NSW GOVERNMENT
Office of Environment & Heritage

Guide to Climate Change Risk Assessment for NSW Local Government

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Introduction

Why assess the risks from climate change?

Growth in the concentration of greenhouse gases in the atmosphere is changing global climate, including in New South Wales. Even if global negotiations succeed in achieving deep cuts in greenhouse gas emissions, further change to the NSW climate and biophysical environment is inevitable. Over the coming years, the state is likely to experience higher temperatures, altered rainfall patterns, a rise in sea level, and changes to natural hazards like bushfires, flooding and heatwaves (DECCW 2010a).

Climate changes will increase the magnitude of risks faced by local councils, sometimes even challenging their ability to maintain infrastructure and provide essential services to their communities.

While many councils have been actively pursuing strategies to reduce their greenhouse gas emissions, there is some evidence to suggest they have only recently begun to prepare for projected changes in climate (ICLEI Oceania 2008; LGSA 2010).

To date decisions on environmental policies, building design and engineering have relied on historical climate conditions. However, we can no longer assume that these conditions will continue in the future. For local councils this means that:

- built assets, such as roads, stormwater drains and buildings, may not be able to withstand future extreme events, such as flooding, fire and intense storms
- land-use patterns may change, with implications for zoning and planning decisions
- there may be an increased demand for council services, such as water supply or community support for the elderly.

By identifying climate change risks, councils will be better able to prioritise and manage these risks and plan how to adapt to them. Early investment in preparation and adaptation planning will help councils avoid or minimise climate change impacts and reduce the costs of adaptation and impacts when they occur.

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 council assets, operations and services
- prioritise risks that require further action as a basis for decision-making and planning.

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 for addressing them.

It is important to note that this guide is focused on assessing the risks to council operations rather than wider community risks. Councils may wish to carry out a separate process to consider these broader risks, in consultation with the community.

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.

Purpose of this guide

This guide is designed to assist councils meet the requirement of the 2011–2012 NSW Waste and Sustainability Improvement Payment Program to prepare a climate change risk assessment for their operations. For more details on the program, go to www.environment.nsw.gov.au/waste/lcwpip.htm.

It will help councils to:

- undertake a qualitative climate change risk assessment for the first time, using a standard approach
- 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.

The guide aims to strengthen the understanding of council staff to use a risk management process to prepare for the impacts of climate change.

Using this guide

This guide outlines a step-by-step process to implement a qualitative climate change risk assessment. It contains practical 'how to' guidance, which complements existing guides and resources, and is tailored to the specific needs of NSW councils.

The guide should be used in conjunction with *Climate Change Impacts and Risk Management: A guide for business and government* (AGO 2006) and *AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines* (AS/NZS 2009).[1] It is also based on the climate change information currently available for NSW. Other relevant documents and resources are referenced throughout the guide.

NOTE: The context of this guide is limited to climate change risks to council assets, operations and services and does not address the risks of climate change to local communities in general.

Where possible, the guide refers to resources, standards and templates relevant to the needs of NSW councils. Councils can also choose to develop their own. Table 1 provides details of the resources relevant to each section of the guide and where they are available.

1 *ISO 31000:2009* incorporates and strengthens *AS/NZS 4360:2004* (AS/NZS 2004)

Table 1 Useful resources, standards and templates

Task	Source	
	Section of AGO Guide	**OEH standards or templates**
Preparing for a climate change risk assessment		
Step 1: Establish why a climate change risk assessment is being undertaken	A2	
Step 2: Assess available resources		
Step 3: Establish internal communication and executive support	A3.2	
Setting the framework for a climate change risk assessment		
Step 4: Determine level of assessment	A3.4	
Step 5: Develop or adopt a climate change scenario	B4.2	Climate change scenarios for NSW regions: www.environment.nsw.gov.au/climatechange/20110593riskassesslg.htm
Step 6: Identify existing data sets and/or gaps		
Step 7: Identify the scope and key elements of the assessment	B4.3	Example key elements for risk identification: page 11
Step 8: Select an assessment team	B4.4	Suggested composition of an assessment team: pages 11–12
Step 9: Establish an evaluation framework	B4.5	Standard risk evaluation frameworks for local government: pages 12–15
Conducting a climate change risk assessment workshop		
Step 10: Identify risks	B5.3	Appendix 2: Example climate change risks
Step 11: Analyse risks	B5.4	
Step 12: Evaluate risks	B5.5	
Reporting the results		

Overview of the climate change risk assessment process

AS/NZS ISO 31000:2009 (AS/NZS 2009) provides principles and guidelines for managing risk within an organisation. The standard can be used to organise and review existing risk management systems or establish a risk management framework, which can then integrate managing risk into an organisation's overall governance.

Climate Change Impacts and Risk Management: A guide for business and government (AGO 2006) ('the AGO Guide') outlines how to integrate climate change impacts into risk management and other strategic planning activities in Australian public and private sector organisations. It adapts the AS/NZS Standard to a climate change context and aims to assist Australian organisations to adapt to climate change. The AGO Guide is consistent with the previous (2004) version of the Australian Standard for Risk Management which with minor changes became the current (2009) version. Both versions of the standard are supported by the *Risk Management Guidelines: Companion to AS/NZS 4360:2004* (AS/NZS 2005).

The AS/NZS Standard and the AGO Guide outline a five-step process for undertaking a climate change risk assessment (Figure 1):

1. Establish the context
2. Identify the risks
3. Analyse the risks
4. Evaluate the risks
5. Treat the risks.

The method outlined in this guide is consistent with *AS/NZS ISO 31000:2009* and broadly follows the AGO Guide, but is tailored to meet the needs of NSW local councils. As such, this guide breaks down the five-step process into more detailed actions and provides examples and templates for critical stages, which can be used by councils.

