to workshops, answer questions and commit to actions required as a result of the risk assessment.

Regular updates can encourage awareness of planned actions and progress, leading to increased opportunities for informed participation in strategy development and positive engagement.

Setting the framework for assessment

Climate change risk assessment can require some additional considerations over and above a general risk assessment. It is suggested that existing frameworks used at council are checked against recommendations made in this document, and the ISO standards Risk management – Guidelines and Climate change adaptation for settlements and infrastructure – A risk based approach. Some councils have successfully adapted their existing risk framework to incorporate climate risks into a familiar process, which may be an approach to consider.

Thorough consideration of the climate change scenarios, the assessment scope and the evaluation framework will help optimise assessment results.

TIP: Sustainability Advantage

Many councils are members of the NSW Government's Sustainability Advantage program. Members of the program have access to support for climate change risk assessment and other sustainability-related objectives. While results depend on an organisation's own efforts, this membership-based program provides expertise, training and business tools such as:

- practical workshops
- a comprehensive range of guides, case studies and templates
- one-on-one specialist support
- facilitated networking and targeted seminars
- an extended network of like-minded organisations.

Step 5: Determine the level of assessment

Risk assessments need to be conducted at a level that is:

- appropriate for the scale of the risk and the nature of the decision
- consistent with the quality and amount of data or information available.

For example, initial research might help identify a number of risks, while a more detailed data-driven assessment can better analyse and evaluate a specific risk.

Climate change risk assessments mostly involve:

- using localised climate projections
- creating scenarios that can apply to different time periods
- considering environmental and social systems with complex relationships
- subject matter expertise
- using quantitative and qualitative research to produce outcomes that readily integrate into frameworks such as the IP&R – see Figure 1.

As mentioned in the introduction, this guide outlines a qualitative approach to risk assessment, due to the level of climate change data currently available at a council scale.

What is a qualitative assessment?

A qualitative risk assessment allows councils to develop an understanding of their risks from climate change in the face of uncertainty about the precise timing, location and amount of climate change. This type of assessment uses expert informed opinion to describe the magnitude of potential consequences and the likelihood these will occur, in order to understand the level of risk. Qualitative risk assessments are:

- relatively inexpensive to undertake
- potentially familiar to councils that already have risk assessment and management processes and established risk assessment templates
- more readily integrated with existing risk management processes
- more readily integrated into the IP&R framework
- able to highlight areas for possible detailed quantitative assessment.

With the uncertainty associated with future climate change impacts, it is generally impractical to do a quantitative assessment of all risks, as it is difficult to describe the likelihood and consequences numerically and requires many assumptions to be made.

New tools to assess and prioritise climate change risks are developing rapidly. Where more information on climate change impacts becomes available, these tools may be applied to generate more detailed analysis of risk and vulnerability.

Information about climate change projections and impacts is also updated regularly. The Department of Planning, Industry and Environment (DPIE) has developed regional climate change impact data, and councils should refer to the regional projections and impacts of climate change page on the [AdaptNSW website](#) for the latest information.

Other reliable sources of information on climate change impacts are included at the end of this guide, in Attachment 3.

Introducing some key concepts

Emissions scenarios and future levels of greenhouse gas in the atmosphere

An emissions scenario is an estimate of future emissions based on our understanding of natural sources of greenhouse gases and how much greenhouse gas will be released into the atmosphere by humans (based on assumptions about future socioeconomic trends).

Because it isn't clear exactly how global social and economic systems will respond to emissions reduction programs, a range of scenarios are used to describe possible future trends in emissions of greenhouse gases into the atmosphere.

Dealing with risk versus uncertainty

While it is clear the climate is changing, uncertainty remains about exactly how much it will continue to change. A large amount of this uncertainty comes from not knowing how much greenhouse gas will be released by humans into the future. Dealing with uncertainty can be a challenge but should not be seen as a barrier to adaptation planning and adapting to climate change.

Local councils are highly familiar with risk management. Framing climate change as a risk rather than an uncertainty can make it easier to facilitate assessments and resulting action plans. In addition to scenarios, documented recent examples of climate related threats to life, property and businesses in areas with similar populations, geography and land-use patterns, can help understanding.

Potential for abrupt changes

Climate changes may occur more rapidly and abruptly than currently modelled due to the intricacy of our climate system. The complexity and interrelationships between ocean, land, biosphere and atmospheric processes around the globe are likely to produce unexpected impacts, some of which are not yet fully understood or able to be adequately captured in modelling projections.

Shift from uncertainty to risk

Most people are used to dealing with the idea of 'risk'. It is the language of the insurance, health and national security sectors. For many audiences – politicians, business leaders or communities – talking about the risks of climate change is likely to be more effective than talking about the uncertainties.

Shifting from an 'uncertainty' to a 'risk' approach also makes it easier for people to weigh up the costs and benefits of inaction, rather than getting stuck in the perception that knowledge is still imperfect. Familiar, everyday examples of risk management offer useful comparisons and analogies; for example, the risk of a town flooding, a farmer's crops being destroyed, or a coastal building slipping into the ocean (Corner et al. 2015⁵).

5 Corner A, Lewandowsky S, Phillips M and Roberts O 2015, *The Uncertainty Handbook: A practical guide for climate change communicators*, University of Bristol, Bristol UK.

Step 6: Develop or adopt a climate change scenario

One way to address future uncertainty is to use climate change scenarios that describe possible changes to climate variables.

A climate change scenario does not present definitive statements about future climate change (see 'Assumptions and uncertainty' below). Instead, it presents a plausible future climate based on the best available science and a number of assumptions about:

- future levels of greenhouse gas in the atmosphere (the emissions scenario)
- the response of global average surface temperatures to increases in greenhouse gases
- local climate change as a result of changes to global average temperatures.

It is important to record and explain these assumptions in the risk assessment as they have an impact on the decisions made to manage the risk.

DPIE recommends that councils use the NARCIIM scenario as the basis for their climate change risk assessments. The model has been co-developed by DPIE to create [climate change snapshots](#) for NSW planning regions. It is a highly rigorous model that has been designed so that non-scientists can readily apply it to their decision-making in New South Wales.

The NARCIIM model – a high-level description

The NSW and ACT Regional Climate Modelling project (NARCIIM) is an ongoing collaboration between the NSW and ACT governments, UNSW, Sydney Water, Hunter Water, and the Sydney Catchment Authority. It is based on:

- 10 kilometre grids (so is very useful for local government applications)
- four global climate models (GCMs)
- three regional models
- IPCC AR4 (the fourth major assessment report for the United Nations Intergovernmental Panel on Climate Change, i.e. the best available climate science)
- a high emissions trajectory (SRES A2), which represents a continuation of current carbon-intensive economic activity. This is projected to result in warming of 3–4°C by 2100



- three-time periods: 1990 to 2009 (baseline), 2020 to 2039 (near future), and 2060 to 2079 (far future).

How was uncertainty addressed in the NARCIIM modelling?

Due to the many uncertainties involved in producing climate projections, NARCIIM provides a collection of 12 simulations, (rather than just one single projection), each using the [IPCC SRES A2 emissions scenario](#).

This approach provides robust regional climate projections that span the range of likely future changes in the climate of south-eastern Australia.

Three configurations of the Weather Research and Forecasting (WRF) model were run with four separate GCMs to produce an ensemble of 12-member runs. Refer to the [About NARCIIM](#) webpage for further details.

Step 7: Identify existing datasets and gaps

Identifying available datasets will help define the scope of the risk assessment and will also help identify any information gaps that need to be filled before the risk assessment can be undertaken. Relevant datasets contain the information needed to inform the risk assessment; for instance, what the current and projected population for the local government area is.