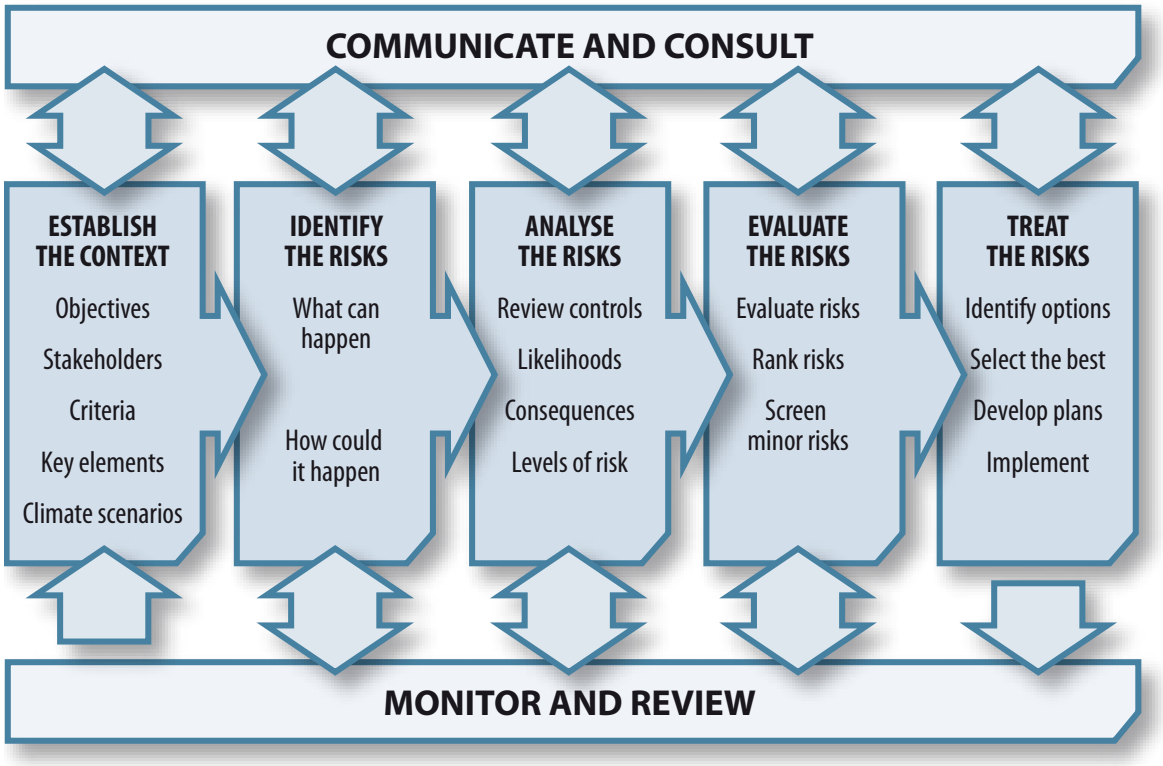


Figure 1 The risk assessment process (AGO 2006)

Preparing for a climate change risk assessment

Step 1: Establish why a climate change risk assessment is being undertaken

Local councils should understand the need for a climate change risk assessment. This will help them determine the objectives of their assessment and the level of assessment required.

Some common reasons for undertaking a climate change risk assessment include:

- where climate change impacts have been identified as affecting a council, but the nature of the risk is unclear
- a voluntary corporate commitment by a council (such as in its corporate plan)
- a need to comply with insurance obligations
- a requirement for regulatory reasons or as part of a state or federal program (such as the NSW Waste and Sustainability Improvement Payment Program)
- a need to update an existing climate change risk assessment or conduct a more detailed assessment of particular risks.

Step 2: Assess available resources

Climate change risk assessment requires a commitment of resources, both staff and financial. The resources required will differ according to the level and method of the assessment, but at a minimum a council will need:

- a staff member to coordinate and drive the process and document the assessment outcomes
- representatives from different operational areas of the council to participate in the assessment process
- resources to undertake a risk assessment workshop.

This guide contains the information and tools to help council staff undertake a qualitative climate change risk assessment. By conducting an assessment internally, councils are able to develop and refine expertise in this area, which is likely to be increasingly important over time as information on future climate change impacts improves.

The guide assumes a climate change risk assessment will be undertaken by council staff with a sound professional knowledge of their local area, council assets and operations, and the risk assessment methodology.

Some examples of climate change adaptation planning, including climate change risk assessments, are available on the Local Government and Shires Association website: www.lgsa-plus.net.au/www/html/1869-risk-management.asp.

In some cases, councils may instead seek to commission a suitably qualified consultant to undertake a climate change risk assessment on their behalf. When selecting a consultant, it is important to confirm that they have a proven track record in preparing these assessments, and that the council has clearly identified the scope and requirements of the assessment.

Councils should consider working with other councils in their region to either develop joint climate change risk assessments, or share information and resources. While some risks will be unique to individual councils, risks will be shared by neighbouring councils. Nearby councils are likely to be subject to similar climate conditions and changes and may have similar population and settlement characteristics.

Examples of collaborative climate change risk assessments include those conducted by the Hunter and Central Coast Regional Environmental Management Strategy for coastal (HCCREMS 2010a) and rural councils (HCCREMS 2010b).

Step 3: Establish internal communication and executive support

Communication is a key element of climate change risk assessment. The process should involve a wide cross-section of the council through the risk assessment team.

As for any significant project, executive support is required. Commitment and support from the general manager, directors and senior staff will help to mobilise resources and ensure efficient delivery of a risk assessment.

Climate change has the potential to affect all aspects of council business. It is therefore important to incorporate the outputs from assessment into everyday business management processes. This can be facilitated by executive involvement.

Once commitment has been obtained it will be important to keep senior staff updated and involved throughout the assessment process.

The results of a risk assessment should be communicated broadly. Local councils should develop a communication plan to disseminate the results both within the organisation and, if desired, to external stakeholders and the community.

A communication plan might include:

- briefings/workshops/reports to elected councillors
- meetings
- staff circulars or updates in staff newsletters
- information workshops for different areas of the council.

For councils planning to publicly release the outcomes of a climate change risk assessment, the following communication methods may also be appropriate:

- media releases
- educational resources for the community.

Setting the framework for a climate change risk assessment

Risk assessment frameworks may already exist within a local council. However, climate change risk assessment is in many ways more complex than general risk assessments, given the inherent uncertainty in climate change science. As a result, councils should check whether existing frameworks are suitable for carrying out a climate change risk assessment, by considering the guidance below and comparing their existing framework to the information in the AGO Guide (AGO 2006).

Councils developing a new framework should pay particular attention to these steps to ensure that a shared understanding of the context has been established. A thorough consideration of the climate change scenario, assessment scope and evaluation framework will maximise the value of the assessment results.

Step 4: Determine the level of assessment

Before starting an assessment, it is necessary to determine its level. 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 level of data or information available.

For example, a first-pass qualitative risk screening might be appropriate for identifying and prioritising a wide range of risks, while a more detailed assessment may be required to better analyse and evaluate very high risks.

Assessing the risks from climate change involves a high degree of uncertainty in climate change projections, long time scales (particularly in relation to infrastructure decisions), environmental and social systems with multiple and complex relationships, and spatial variation in climate impacts.

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 that these will occur, in order to understand the level of risk. Qualitative risk assessments are:

- able to be carried out in the absence of detailed climate change data
- 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 a council's existing corporate plans
- 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 (see 'Quantitative vs qualitative' below) as it is difficult to describe the likelihood and consequences numerically and requires many assumptions to be made.

However, new tools to assess and prioritise climate change risks are developing rapidly. Where more information on climate change impacts becomes available, these may be applied to generate more detailed analysis of risk and vulnerability. Appendix 3 discusses some of these more detailed assessment methods.

Quantitative vs qualitative

Both quantitative and qualitative techniques can be used to describe and assess risks. **Quantitative assessments** assign a numerical value to the probability of an event occurring and the likely loss should that event occur. This usually means that financial values are assigned to assets, expected losses, and the cost of controls.

On the other hand, **qualitative assessments** use words to describe the magnitude of potential consequences and the likelihood that they will occur. Qualitative risk analysis is usually conducted through a collaborative process involving people from a variety of groups. Qualitative assessments are useful for risk assessments that involve a high degree of uncertainty.

In addition, information about climate change impacts is updated regularly. The Office of Environment and Heritage (OEH) is working to update regional climate change impact data and councils should refer to the regional impacts of climate change page on the agency's website for the latest information: www.environment.nsw.gov.au/climatechange/RegionalImpactsOfClimateChange.htm. Other reliable sources of information on climate change impacts are included in Appendix 1.

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.

Step 5: 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.

'Assumptions and uncertainty' below has more about these assumptions which are likely to be common across all climate change scenarios.

OEH has developed a climate change scenario for each region of NSW and these are available on the agency's website at www.environment.nsw.gov.au/climatechange/20110593riskassesslg.htm

The scenarios summarise the information contained in the following reports:

- *NSW Climate Impact Profile: The impacts of climate change on the biophysical environment of NSW (*DECCW 2010b)
- *Impacts of Climate Change on Natural Hazard Profiles (*DECCW 2010a)

The projections in these documents are based on the Intergovernmental Panel on Climate Change (IPCC) A2 emission scenario (see 'Assumptions and uncertainty' below) and outline climate change, changes to natural hazards and biophysical impacts for 2050. It is recommended that councils adopt the relevant regional scenario from the OEH website for the qualitative risk assessment process outlined in the guide.

Assumptions and uncertainty

While it is clear that the climate is changing, uncertainty remains about exactly how, and by how much, it will change. This is a challenge for the policy development process, but should not be perceived as a barrier to understanding and adapting to climate change. This guide uses a climate change scenario to carry out a risk assessment in the face of this uncertainty. When using a scenario approach, it is assumed that the chosen scenario is certain to occur. This means that assumptions are made in the following areas:

Future levels of greenhouse gases in the atmosphere

Future levels of greenhouse gases in the atmosphere depend on decisions that are made now and into the future about economic development, technology and environment management. As a result, future levels of these gases cannot be accurately predicted and a scenario for their future emissions must be chosen.

The IPCC developed four base greenhouse gas emission scenarios for its fourth assessment report: A1, A2, B1 and B2 (IPCC 2007a; IPCC 2007b). These scenarios describe different levels of economic development, environmental sustainability and technology development, and correspond to different levels of greenhouse gas emissions.

The climate projections used as the basis for scenarios in this guide were developed using the A2 emissions scenario, which assumes rapid economic growth, low uptake of carbon-alternative fuels and more disparate regionalisation of economic development. The A2 scenario leads to higher greenhouse gas emissions.

The A2 scenario is towards the upper range of greenhouse gas emission levels and reflects the current trends in global emissions growth and the latest climate observations.

Response of global average surface temperature to increases in greenhouse gases

In the scenario presented in this guide, the global average surface temperature is assumed to respond to increases in greenhouse gases according to the consolidated results of four global climate models.

However, the complexity of our climate system may result in changes occurring more rapidly and abruptly than modelled. The complexity and interrelationships of ocean, land, biosphere and atmospheric processes around the globe are likely to produce unexpected synergistic impacts, some of which are not well understood or able to be adequately captured in modelling projections.

Nonetheless, climate change modelling clearly shows that the temperature is rising, oceans are warming and rainfall patterns are changing. Also, regardless of which emission scenario is used to model future climate change, the projected climate changes to 2050 are consistent: that is, there is little difference between a low and high emission scenario in terms of the climate change impacts to 2050. However beyond 2050 the models diverge.

Local climate change as a result of changes to global average temperatures

This guide adopts one climate change scenario to provide an indication of the nature and likelihood of climate change impacts at a regional scale. By using the scenarios presented in the guide, it is assumed that the regional changes in climate will be the same in all council areas within a region. It is actually uncertain how regional changes will affect the biophysical environment at a local scale. While temperature increases and sea level rise projections have a high degree of certainty associated with them, the impacts on rainfall, fire and flood are less well characterised.

Irreducible uncertainty: natural variability

Natural variability in climate means, for example, that some years are hotter and drier than average and some years cooler and wetter. This variability is captured in the OEH regional climate change scenarios. As a result, these scenarios will present a range of possible temperatures, rainfall and other climate impacts. Climate change scenarios are not able to resolve the natural variability in the climate.