There is a large body of existing work that councils can access to assist in the risk assessment process. Resources that can assist in providing the data needed for the completion of a climate change risk assessment include:

- the [NSW Climate Data Portal](#), part of the NARcliM project, allows users to construct and submit data requests to extract regional data for relevant simulations, locations, time periods and climate variables
- knowledge of local climate related risk
- regional AdaptNSW [climate change snapshots](#)
- previous climate change risk assessments
- access to information on programs that manage risks; for example: coastal hazards such as erosion and inundation, projected sea level rise, flood and fire risks in the local government and surrounding areas, as well as other potential indicators of localised climate change such as prevalence of invasive species, and health risks such as mosquito-borne disease
- audit of council assets including class, location, maintenance and depreciation status as well as services provided
- audit of critical infrastructure and other services in the area
- local population and business profiles
- mapping of ecosystems, refugia, fauna and flora present in the council area, particularly endangered species, ecological communities and assemblages
- the Adapt NSW guide to [impacts of climate change](#)
- the IPCC [Fifth Assessment Report](#).

Coastal and floodplain risk management programs

The NSW Government works with councils to deliver coastal and floodplain risk management in New South Wales. Any studies undertaken by council to understand coastal and floodplain management risks will need to consider climate change impacts. Where this has been achieved the identified climate change risks and associated treatments can be incorporated into the climate change risk assessment. There are a number of other resources available that can further support councils to consider coastal and flood related risks; these include:

- [CoastAdapt](#) – an information delivery and decision support framework that addresses the risks presented by climate change and sea level rise, and what can be done to respond to those risks. CoastAdapt contains information and guidance to help people from all walks of life understand climate change and the responses available to manage the impacts.
- [NCCARF](#) – the National Climate Change Adaptation Research Facility, works to support decision-makers throughout Australia as they prepare for and manage the risks of climate change and sea level rise.

Councils should note that if using resources from CoastAdapt and NCCARF, their work may be based on different emissions scenarios to the NARcliM model. It is important to understand and communicate this when stating baseline assumptions in the climate change risk management plan.

Step 8: Identify the scope and key elements of the assessment

Best practice sees local government consider the risks climate change poses to all areas of responsibility, either through a single or series of assessments. Classifying risks by operations and service delivery will help promote a systematic and efficient approach to risk identification and establishes a clear ownership of and responsibility for management of the associated risks.

To define the scope of climate change risk assessments, operational activities, geographical area and organisational boundaries can be used as key elements, also known as functional areas, during the risk identification process. Table 1 sets out an example list of key elements based on organisational functions.

Table 1 Key elements for climate change risk assessment

Key elements	Examples of issues to be considered
Infrastructure and assets	Council buildings, stormwater, transport and water supply infrastructure, wastewater treatment facilities, bush and recreation reserves
Land-use planning and development	Assessment of development applications and planning instruments such as local environmental plans and zoning
Emergency management and natural disaster preparedness	Traffic management, business continuity, emergency response and recovery from storms, bushfires, heatwaves, etc.
Environment management and protection	Water quality, air quality, biodiversity and ecosystems, pests and weeds, solid waste management, energy management
Community services	Childcare, recreational facilities, waste services
Corporate services	Insurance, council functions, financial sustainability, communications, IT, human resources

Step 9: Establish the evaluation framework and risk assessment tools

The evaluation framework is used by the assessment team to evaluate and prioritise risks. It is designed so all team members have a common understanding of how risks will be assessed, to allow for comparable assessments against council's existing corporate risk framework.

The evaluation framework generally has four components:

- success criteria based on council corporate objectives
- a consequence scale identifying a range of possible outcomes if risk becomes reality
- a scale that scopes the likelihood of an event
- risk priority levels based on the consequence and likelihood relating to that risk.

Success criteria

To help gain further traction and emphasise the immediacy of the need to develop action plans, it is recommended assessments are developed in the context of the overarching goals of council and other documents that establish the organisation's strategic priorities (e.g. the community strategic plan).

Climate change risk assessments and subsequent adaptive strategies can help achieve and sustain corporate objectives such as:

- boosting the local economy as well as offering incentives to potential investors by promoting the protection of assets, infrastructure and service delivery that is resilient to extreme weather events and other ongoing impacts of climate change
- delivering better value to ratepayers by helping ensure council expenditure is responsive to short-term, climate-based emergency contingencies and long-term models of resilience that work with providers of critical infrastructure and services
- ensuring council actions are informed by best practice approaches and proven science for protecting the physical and natural environment

- enhancing and protecting lifestyle, amenity and local character
- responding to transparency and governance.

Assessment tools

The following three tools are adapted from conventional risk management practice and so will be familiar to many council managers and officers.

i. Likelihood scale

A likelihood scale assigns the likelihood of a risk occurring under the chosen climate change scenario. The following table is a demonstration of a likelihood scale that compares five likelihood ratings in the context of recurrent and single event risks.

Table 2 Likelihood ratings, from the DPIE Sustainability Advantage program

Likelihood	Recurrent risks	Single events
Almost certain	Could occur several times per year	More likely than not – probability greater than 50%
Likely	May arise about once per year	As likely as not – 50/50 chance
Possible	May arise once in 10 years	Less likely than not but still appreciable – probability less than 50% but still quite high
Unlikely	May arise once in 10 to 25 years	Unlikely but not negligible – probability low but noticeably greater than zero
Rare	Unlikely during the next 25 years	Negligible – probability very small, close to zero

When undertaking the risk analysis, it is important to remember that the likelihood refers to the likelihood of a risk event occurring under the chosen climate change scenario; that is, when considering the likelihood of the risk, it must be assumed that the scenario is certain to occur.

ii. Consequence ratings

Evaluating the consequences of a risk means asking, ‘How bad is it likely to be?’. Risks can affect a council in different ways depending on objectives (success criteria) and the thresholds that define the various levels of consequence will vary from council to council.

Table 3 Example consequence rating, from the Australian Greenhouse Office guide (AGO 2006)

Rating	Consequence \ criteria				
	Public safety	Local economy and growth	Community and lifestyle	Environment and sustainability	Public administration
Catastrophic	Large numbers of serious injuries or loss of lives	Regional decline leading to widespread business failure, loss of employment and hardship	The region would be seen as very unattractive, moribund and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fall into decay and cease to be effective
Major	Isolated instances of serious injuries or loss of lives	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be seen to be in danger of failing completely
Moderate	Small numbers of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under severe pressure on several fronts
Minor	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under severe pressure
Insignificant	Appearance of a threat but no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	There would be minor instances of public administration being under more than usual stress but it could be managed

iii. Risk matrix

The design of this risk priority rating table will reflect the council’s level of aversion to risk. If a council is risk-averse, the table will contain many cells which are rated ‘high’ or ‘extreme’ risk and, as such, must be dealt with quickly (given the risk response). Alternatively, where a council is more inclined towards risk-taking, many risks will be rated ‘low’ or ‘medium’, meaning they do not require urgent attention.

Councils that already have risk priority tables may find them appropriate to use, but they should consider whether the nature of the risks that result from climate change will warrant any change to their existing rating system.

If council does not have an existing risk matrix, the following matrix can be used.

Table 4 Risk rating matrix, from the DPIE Sustainability Advantage program

Consequences		Catastrophic	Major	Moderate	Minor	Insignificant
Likelihood	Almost certain	Extreme	Extreme	High	Medium	Medium
	Likely	Extreme	High	High	Medium	Low
	Possible	High	High	Medium	Medium	Low
	Unlikely	Medium	Medium	Medium	Low	Low
	Rare	Medium	Low	Low	Low	Low

Conducting the risk assessment workshop

It is recommended the key risk assessment activities are carried out as a single exercise in a workshop setting to ensure a consultative and inclusive process. The workshops ideally involve all members of the project team and a broad range of council staff from across all functional areas of council.