Step 6: Identify existing data sets and/or gaps

Identifying available data sets can help define the scope of a risk assessment. Significant information gaps might need to be addressed before commencing the risk assessment. Data that local councils might need for a climate change risk assessment include:

- type, number and location of major assets and infrastructure
- current significant climate-related risks
- projected sea level rise, coastal inundation and retreat levels
- flood- or fire-prone areas in the local government area or surrounding areas
- floodplain risk management plans
- regional or local climate change predictions
- socio-economic profile of the population in the council area as it relates to council service delivery
- main businesses operating in the council area
- ecosystems, refuges, fauna and flora present in the council area, particularly endangered species, ecological communities and assemblages.

Step 7: Identify the scope and key elements of the assessment

Local councils will need to clarify what to include in a climate change risk assessment and what to exclude. It is considered best practice that councils consider the risk climate change poses to all areas of their responsibility, either through a single assessment or a series of them.

The context of this guide is limited to climate change risks to council assets, operations and services and does not address the risks of climate change to local communities in general.

Councils should classify their operations and service delivery in order to promote a systematic and efficient approach to risk identification. Key elements (sometimes referred to as 'functional areas') are topics that can be considered by workshop participants during the risk identification process. Operational activities, geographical area or organisational boundaries can be used as key elements to define the scope of climate change risk assessments.

Table 2 suggests a list of key elements for a council climate change risk assessment, based on organisational functions. However, individual council lists of elements may differ according to their needs.

Table 2 Key elements for climate change risk assessment

Key elements	Examples of functional area
Infrastructure and assets	Council buildings, stormwater infrastructure, transport infrastructure, water supply infrastructure, wastewater treatment facilities, bush reserves, recreation reserves
Land-use planning and development	Assessment of development applications, planning instruments (such as local environmental plans and zoning)
Emergency management and natural disaster preparedness	Traffic management, emergency response and recovery (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	Child care, recreational facilities, waste services
Corporate services	Insurance, council functions, financial sustainability, communications, IT

Step 8: Select an assessment team

An assessment team will be responsible for identifying and evaluating risks at the risk assessment workshop (Steps 10–12). The assessment team may also be involved in developing the evaluation framework and providing relevant data, such as information about a local council's infrastructure assets.

Councils should ensure the assessment team includes representatives of all their major functional areas, including managers of major assets and services. Ideally the assessment team should include:

- strategic planners
- assets and facilities managers
- risk management coordinators
- community and development consultation managers
- service managers
- finance staff
- emergency management coordinators
- natural resource/sustainability/environmental management personnel
- marketing and communications coordinators
- education officers.

It is useful to include long-serving council staff in the risk assessment who have good knowledge of past climate-related events and how the council responded to hazards associated with them.

Councils may also choose to include external stakeholders in their assessment teams or as a reference group. Possible stakeholders include representatives of community groups, local business owners, neighbouring council members, or representatives of state or federal agencies and utility companies.

It is also important to consider the level of representation on an assessment team. The representatives should have sufficient responsibility to ensure support for action, but also have a good understanding of the operations of their particular functional area.

Step 9: Establish an evaluation framework

An evaluation framework consists of qualitative statements that will be used by workshop participants to assess and prioritise risks. The evaluation framework will ensure that all workshop participants have a common understanding of how risks will be assessed, and allow for comparable assessments to be repeated.

The evaluation framework consists of four components:

- several **success criteria**, which summarise a council's long-term corporate objectives
- a **consequence scale** that describes a range of possible consequences of a risk
- a **likelihood scale** that describes the likelihood of suffering a level of consequence
- **risk priority levels** which assign a priority rating to risks, based on the consequence and likelihood relating to that risk.

Developing success criteria

Local councils will need to determine several success criteria (usually 4–6), which summarise their long-term objectives. These objectives may be outlined in council corporate plans or annual reports. Success criteria have two roles:

- They identify the council values at risk as a result of climate change hazards.
- They allow meaningful descriptions of consequence ratings to be developed, which ensure all participants have a shared understanding of what each level of consequence means.

Example success criteria from the AGO Guide (AGO 2006) are outlined below and can be used by a council if they align with its stated goals:

- maintain public safety
- protect and enhance the local economy
- protect existing community structures and the lifestyle enjoyed by local people
- sustain and enhance the physical and natural environment
- ensure sound public administration and governance.

Developing a likelihood scale

A likelihood scale should assign qualitative descriptions to the likelihoods of a risk occurring. For example, a likelihood of 'almost certain' may be described as 'could occur several times per year'. These descriptions mean that when likelihood is discussed and rated by a council, all participants will have a similar understanding of what each rating means.

When undertaking the risk analysis it is important to remember that the likelihood refers to the likelihood of a risk 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.

Table 3 Example likelihood scale (AGO 2006)

Rating	Recurrent risk	Single event
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 about once in 10 years	Less likely than not but still appreciable: probability less than 50% but still quite high
Unlikely	May arise about once in 25 years	Unlikely but not negligible: probability noticeably greater than zero
Rare	Unlikely during the next 25 years	Negligible: probability very small, less than zero

Developing a consequence scale

A consequence scale consists of descriptions which articulate major, minor or other consequences for each success criterion. For example, for the criterion of 'Public safety' a catastrophic consequence may be described as 'Large numbers of serious injuries or loss of lives'. An example consequence scale from the AGO Guide (AGO 2006), based on the criteria outlined above, is provided in Table 4.

Table 4 Example consequence scale for local government (AGO 2006)

Rating	Success 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	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 danger of continuing environmental damage	Public administration would struggle to remain effective and be seen as 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

Assigning risk priorities and responses

Risk priorities are a function of the likelihood and consequence of an event. For example, risks that have a likelihood rating of 'rare' and a consequence rating of 'insignificant' will be given a low risk priority.

The different risk priorities require different responses. These will need to be determined by councils within the context of their operating systems.

Example risk responses are outlined below:

- **Extreme risk** – Urgent attention is required at a senior level. Action plans and management responses are required. This risk cannot be accepted as part of routine operations.
- **High risk** – This risk can be accepted as part of routine operations but must be managed by a senior manager, who reports on progress to the executive.
- **Medium risk** – This will be part of routine operations where specific monitoring and response procedures exist. Management will be assigned to a particular manager and reported on.
- **Low risk** – This will be part of routine operations and management and can be expected to be dealt with by existing controls.

The priority given to a risk is determined by using a risk priority rating table, which maps a risk's likelihood and consequence and gives a risk rating. Table 5 is an example risk priority table.

Table 5 Example risk priority ratings (given that a scenario arises) (AGO 2006)

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

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 who 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.

Conducting climate change risk assessment workshops

It is recommended that the following Steps 10–12 are carried out as a single exercise in a workshop setting to ensure a consultative and inclusive process. The workshops should involve the full assessment team.

Module 3 of the Local Government and Shires Associations' *Climate Change Action Planning for Local Government Workshop Package* (LGSA 2010) provides practical guidance on how to run a workshop, including preparing workshop materials, the roles and responsibilities of a facilitator, and documenting workshop results.

An experienced facilitator and someone familiar with the risk assessment process should be responsible for coordinating and running the risk assessment workshops.

Step 10: Identify risks

The risk assessment team and other key stakeholders should identify the risks by describing and listing how the climate change hazards from the chosen scenario (Step 5) might have an impact on each of the key elements of the organisation identified in Step 7.

The risk assessment team should consider in turn the risks posed to key organisational elements by each climate variable. It is important to remember that there may be 'positive risks' (opportunities) as a result of climate change.

Each risk should be described using the following order and naming convention:

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

For example: 'Flooding and inundation **damaging council infrastructure**, *which reduces public safety*'

The climate change hazard and impact on council operations may affect several success criteria and it is important that these risks are identified separately. This will allow each risk to be rated separately to reflect any potential differences in priority. For example, flash flooding may have catastrophic consequences for public safety, but only moderate consequences for sustainability and minor consequences for public administration. Further discussion on analysing the risks from climate change hazards and their impact on a particular key element of council operation is provided in Step 12.

Risk identification should include consideration of knock-on effects or incremental impacts of particular consequences, such as cascade and cumulative effects. For example, a direct risk would be flooding or inundation damaging council infrastructure which reduces public safety. An indirect risk would be flooding or inundation damaging state-owned roads which in turn prevent council maintenance vehicles getting to problem areas. Analysis (Step 11) will screen out any risks that may not be due to climate change, are duplicates, or are considered trivial.

Appendix 2 provides a list of common climate change risks to local councils in NSW. This should be treated as a starting point for council discussion and not as a substitute for councils identifying their own risks.

Step 11: Analyse risks

Once the assessment team has developed a list of risks, these should be systematically analysed using the framework in Step 9. Risk is analysed by identifying the consequence and likelihood in the context of existing controls. This will develop a council's understanding of the risks and allow it to assign a priority to each risk.

Risk analysis involves considering the source of risks, their positive and negative consequences, and their likelihood. When performing a qualitative climate change risk assessment, analysis of consequence and likelihood is made subjectively, based on the group's professional opinion that a particular outcome will occur. Nonetheless the group should draw on relevant information and data to inform their analysis, such as:

- past events
- practice and relevant experience
- relevant published literature.

The assumptions that underlie the analysis should be made explicit. In this assessment it is assumed that the climate change scenario chosen in Step 5 is occurring. See the earlier discussion 'Assumptions and uncertainty' for details about the assumptions that underlie this scenario.

Analysis involves three stages as discussed below.

Analyse existing controls

In this stage the risk assessment team identifies any existing controls that would act to reduce the consequence or likelihood of each risk and how effective they would be. Only existing controls which are funded and require no further work to be implemented should be considered in this stage.

Note that during the risk assessment it is assumed that the climate change scenario is occurring. For that reason the effectiveness of the controls in reducing the consequence or likelihood of the risk in the future (at 2050 when the scenario is occurring) should be assessed.

For example, the council may have planning controls that require buildings to be a certain height above current flood level. This control is currently effective, but may be less so following climate change. Where this is the case, the control's effectiveness rating will be low in the context of the climate change risk assessment.

Analyse the event's magnitude of consequence and likelihood

In this stage the magnitude of the consequence of an event and its likelihood of occurring are determined. The consequence and likelihood are considered in the context of:

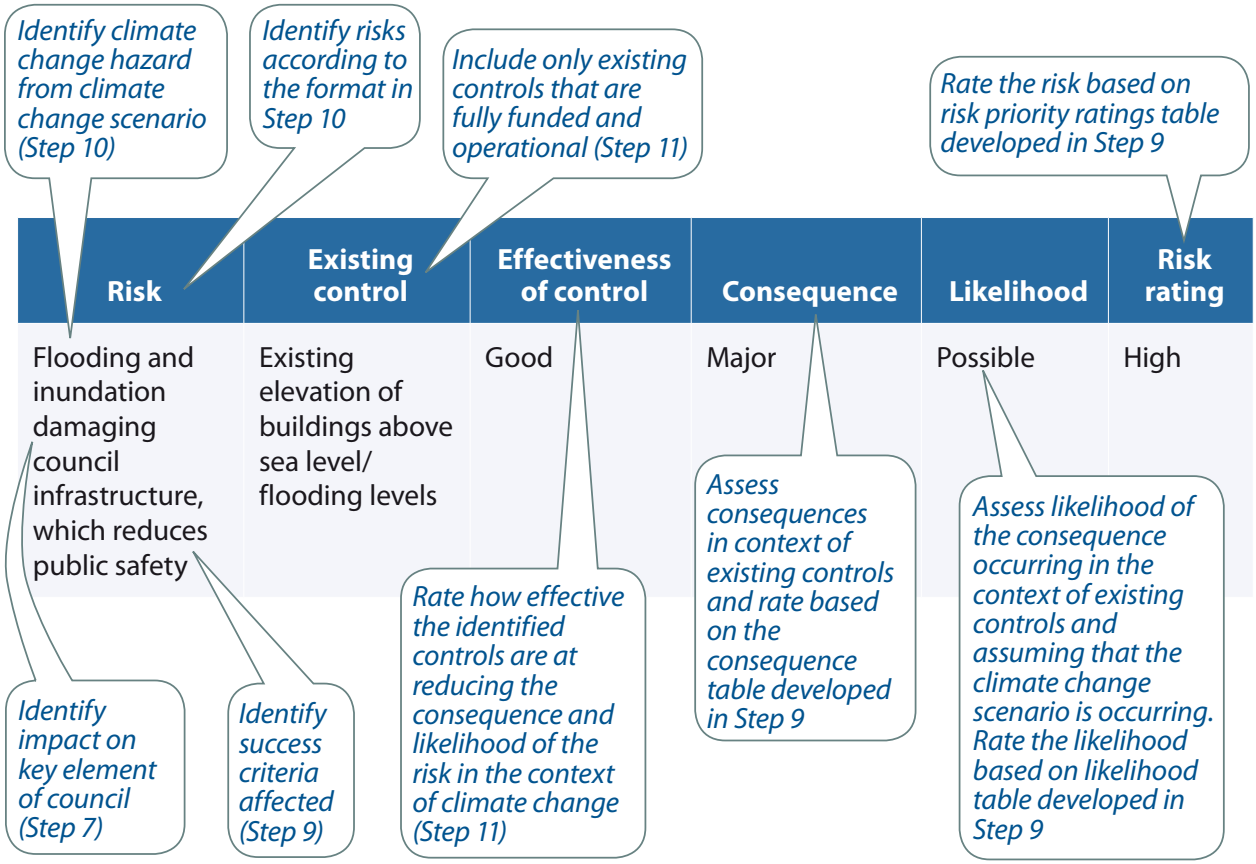
- the climate change scenario being considered
- the existing controls to manage the risk.