Module 3 of the [LGNSW Building Resilience to Climate Change](#) workshop package provides guidelines on how to run a workshop, including preparing materials, roles and responsibilities of a facilitator, and documenting results.

TIP: Accessing useful materials

[LGNSW](#) has many free online resources to assist the climate change risk assessment process such as a workshop package that includes:

- a template for a climate change action plan
- evaluation forms
- group activities and facilitation techniques
- PowerPoint presentations
- technical guidance and references
- risk assessment tools and templates
- step-by-step guide to facilitating structured workshops and meetings
- examples and case studies.

[AdaptNSW](#) also has a range of resources to support councils as they undertake this process, including:

- interactive maps by region
- information on the impacts of climate change
- Regional Vulnerability Assessments
- adaptation planning check lists.

For councils that are members of [Sustainability Advantage](#), there are many useful supporting materials available to you such as:

- how to write a risk statement
- workshop activity sheets
- regional climate snapshots
- implications of climate change check sheet
- risk management plan template.

Step 10: Key workshop activities

Identify risks and opportunities

Risks are identified by describing and listing how the climate change hazards from the chosen scenario or relevant regional snapshot from Step 6, could impact on each of the key elements of the organisation, identified in Step 8.

Reviewing previous climate change risk assessments, if they exist, will help identify if a risk has changed.

The risk assessment team should consider each of the risks posed to key organisational elements by each climate variable. There might be opportunities as well as negative outcomes as a result of climate change.

Each risk can be described in the following order:

- climate change hazard
- impact on a key element of council operations
- success criteria affected.

For example: 'Flooding and inundation [*hazard*] damaging council infrastructure [*impact*], which reduces public safety [*success criterion*]'.

The climate change hazard and impact on council operations might affect several success criteria. So that these risks can be more readily prioritised, it is important that each risk is identified and rated separately.

For example, flash flooding might have catastrophic consequences for public safety, but only moderate consequences for sustainability, and minor consequences for public administration.

Risk identification needs to include consideration of knock-on effects or incremental impacts of particular consequences, such as cascade and cumulative effects. For example, a direct risk could be flooding or inundation damaging council infrastructure, reducing public safety. An indirect risk would be flooding or inundation damaging state-owned roads, which in turn prevents council maintenance vehicles getting to problem areas.

Identify risk interdependencies

Identifying and understanding risk interdependencies is a relatively new part of the climate change risk assessment process. It can help capture and manage additional risks that whilst falling outside council’s direct control, can still have a big impact on council’s assets, operations and community. Strong stakeholder engagement is needed to understand and address interdependent risks as they are invariably multi-disciplinary with multiple owners. By identifying what these risks are and who has control to manage them, council can understand its risk exposure and required adaptation response.

Managing interdependencies is not new for councils in New South Wales. The crucial coordination role played by the local emergency management officer (LEMO) helps manage interdependent risks in times of emergency. Just like the ongoing engagement needed to develop and maintain an effective Local Emergency Management Plan, climate change risk interdependence requires coordination, active relationships and careful planning.

Example questions to ask in the assessment workshop:

- What critical infrastructure do we depend on, that is not under our control? Examples are stormwater, electricity, gas, roads, bridges, ICT, etc.
- What social infrastructure and services do we rely on that are not under our control? Examples are social housing, health care, etc.
- Who controls these?
- Are they managing climate change risks for that infrastructure?
- Could we collaborate to manage the risk?

The risk analysis table in Figure 4 below has an added column to a conventional analysis, to capture interdependencies that are identified in the analysis.

Understanding council’s spheres of influence is very helpful when analysing risk interdependence. The model shown in Figure 3 is used by several NSW councils to articulate what comes under council’s control, what it can influence, and what council neither controls nor influences, yet has concern over outcomes. This can be a very useful way of breaking down an interdependent risk and working towards a practical adaptation response.

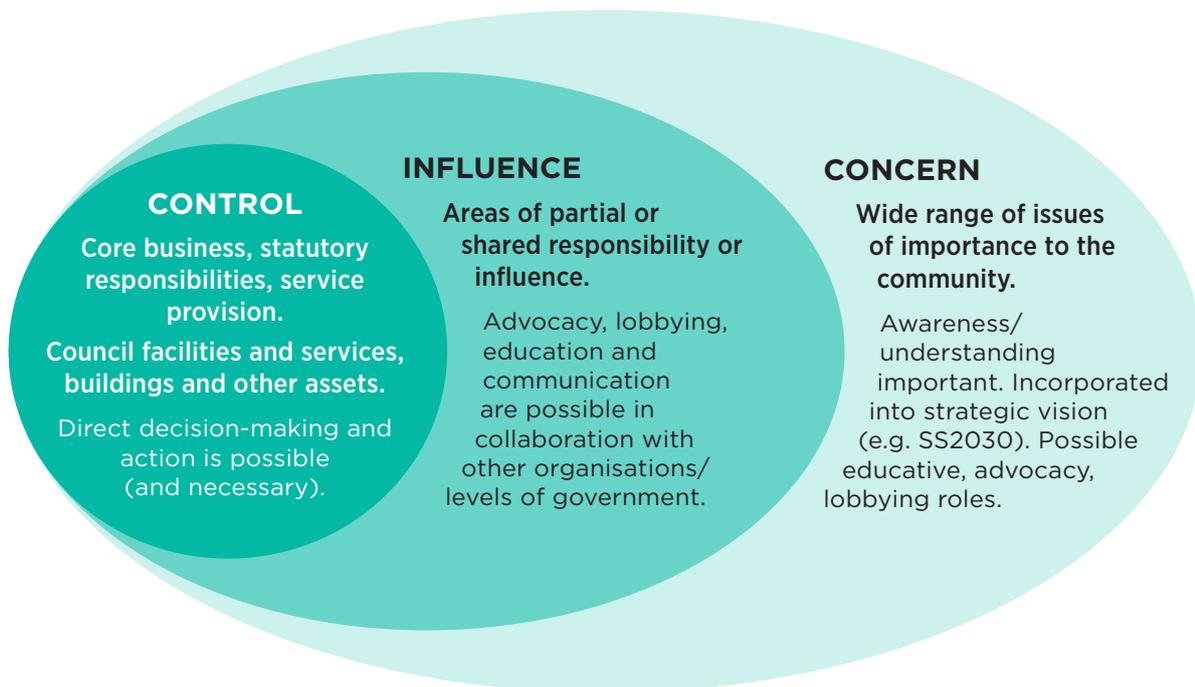


Figure 3 Spheres of influence diagram from *Adapting for Climate Change: A long term strategy for the City of Sydney*, also used by several other councils

Analyse the risks

Once identified, risks need to be systematically analysed using the framework and tools in Step 9. Risk is analysed by identifying the consequence and likelihood in the context of existing controls, enabling them to be prioritised.

When performing a climate change risk assessment, analysis of consequence and likelihood can be subjective, based on the team's opinion on whether a particular outcome will occur. This expert opinion needs to be supported by objective inputs such as accurate information on past events, case studies and peer reviewed literature.

Assumptions underlying the analysis need to be made clear.

Risks are analysed in the context of existing controls and magnitude of consequence and likelihood before a priority rating is assigned.

Analyse existing controls

During the risk assessment, it is assumed that the chosen climate change scenario is occurring. To analyse existing controls the risk assessment team identifies any current controls that would reduce the consequence or likelihood of each risk and their effectiveness. Only existing controls that are funded and do not need further work to be implemented should be considered in this stage.

For example, council might have planning controls that require buildings to be a certain height above the current flood level. This control is currently effective, but may be less so if climate change increases the intensity and frequency of rain. In this instance, the control's effectiveness rating will be low, in the context of the climate change risk assessment.

Analyse magnitude of consequence and likelihood

In this stage the magnitude of the consequence of an event and its likelihood of occurring are determined.

Consequence and likelihood are considered in the context of:

- the climate change scenario being considered
- existing controls to manage the risk.

Assign the risk priority rating

From the analysis of consequence and likelihood, the risk rating can be obtained using the risk priority table developed in Step 9; see Figure 4. This process is carried out for each risk, within the chosen climate change scenario. See Table 4 for a template matrix for analysing risks, including an example risk analysis.

Guidance on integrating the results of multiple scenarios can be found in Section 5.5 of the AGO Guide.

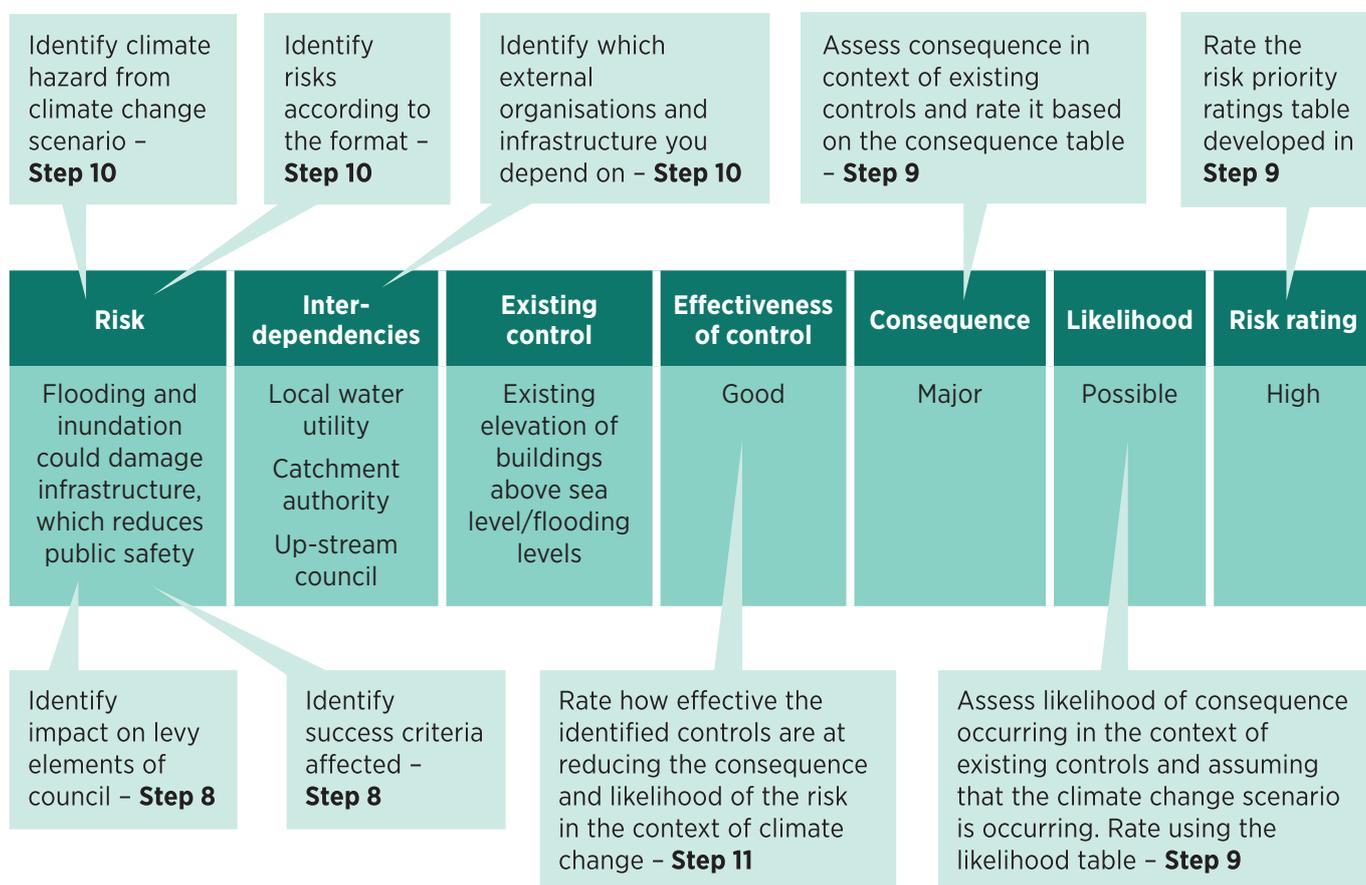


Figure 4 Annotated example risk analysis table – Step 10

Evaluate the risks

Evaluation helps to prioritise identified risks. Step 9 shows how to develop a priority rating for each risk of extreme, high, medium or low, based on likelihood and consequence scales. Here, all of the risks are put into one list and ordered by their priority, either by success criteria or aggregated risk exposure or risk rating.

Once any duplicates are eliminated, the first stage of evaluation is to adjust any risks that appear to be over or underestimated by checking that the risk priority ratings:

- are consistent with one another
- are logical
- sit within council's operational context.

Once all risk ratings are finalised, priority risks need to be placed in order, starting with those requiring the most urgent action and stating what that action would be. Ranking the priority risks is important as councils have finite resources and are unlikely to be able to address all risks simultaneously.

A single climate change hazard can pose multiple risks due to its impacts on a number of success criteria; see *Identify risks and opportunities* above. In this situation the evaluation can be simplified by ranking each success criteria and/or determining an aggregated rating. This will facilitate prioritisation and allow a council to understand the best way to respond to this climate change hazard.

Using the example from above of flash flooding, this may have a catastrophic consequence for public safety, but a moderate and minor consequence for sustainability and public administration, respectively. Where this is the case, the risk to public safety is the highest risk and is the priority.

Factors that can be considered in the evaluation include:

- Is it council's responsibility to mitigate the risk or is an emergency agency responsible?
- Is it council's responsibility to manage the risk?
- Can council make an effective contribution to finding a solution?
- What is the wider organisational context for the identified risks?
- What is council's tolerance for the risks?
- Are there any regulatory, legal or other requirements to consider?
- How much uncertainty is associated with the risk assessment?
- Is there likely to be any cost-effective way to address the risks, for example, adaptation responses that deal with multiple risks?
- Are there any information gaps?
- Is further work needed?

Acting on the results

Step 11: Develop risk treatments, and write up and communicate results

Adaptation and treating the risks

Acting on the results is vital; once the risks for council from climate change have been identified, the actions needed to treat the risks and adapt to the changing climate can be planned and delivered.

Adaptation to climate change is defined as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Risk treatments developed and implemented by an organisation in response to a climate change risk assessment can be regarded as a type of climate change adaptation.

The following can be considered when developing a response:

- aim for a balance between climate and non-climate risks; risks from climate change are not the only risks that councils face and treating them must be balanced against the need to treat non-climate risks
- manage priority climate change risks; focusing on high priority risks or areas with greater certainty will help to ensure a targeted adaptation effort
- use adaptive management that involves small, flexible, incremental changes based on regular monitoring and revision of plans based on information available at the time
- look for win/win or no regrets options
- avoid adaptation constraining decisions or maladaptation, by keeping future options open
- focus on cost-effective actions so council has a clear understanding of the costs, benefits and likely effectiveness of alternative adaptation options as well as the financial impacts of no action
- include some new ways to fund possible responses, including inviting investment from stakeholders potentially most affected by climate change
- review treatment strategies.