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 (Table 5). This process should be carried out for each risk, in the climate change scenario being used. A template matrix for analysing risks, including an example risk analysis, is shown in Table 6.

For councils using multiple scenarios, guidance on integrating the results of each scenario can be found in Section 5.5 of the AGO Guide (AGO 2006).

Table 6 Annotated example risk analysis table (Step 11)



Step 12: Evaluate risks

The purpose of evaluation is to assist in prioritising identified risks.

Step 9 showed how to develop a priority rating (extreme, high, medium or low) for each risk based on likelihood and consequence scales. At this step, all of the risks are assembled into one list and ordered by their priority, either by success criteria or aggregated risk exposure/ risk rating.

The first stage of evaluation is for the risk assessment team to manually adjust any risks that appear to be overestimated or underestimated. The risk assessment team should check that the risk priority ratings:

- are consistent with one another
- are logical
- agree with the participants' general view of the council's operational context.

At this step, the assessment team should also ensure that no risks have been repeated.

Once all the risk ratings have been finalised, the council needs to identify its overall priorities for risk treatment, by ranking priority risks starting with those requiring the most urgent action, and what that action would be. Ranking the priority risks is important since councils have finite resources and are unlikely to be able to address all risks simultaneously.

As discussed in Step 10, a single climate change hazard may pose multiple risks due to its impacts on a number of success criteria. In these cases, councils may simplify the evaluation by ranking each success criterion 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 Step 10, flash flooding 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 should be addressed as a priority.

Some factors councils may wish to consider include:

- Is it the council's responsibility to mitigate the risk or is there an emergency combat agency responsible for managing it?
- Is it the council's responsibility to manage the risk?
- Can the council make an effective contribution to finding a solution?
- What is the wider organisational context for the identified risks?
- What is the 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 and is further work needed?

Reporting the results

Results of the climate change risk assessment should be documented and presented widely throughout the council (to councillors, senior managers and staff across the organisation). The report should clearly identify priority risks and document the method used to identify, analyse and evaluate the risks. This will provide an evidence base for the council to develop and implement an adaptation plan with identified actions, resources and time frames that maximises its ability to refine and adjust the assessment and adaptation response in the future as better information becomes available.

Councils may also wish to communicate the outcomes of the process to their communities.

Next steps

Adaptation and treating the risk

Once the risks from climate change have been identified, it is important to consider how the council will respond to minimise or remove these risks. 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 one type of climate change adaptation.

When treating risks from climate change, councils should consider the following principles:

- 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 requirements 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 which 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 mal-adaptation by keeping options for future adaptation open where possible
- focus on cost-effective actions – it is important that councils have a clear understanding of the costs and benefits and likely effectiveness of alternative adaptation options
- review treatment strategies.

The process for identifying adaptation options can be similar to that used in the risk assessment. It should also include a cross-section of council staff, relevant to the risks that have been identified. It may also be valuable to include other stakeholders (such as neighbouring councils, state and federal agencies, and utility providers) in the adaptation planning process as they are typically facing common issues and have similar information needs. It involves using the outputs of the risk assessment in the form of the high priority risks and for each risk:

- reviewing existing risk controls to identify why current controls are not sufficient
- identifying changes in thinking or new measures to overcome gaps.

Examples of risk treatment include:

- spreading the risk by, for example, 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
- changing council policies, strategies and plans, such as increasing 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, for example, seeking advice from a panel of key experts when making regional transport decisions in light of climate change
- researching the risk, such as developing more refined projections of rainfall to inform flood modelling
- 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 a new way of thinking about how we design and build our communities to live with impacts and in a carbon-constrained future. It is important to think creatively about these risks and look for new and integrated solutions.

Climate change will have implications for almost all council functional areas. Integrating climate change risk into existing corporate risk management systems and reporting frameworks, including business continuity planning, will be important to ensure that climate change is considered in all local government decision-making processes.

Detailed guidance on risk treatment approaches is outlined in the *Risk Management Guidelines: Companion to AS/NZS 4360:2004* (AS/NZS 2005) and the AGO Guide (AGO 2006). Further information on adaptation and risk treatment is outlined in Appendix 3. Examples of climate change adaptation include those for coastal and rural councils in the Hunter: see HCCREMS 2010a and 2010b.

Ongoing monitoring and review

Monitoring and review are important to the risk assessment process. This is particularly so for climate change where information is being continually updated. Monitoring and review can be regular and should:

- incorporate new climate change information as it becomes available
- check that controls are effective
- include new information gained from events
- account for any changes in context
- identify any new risks.

Where to find further information and support

There is now a growing body of knowledge as local councils and other organisations undertake climate change risk assessment and adaptation planning processes. Where relevant, councils should build on the experiences of other local councils. Talking to local councils nearby can also help identify common risks, which then may be able to be managed in cooperation.