The process for identifying adaptation options can be similar to that used in the risk assessment, with the adaptation team including a cross section of council staff, with expertise in the risks identified, and external stakeholders such as neighbouring councils, and service and utility providers.

Steps include:

- reviewing existing risk controls to identify why current controls are insufficient
- identifying changes in thinking or new measures to overcome gaps.

Approaches to risk treatment can include:

- spreading the risk by ensuring adequate insurance
- making structural or engineering adjustments, such as building larger stormwater retention basins in response to a projected increased intensity of rainfall events
- amending council policies, strategies and plans to increase setback distances for fire management in development control plans or planned retreat strategies for vulnerable areas
- changing or developing institutional structures and decision-making systems by seeking input from external experts when making regional transport decisions in light of climate change
- further researching risk, such as developing more refined projections of rainfall to inform flood modelling accuracy
- providing education or behaviour change programs, such as professional development programs for asset management staff on climate change and asset planning, or community information packages on future flood risks and management controls.

While many of these examples build on existing emergency response and risk management systems, adaptation planning can include new ways of thinking about how more resilient communities can be designed and built using innovation and integrated solutions.

Climate change has potential implications for almost all council functional areas. Integrating climate change risk into existing corporate risk management systems and reporting frameworks, including business continuity planning, helps

ensure that climate related risk is considered in all local government decision-making processes.

The AGO Guide (AGO 2006) has detailed guidance on risk treatment approaches. See Attachment 3 for more information on adaptation and risk treatment. LGNSW also has examples of climate change adaptation case studies.

Vulnerability assessments

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes (IPCC 2007⁶).

It is determined by:

- exposure to climate hazards at a local scale
- sensitivity to climatic variability
- capacity to adapt.

A good starting place when seeking to understand local climate vulnerability is the DPIE-led Integrated Regional Vulnerability Assessments (IRVAs) by State Planning Region, which are:

- Central West Orana
- Far West
- Hunter Central Coast
- Illawarra Shoalhaven
- New England North West
- North Coast
- Riverina Murray
- South East
- Sydney.

Understanding vulnerability is central to identifying adaptation needs and developing associated policies. A vulnerability analysis helps local government explore the climate change risks to the community or analyse climate change risks in cooperation with other councils in the region. It can facilitate the analysis of more complex and socially driven elements of climate change risk that exist in an assessment.

Vulnerability assessment and risk assessment can be complementary processes. Vulnerability assessment looks inwards and measures the susceptibility of council to harm, whereas risk assessment looks outwards to assess the likelihood and consequence of a specified harm occurring.

Adding a vulnerability assessment to a risk assessment can further prioritise responses. For example, areas where a council faces medium risk but has high vulnerability call for more urgent action.

Reporting the results

Results of the climate change risk assessment need to be documented and ideally presented widely; to councillors, senior managers and other staff across the organisation, and if appropriate, partner agencies, local business and the wider community.

The climate change risk assessment report clearly identifies priority risks and documents methods used to identify, analyse and evaluate these risks. This provides an evidence base for the council to develop and implement an adaptation plan with identified actions, resources and timeframes. Developing adaptation strategies also provides opportunities for the risk assessment to be reviewed and updated.

6 IPCC 2007, 'Climate Change 2007: Impacts, adaptation and vulnerability', contribution of Working Group II to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson [eds]), Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York.

Step 12: Embed risk treatments

Embedding the treatment of the identified climate change risks is vital to the success of the assessment process. In addition to the relevant components of the IP&R framework (see [Incorporating climate change risk into the IP&R framework](#) on page 3) there are several key council documents that need to reflect what has been learned through the climate change risk assessment. These include the:

- Corporate Risk Register
- Business Continuity Plan
- Community Strategic Plan.

Council's decision-making processes must also reflect what has come out of the risk assessment. For example, is there a need to change existing governance to ensure the outcomes of the assessment continue to inform decision-making, or to change monitoring and reporting processes to include metrics and targets developed through the climate change risk assessment?

Embedding climate change risk into asset planning

Asset management is a systematic process to guide the planning, acquisition, operation and maintenance, renewal and disposal of assets, and is fundamental to overall council service delivery and planning.

An asset management strategy identifies assets critical to operations and risk management strategies for these assets. It includes actions needed to improve the asset management capability, projected resource requirements and timeframes.

A risk register can facilitate the integration of a climate change risk assessment into the asset management strategy. The register matches the level of risk with treatment options for affected assets; see Figure 5.

Climate Change Asset Risk Register									
Asset ID #	Asset type	Location	Climate risk	Asset risk timeframes			Win/Win and no regrets action	Future trigger/ timeframe	Treatment options
				Current	Short-term	Long-term			
123	Pump station	1 Smith Rd	Coastal erosion	Medium	High	Extreme	Monitor	When erosion escarpment is within Xkm of structure	Identify adaptation options
1234	Major road	Smith Rd	Flooding	Low	Medium	High	Monitor	When flooded X times a year	Identify adaptation options
12345	Minor road	50 Smith Rd	Coastal inundation	Low	Low	Medium	Monitor	When inundation X times a year	Identify adaptation options
123456	Water main	1 Steep Rd	Hillslope erosion	High	High	Extreme		Trigger activated – intervention required	
1234567	Remote IT trans-missions	435 Long Rd	Heat	Medium	High	Extreme	Monitor	Number of outages per year	

Figure 5 Example of a climate change asset risk register

The location of the asset, its age and condition, and adaptation measures currently in place, will affect climate change impact. [Practice Note 12.1: Climate Change Impacts on the Useful Life of Infrastructure](#) provides a methodology and guidance for asset managers on how to assess the impact of climate change on infrastructure useful life to the year 2100.

Resourcing strategy, delivery program and operation plan

Based on the IP&R framework, a resourcing strategy quantifies the financial commitment to implement strategies established in the community strategic plan and is critical to the planned and costed implementation of actions to reduce climate change risk.

Under this model, strategic financial planning is undertaken for a 10-year period, to accommodate longer-term infrastructure and planning commitments; however, actions needed to effectively implement a climate change risk assessment can extend beyond this 10-year cycle yet need to be reviewed at least every five years. Identified treatments of climate change risks are implemented through schedules and detailed project and budget planning established in the four-year delivery program and annual operational plans.

Ongoing review

As with any quality system, continuous monitoring and review are important to the climate change risk assessment process, as information is being continually updated. Once climate change risks have been fed into council’s corporate risk management process, the review of climate risks will be included along with the review and monitoring of all council’s risks.

Monitoring and review can:

- incorporate new climate change data
- check that controls are effective (what has worked and what hasn’t?)
- include new information gained from events
- account for changes in context
- identify new risks and opportunities
- report back through the annual report process.

It is recommended that the risk assessment be reviewed on a regular basis; every five years or when triggered by the availability of new data or an event prompts the reassessment of council’s risk management plans. Figure 6 references the climate change risk assessment stages (in Figure 2) in the form of a continuous improvement cycle, which is the final component of the risk assessment process.

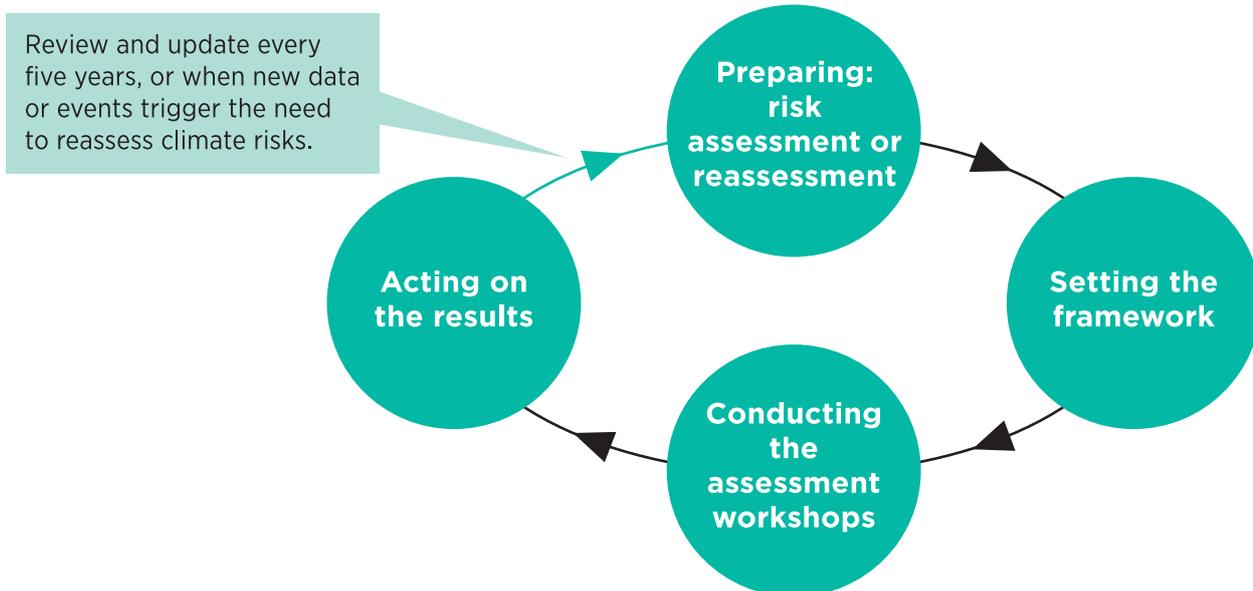


Figure 6 The review cycle is a key part of successful climate change risk management

Attachment 1: Case studies – adaptation in action

CASE STUDY 1: Parkes Shire Council – Climate change risk assessment to inform critical infrastructure design

The proposed scheme aligns with council's commitment to incorporating climate change adaptation and mitigation into existing operations.

Parkes Shire Council is establishing a recycled water scheme (RWS) as part of its integrated water cycle management strategy (IWCM). The RWS will help reinforce the water security and drought resilience of the Parkes water supply and reduce potable water consumption. The proposed scheme aligns with council's commitment to incorporating climate change adaptation and mitigation into existing operations. In 2014–15, funding was secured for an RWS, comprising an advanced water recycling facility and a recycled water rising main to distribute recycled water for municipal irrigation purposes within the township. If the scheme proves successful, additional connection options to other end users will be investigated in future phases.

To understand and design for climate change impacts on the planned infrastructure, council undertook a climate risk and adaptation assessment (CRAA) with the assistance of external consultants. The assessment was completed in line with the requirements outlined in AS 5334:2013 and the Infrastructure Sustainability Council of Australia (ISCA) rating scheme¹. Through a multi-stakeholder workshop and engagement process, and using NARClIM projections from AdaptNSW, the CRAA identified climate effects relevant to the project and provided an assessment of the potential climate risks to the proposed works. The process also identified critical interdependencies on other infrastructure providers as well as appropriate risk management and adaptation measures to be incorporated into the construction and operation phases, to build the resilience of the proposed works to changing climate conditions.

The risk assessment identified that the proposed water infrastructure was vulnerable to climate hazards with extreme risk events including heat waves, flooding, extreme rainfall and bushfire. Adaptation options were identified, assessed and are in varying stages of implementation, to treat the identified very high and high risks for both the 2030 and 2070 time periods. The key risks revolved around:

- loss of power resulting from extreme events
- direct impacts of extreme weather on pumps and building structures

¹ [Infrastructure Sustainability Council of Australia \(ISCA\) Rating Scheme](#) version 1.2 relating to Cli-1: Climate Change Risk Assessment and Cli-2: Adaptation Measures.



High quality recycled water will be used for open space irrigation around Parkes. Source: Parkes Shire Council

- risk to health and safety of staff needing to undertake work during extreme events, and
- isolation and/or loss of access to assets during extreme rainfall events, flood events or extreme storms.

The ability of each adaptation action to treat very high, high and medium risks was then tested in the residual risk assessment that was undertaken for the project. Each risk statement was reviewed with various adaptation actions applied to help treat and subsequently reduce the risk rating. In most instances, multiple adaptation actions could be applied to an individual risk, while a single adaptation action could also be applied to multiple risks.

As a result of the CRAA, no residual high or very high risks remained, and some operational procedures were identified that need to be updated or established.

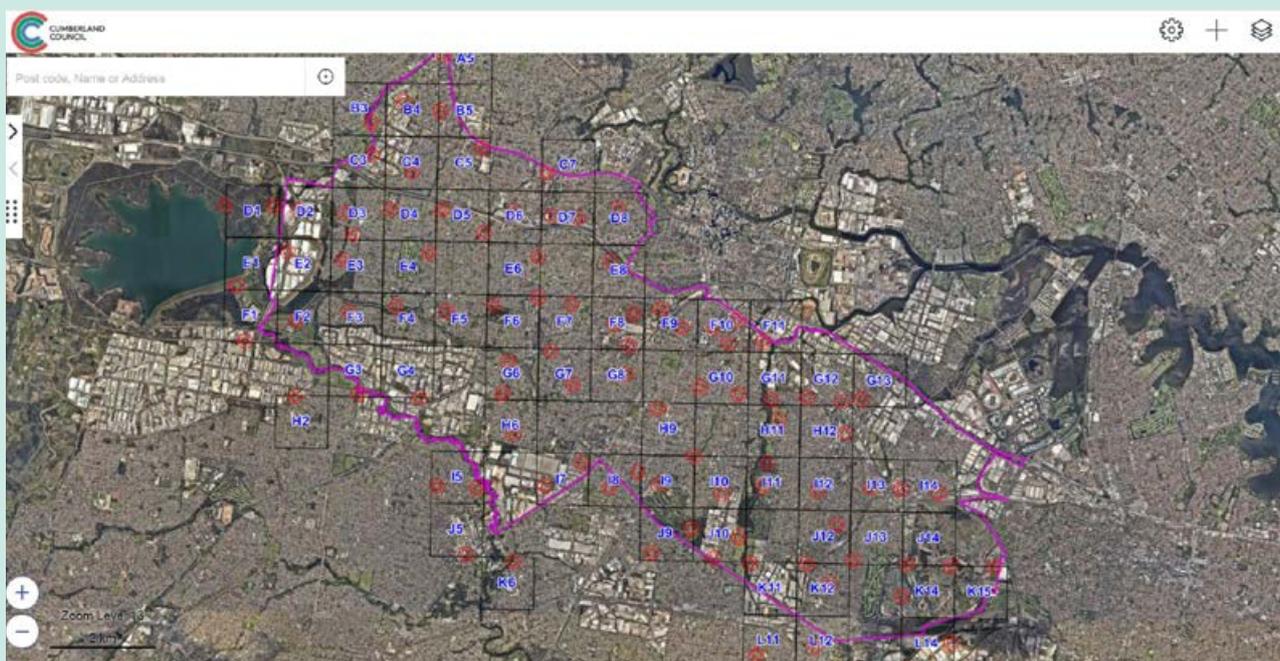
CASE STUDY 2: Cumberland Council – Outdoor Ambient Air Temperature (OATH) Project

Council collaborated with Western Sydney University to install 100 heat sensors throughout the LGA, collecting air temperature readings at 10-minute intervals for three months during the summer of 2018–19.