CSIRO: www.csiro.au/science/Climate-Change.html

Department of Climate Change and Energy Efficiency:
www.climatechange.gov.au/en/climate-change/impacts.aspx
www.climatechange.gov.au/en/government/adapt.aspx

Intergovernmental Panel on Climate Change: www.ipcc.ch

Local Government and Shires Associations of NSW:
www.lgsa.org.au/www/html/1899-climate-change.asp

Office of Environment and Heritage:
www.environment.nsw.gov.au/climatechange/impacts.htm
www.environment.nsw.gov.au/climatechange/adaptation.htm

International Council for Local Environmental Initiatives (ICLEI) Oceania:
www.iclei.org/index.php?id=11322

Appendix 1: Recommended sources of climate change information

Climate variable or impact	Source of information	Comments
Temperature Rainfall	DECCW 2010: *NSW Climate Impact Profile: The impacts of climate change on the biophysical environment of NSW*, Department of Environment, Climate Change and Water NSW, Sydney: www.environment.nsw.gov.au/climatechange/20100171ClmtChngNSW.htm	Based on IPCC Special Report Emissions Scenario (SRES) A2 emissions scenario for 2050
	CSIRO 2007: *Technical Report 2007 – Climate Change in Australia*, CSIRO and Bureau of Meteorology Australia: www.climatechangeinaustralia.gov.au/technical_report.php	Based on IPCC SRES A1B emissions scenario for 2030, B1 and A1FI for 2050 and 2070
	DWE 2008: *Future Climate and Runoff Projections (~2030) for New South Wales and Australian Capital Territory*, Department of Water and Energy NSW, Sydney: www.water.nsw.gov.au/ArticleDocuments/34/monitor_climate_climate_runoff_projections_nsw_act.pdf.aspx	Based on IPCC SRES A1B global warming scenario for 2030
	NSW Office of Water 2010: *Climate Change and its Impacts on Water Supply and Demand in Sydney*, NSW Office of Water, DECCW, CSIRO, DCCEE, SCA, Sydney Water and UNSW: www.waterforlife.nsw.gov.au/mwp/understanding_climate_change/climate_change_study	Based on CSIRO Mark 3.0 (Mk3) global climate model (GCM). Outputs from CSIRO Mk3 GCM, representing B1, A1B, and A2, were downscaled to the local/regional level using statistical techniques developed by UNSW. The report focuses primarily on the higher emission A2 scenario as it is now considered more realistic than the low and mid-range scenarios (B1 and A1B).
	UNSW 2009: *High Resolution Climate Change Projections and Impacts*, University of NSW, Sydney: www.waterforlife.nsw.gov.au/mwp/understanding_climate_change/climate_change_study	Based on IPCC SRES B1 and A2 emissions scenarios for 2030 and 2070

Climate variable or impact	Source of information	Comments
Natural hazards (flooding, bushfires, storms, heatwaves)	DECCW 2010: *Impacts of Climate Change on Natural Hazards Profiles*, Department of Environment, Climate Change and Water NSW, Sydney: www.environment.nsw.gov.au/climateChange/naturalhazardprofiles.htm	Based on A2 emissions scenario for 2050
	Bradstock, R, Davies, I, Prive, O and Cary, G 2008: *Effects of Climate Change on Bushfire Threats to Biodiversity, Ecosystem Processes and People in the Sydney Region*, University of Wollongong and Australian National University: www.environment.nsw.gov.au/climateChange/bushfires.htm	Based on forecast 2050 climate and fire danger scenarios ('Low' and 'High') by Hennessy, K, Lucas, C, Nichols, N, Bathols, J, Suppiah, R and Ricketts, J 2005, *Climate Change Impacts on Fire-weather in South-east Australia*, CSIRO, Australia
Sea level rise	DECCW 2009: *NSW Sea Level Rise Policy Statement*, Department of Environment, Climate Change and Water NSW, Sydney: www.environment.nsw.gov.au/climatechange/coast.htm	Based on assumptions that sea level along the NSW coast will rise relative to 1990 mean sea levels of 40 cm by 2050 and 90 cm by 2100. For derivation of assumptions, see the DECCW *Technical Note: Derivation of the NSW Government Sea Level Rise Planning Benchmarks*
	McInnes, K, Abbs, D, O'Farrell, S, Macadam, J and Ranasinghe, R 2007: *Projected Changes in Climatological Forcing for Coastal Erosion in NSW*, CSIRO: www.environment.nsw.gov.au/climatechange/nswreports.htm	Based on IPCC SRES A2 emissions scenario for 2030 and 2070
Biodiversity	DECCW 2010: *Priorities for Biodiversity Adaptation to Climate Change*, Department of Environment, Climate Change and Water NSW, Sydney: www.environment.nsw.gov.au/biodiversity/climatechange.htm	Based on IPCC SRES A2 emissions scenario for 2050. Priorities outlined were identified in response to the listing in 2000 of 'anthropogenic climate change' as a key threatening process to NSW biodiversity under the *Threatened Species Conservation Act 1995*

Appendix 2: Example climate change risks

This list of potential climate change risks is based on the results of risk assessments that have been undertaken to date by local councils in NSW.

It is important to note, however, that this appendix only contains examples of the types of risks councils will face, and should not be considered an exhaustive list of risks. The risks local government will face as the climate changes will vary considerably between individual councils and will depend on factors such as population characteristics, existing climate, topography and location, and economic situation.

When identifying risks, reference to these clarifies what council values are at risk from climate change hazards. They allow meaningful descriptions of consequence ratings to be developed, permitting a shared understanding of levels of consequence. Some examples of success criteria outlined in the AGO Guide (2006) are:

- maintain public safety
- protect and enhance the local economy
- protect existing community structures and the lifestyle enjoyed by local people
- sustain and enhance the physical and natural environment
- ensure sound public administration and governance

Climate change hazard (also climate change response)	Impact on key element	Impact on success criteria
Key element: Infrastructure and assets		
Flooding and inundation	Damages council infrastructure	Reduces public safety
Changes to rainfall intensities and increased likelihood of flooding	Inundates sewage treatment plants	Reduces public safety due to health threat Impacts on local economy due to increased maintenance and upgrade costs Threatens the physical and natural environment Impacts on public administration and governance
Increased frequency and intensity of heatwaves	Results in loss of power to traffic control systems	Reduces public safety and impinges on existing community structures
Increased temperatures	Increases life-cycle costs of council assets and buildings	Impacts on the local economy Impacts on existing community structures and the lifestyle enjoyed by local people due to higher rates