This project was conceived to better understand the emerging issue of the urban heat island (UHI) effect in the Cumberland Council local government area (LGA) in Western Sydney. Council collaborated with Western Sydney University to install 100 heat sensors throughout the LGA, collecting air temperature readings at 10-minute intervals for three months during the summer of 2018–19, to identify microclimates and other locally-specific insights. The sensors logged data to enable analysis of the following:

- detailed analyses of day- and night-time temperatures
- detailed analyses of spatio-temporal variation of thermal regimes (ranking, etc.)
- geo-referenced maps of temperature distribution across the LGA
- geo-referenced streaming videos depicting daily/weekly evolution of air temperature variation
- special emphasis on analyses of data recorded during heat waves
- comparison of the ability of different tree species to affect ambient air temperatures.

Mayor Greg Cummings said ‘to know how hot it feels to residents, we need to record the air temperatures across the whole LGA. This is what the heat sensors are doing now. [The project] will help us create policies that keep residents cool and safe; contribute to future developments and planning controls; and understand the impact of heat on people’s movements and use of public spaces.’



GPS locations of the heat sensors throughout the Cumberland LGA. Source: Cumberland Council GIS team

CASE STUDY 3: Burnett Catchment Flood Resilience Strategy – an interstate example of managing interdependent risks

The purpose of the project was to partner with local councils and organisations that have lived through significant disaster-led response and recovery challenges in recent years, to test a more people-centric approach to flood resilience.

The Queensland Reconstruction Authority facilitated a multi-stakeholder planning process in the Burnett catchment to build upon local leadership and hard lessons learnt in the region following the devastating floods of 2011 and 2013. The purpose of the project was to partner with local councils and organisations that have lived through significant disaster-led response and recovery challenges in recent years, to test a more people-centric approach to flood resilience.

This integrated approach to catchment planning was a new take on the traditional process of flood risk management. Completed in May 2018, it involved:

- Queensland Government – including state agencies and government-owned corporations
- Bundaberg Regional Council
- Cherbourg Aboriginal Shire Council
- North Burnett Regional Council
- South Burnett Regional Council
- community groups and non-government organisations.

Collaboration and integrated engagement were seen as critical to the development of this strategy due to the many organisations and jurisdictions impacted by flooding. The multi-disciplinary approach involved professionals from many fields including:

- mental health
- engineering
- land-use planning
- community and economic development
- disaster management
- transport
- environmental management
- communications.

Through a series of workshops, which at times involved experts (literally!) walking over large-scale maps of the catchment, the many stakeholders identified interdependent vulnerabilities and resilience measures that are central to the Flood Resilience Strategy.

Implementation of the strategy will now be overseen by the Wide Bay Burnett Regional Organisation of Councils (WBBROC), building on the actions and opportunities identified by the strategy. A Regional Resilience Officer has been funded from the National Disaster Resilience Program 2017-18 to coordinate the strategy on behalf of WBBROC.

A key learning of the work has been the importance of relationships in developing shared solutions to common problems, and for sustaining commitment to implementation over time.



Sharing issues and challenges in a common workspace – the stakeholders’ ‘backyard’. Source: Burnett Catchment Flood Resilience Strategy

A key learning of the work has been the importance of relationships in developing shared solutions to common problems, and for sustaining commitment to implementation over time. It involved different disciplines examining and discussing common issues, reaching consensus on actions, and identifying collective solutions that could be advanced either internally or through funded opportunities available at state or federal level.

The people-centred focus of developing the Burnett Catchment Flood Resilience Strategy highlighted that local energy and commitment, coupled with regional coordination of effort for efficiency, all supported by state-level resources and funding, is a model for future resilience planning and implementation across Queensland.

The learnings from the Burnett work are being further tested in other parts of Queensland through delivery of three other pilot projects, in the Central West, Mary River, and Fitzroy River regions. The pilots in these additional areas are adding to the body of knowledge around working together to develop shared solutions to common resilience problems.

Building on learnings from all four pilots, statewide rollout of similar regional resilience strategies is intended from January 2020 as part of continued delivery of Resilient Queensland 2018–21, the implementation plan for the Queensland Strategy for Disaster Resilience.

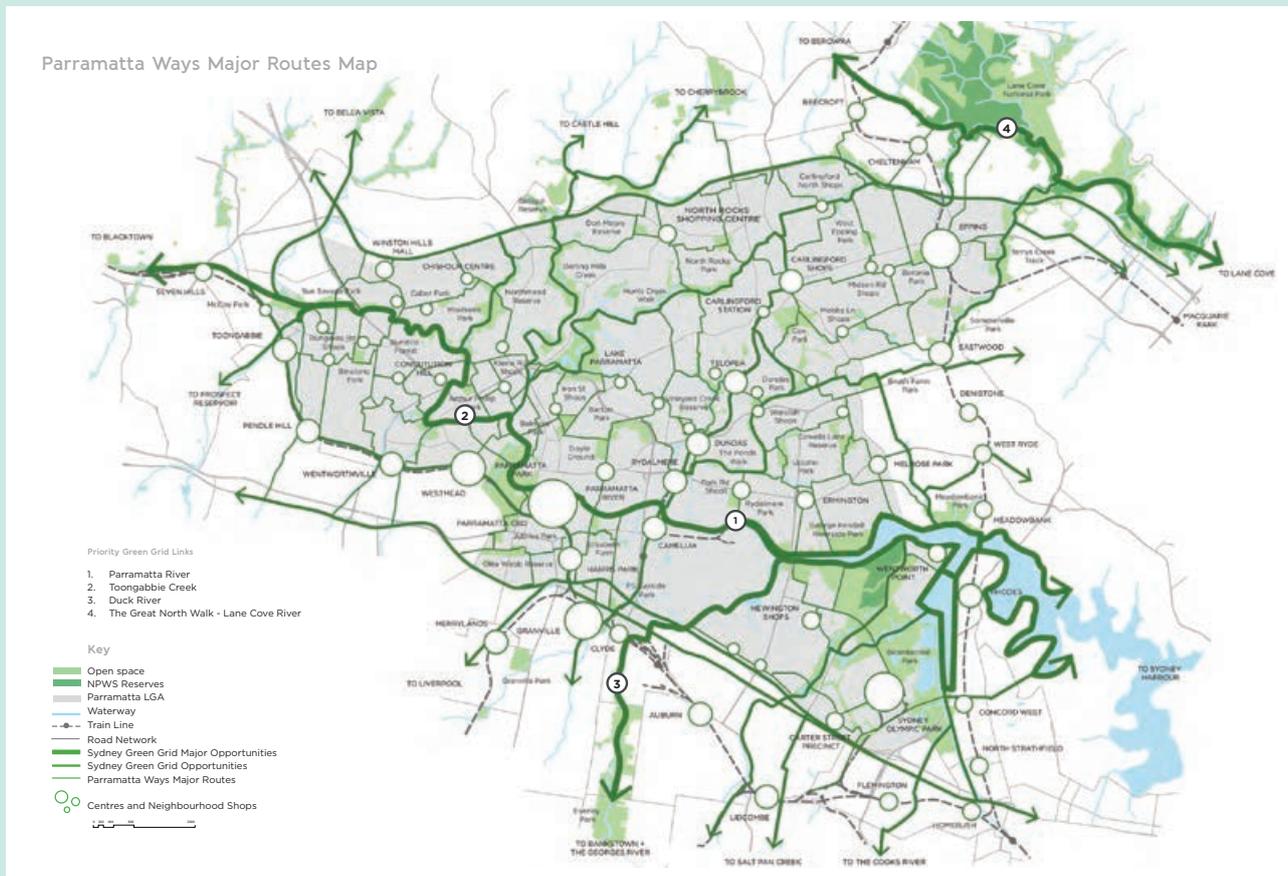
CASE STUDY 4: City of Parramatta – active transport strategy, Parramatta Ways

To make the city more walkable, council is working to better connect people to these places and support walking in their everyday journeys.

Parramatta Ways is a plan to improve walkability across Parramatta. Walkability is a measure of how pleasant and attractive an area is to walk. Internationally, it is recognised as one of the key aspects that make a city liveable. Anticipated co-benefits include:

- reduced urban heat island
- reduced flood risks
- carbon and energy savings
- increased biodiversity
- improved water-sensitive urban design (WSUD)
- improved resident and visitor wellbeing.

Parramatta has many great destinations such as parks, natural bushland and heritage sites that provide good reasons to walk. To make the city more walkable, council is working to better connect people to these places and support walking in their everyday journeys.



Parramatta Ways will create an extensive network of streetscapes and green corridors.

Source: Parramatta Ways Walking Strategy

Together these streetscapes and green corridors provide an opportunity to create an extensive network, tying together the places people live and work with great places to visit.

At the core of this strategy is the street network, the local corridors and footpaths that provide access to shops, schools, open space, transport options and community facilities. Some of the key destinations are also the urban creek and open space trails that form green corridors across Parramatta. Together these streetscapes and green corridors provide an opportunity to create an extensive network, tying together the places people live and work with great places to visit.

As a result, the Parramatta Ways Walking Strategy is not just about transport but also a plan for increasing urban greening, recreation and local centre amenity. It is about continuing to improve the quality of the LGA's streetscapes, open space and river corridors to make the city more attractive for walking.

To realise Parramatta Ways, council will bring together the existing programs of work and teams across council that are already delivering outcomes such as transport, streetscapes, urban greening, recreation, environment, place making, city activation, water-sensitive urban design, heritage, and urban heat island effect mitigation.

CASE STUDY 5: City of Penrith, adaptation in action – revision of the CBD drainage strategy

It also challenged a long-held local assumption that the Penrith CBD would not flood, as it sits 'above' the Nepean River.

In response to flooding events in the Penrith CBD, council undertook a review of its CBD drainage strategy. This involved revisiting a key flood risk management question: what level of stormwater damage is acceptable? It also challenged a long-held local assumption that the Penrith CBD would not flood, as it sits 'above' the Nepean River (as opposed to sitting within its floodplain and also being affected by the local overland flow flooding). The review was supported by a cost-benefit analysis of the existing and proposed drainage standard.

The council's engineering team benchmarked other regional cities (Liverpool, Parramatta, Gosford, North Sydney) to understand the standards applied by comparable councils, as well as looking further afield to Austroads and the Queensland Urban Drainage Manual. The team investigated a range of options and drainage system components, including:

- various detention basins in the catchment
- additional pipework
- flow deflection levees
- downstream control devices to address stormwater quality.

After a thorough review, council adopted an updated strategy in May 2015 which changed the drainage pipe capacity:

- from 5 to 10-year average recurrence interval (ARI) for residential areas, and
- from 20 to 50-year ARI for commercial, business and industrial areas.



Floodwaters lapping at the steps of the Penrith RSL Club. Source: [Penrith City Council Floodplain Management](#)

Attachment 2: Glossary

Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities
Assessment team	The team that will be responsible for identifying and evaluating risks at the risk assessment workshop
Climate change scenario	A coherent, plausible but often simplified description of a possible future state of the climate as influenced by climate change. It is not a prediction about the future, but rather it provides a means of understanding the potential impacts of climate change
Event	Occurrence of change of a particular set of circumstances
Likelihood	Chance of something happening. Generally described in terms of probability or frequency. It can be expressed qualitatively or quantitatively
Risk	The effect of uncertainty on objectives
Risk assessment	The overall process of risk identification, analysis and evaluation
Risk analysis	A systematic process to understand the nature and level of risk based on the consequence of an event and the likelihood of that consequence
Risk evaluation	The process of comparing the level of risk identified in the risk analysis against risk criteria, to inform decisions about risk treatment
Vulnerability	The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity

Attachment 3: Relevant resources

Resource	Source	Link
IP&R framework	NSW Office of Local Government	www.olg.nsw.gov.au/councils/integrated-planning-and-reporting
AdaptNSW website	NSW Government	climatechange.environment.nsw.gov.au/
NSW Climate Data Portal	NSW Government	climatedata.environment.nsw.gov.au/
The Guide to Integrated Regional Vulnerability Assessment (IRVA) for Climate Change (OEH 2013 ¹)	NSW Government	www.environment.nsw.gov.au/resources/climatechange/130016IRVAguide.pdf
Climate change risk resources and case studies	Local Government NSW	www.lgnsw.org.au/policy/planning-climate-change
How to conduct a climate change risk assessment	CoastAdapt	coastadapt.com.au/how-to-pages/how-to-conduct-a-climate-change-risk-assessment
Sea level rise information for all Australian Coastal Councils	CoastAdapt	coastadapt.com.au/sea-level-rise-information-all-australian-coastal-councils
NCCARF Adaptation Library	National Climate Change Adaptation Research Facility (NCCARF)	www.nccarf.edu.au/adaptation-library
NCCARF Local Government Portal	NCCARF	www.nccarf.edu.au/localgov/
Goal 13: Take urgent action to combat climate change and its impacts	United Nations Sustainable Development Goals (SDG)	www.un.org/sustainabledevelopment/climate-change/
Climate Change Impact and Risk Management – A Guide for Business and Government	Australian Department of the Environment and Energy	www.environment.gov.au/climate-change/adaptation/publications/climate-change-impact-risk-management
Practice Note 12.1: Climate Change Impacts on the Useful Life of Infrastructure	The Institute of Public Works Engineering Australasia (IPWEA)	www.ipwea.org/publications/ipweabookshop/pn12-1
Resources Portal and Common Reporting Framework	Global Covenant of Mayors for Climate Change & Energy	www.icleioceania.org/global-covenant-of-mayors-for-climate-energy
Climate-ready planning laws for NSW and beyond	Environmental Defenders Office NSW	issuu.com/envirodefenders/docs/edo_cc_report_singles/1?ff&e=35832012/68566748
Climate Change Litigation	Environmental Defenders Office NSW	www.edonsw.org.au/climate_change_litigation
AS/NZS ISO 31000:2018 Risk Management – Guidelines	Standards Australia via SAI Global	infostore.saiglobal.com/en-au/Standards/AS-ISO-31000-2018-1134720_SAIG_AS_AS_2680492/

1 OEH 2013, Guide to Integrated Regional Vulnerability Assessment (IRVA) for Climate Change, NSW Office of Environment and Heritage, Sydney.

Resource	Source	Link
AS 5334:2013 Climate change adaptation for settlements and infrastructure – a risk based approach	Standards Australia via SAI Global	infostore.saiglobal.com/en-au/Standards/AS-5334-2013-119943_SAIG_AS_AS_251367/
NSW Heat Vulnerability Index	NSW Government	datasets.seed.nsw.gov.au/dataset/3b59f3c4-51e2-40c3-af35-e7a7a63fd207
Risk Management Guidelines: Companion to AS/NZS 4360:2004 (AS/NZS 2005)	Standards Australia via SAI Global	www.saiglobal.com/PDFTemp/Previews/OSH/as/misc/handbook/HB436-2004(+A1).pdf
Emissions Scenarios: Summary for Policymakers	United Nations Intergovernmental Panel on Climate Change	www.ipcc.ch/site/assets/uploads/2018/03/sres-en.pdf
Assets and Risk Tool	100 Resilient Cities	www.100resilientcities.org/tools/assets-and-risk/