Climate change hazard (also climate change response)	Impact on key element	Impact on success criteria
Key element: Land-use planning and development		
Increased temperatures	Requires alteration of LEPs, DCPs and zoning due to increased fire hazard, altered rainfall patterns and changed vegetation	Impinges on the local economy due to impact on agriculture and residential development proposals Alters existing community structures and the lifestyle enjoyed by local people due to changes to urban planning
Changes in rainfall intensities	Requires changes to land zoning for increased water capture by dams and water retention ponds	Impinges on the local economy and land values as there is reduced land for development Impacts on planned infrastructure to support growth areas from existing development
Changing climatic conditions	Changes demand for energy, which requires revision of urban development planning, including energy efficiency, water reuse and subdivision layout	Impacts on existing community structures and the lifestyle enjoyed by local people
Bushfire, flooding, inundation, erosion, salinity	Causes loss of arable land available for agriculture	Impacts on the local economy Threatens existing community structures and the lifestyle enjoyed by local people Threatens the physical and natural environment
Key element: Emergency management		
Increased occurrence of extreme weather events, causing natural hazards	Increases pressure on emergency services and social services, including financial and provision of services and resources	Reduces public safety
Falling trees due to extreme weather events	Increases potential for injury, death, damage or delays to emergency response	Reduces public safety

Climate change hazard (also climate change response)	Impact on key element	Impact on success criteria
Extreme weather events and natural hazards	Increases stress on volunteer base for SES/RFS, requiring increase in voluntary resources	Threatens public safety as emergency volunteers are 'stretched thin' Impacts on the local economy as greater resources required by volunteer EMS Threatens existing community structures and the lifestyle enjoyed by local people due to increased demand on EMS Threatens the physical and natural environment through the reduced ability of EMS Increases pressure on public administration and governance
Key element: Environment management and protection		
Increased temperatures	Increases bushfire intensity, frequency and extended bushfire season	Reduces public safety Threatens the local economy due to threat to national parkland, reduced tourism and costs to local community associated with firefighting Threatens existing community structures and the lifestyle enjoyed by local people Disrupts the physical and natural environment
Increased temperatures	Reduces biodiversity	Threatens the physical and natural environment Threatens the local economy due to threat to national parkland, reduced tourism
Increased temperatures and altered rainfall patterns	Threatens ecosystem stability and biodiversity Increases the occurrence of invasive species in waterways	Threatens the physical and natural environment Threatens the local economy due to threat to national parkland, reduced tourism

Climate change hazard (also climate change response)	Impact on key element	Impact on success criteria
Falling trees due to extreme weather events	Tree loss reduces amenity	Disrupts the physical and natural environment
Key element: Community services		
Increased temperatures	Increases heat-related illnesses, placing greater demand on health service provision and need to recruit health professionals	Threatens existing community structures and the lifestyle enjoyed by local people Reduces public safety Threatens the local economy due to increased expenditure to deal with demand
Flash flooding, sea level inundation, bushfires, increased frequency and intensity of heatwaves	Increases potential for mental stress	Threatens existing community structures and the lifestyle enjoyed by local people Threatens the local economy due to increased expenditure to provide community support mechanisms
Extreme weather events, such as flooding, bushfire, drought	Disables use of council assets	Threatens the local economy and impacts upon existing community structures and the lifestyle enjoyed by local people
Drought, increased temperatures and evaporation	Increases reliance on external/ offsite water for household use	Threatens the local economy and impacts upon existing community structures and the lifestyle enjoyed by local people Impacts on public administration and governance
Key element: Economic development		
Increased temperatures	Requires alteration of LEPs, DCPs and zoning due to increased fire hazard, altered rainfall patterns and changed vegetation	Impinges on the local economy due to impacts on agriculture and residential development proposals
Extreme weather events	Causes increased insurance claims which decreases commercial wealth and increases insurance premiums	Threatens the local economy

Climate change hazard (also climate change response)	Impact on key element	Impact on success criteria
Sea level rise, coastal erosion and inundation	Reduces local tourism due to loss of beaches and holiday parks	Threatens the local economy
Extreme weather events	Causes business closure and job losses due to business interruption from blackouts, sea level inundation and flooding	Threatens the local economy and impacts upon existing community structures and the lifestyle enjoyed by local people
Extreme weather events	Reduces revenue due to cancellation of events and inability to use council assets	Threatens the local economy and impacts upon existing community structures and the lifestyle enjoyed by local people
Changed climatic conditions	Alters agricultural regimes and practices, such as change in crop type because of reduced water availability or livestock due to heat stress	Threatens the local economy as traditional sources of rural revenue are altered and educational resources are required to allow adaptation
Key element: Corporate services		
Climate change and increased likelihood of extreme weather events	Increases insurance premiums	Impacts on the local economy and potentially affects existing community structures and the lifestyle enjoyed by local people due to reduced council service provision
Extreme emergencies	Produces higher claims to Section 44 State of Emergency and increases risk of litigation	Impacts on the local economy as councils assists with rebuilding after emergency
Natural hazards and extreme events	Increases pressure on emergency and social services, including financial and provision of resources and services	Impacts on the local economy and potentially affects existing community structures and the lifestyle enjoyed by local people due to reduced council service provision Reduces public safety

Appendix 3: Detailed assessment

Getting started

When assessing whether to do a more detailed climate change risk assessment, local councils should consider a number of factors.

Are the costs or consequences of being wrong in the initial risk assessment severe?

The more that is at stake, the more important it is that the risk analysis is robust. If a council has identified some very high risks with major consequences, or risks for which there are only costly responses, more detailed analysis of the risks may be required in order to make an informed decision about how they should be treated.

Complexity of the problem

The risk being analysed may be too complex to be adequately characterised in a basic risk assessment. More detailed analysis, which explores sources of uncertainty, different time scales or a more detailed description of the consequences could be helpful. Alternatively, the complex social or economic context may not able to be adequately assessed in a risk assessment framework and a different approach, such as vulnerability assessment, may be required.

Adequacy of the data

Where better data has become available since the initial risk assessment, a more detailed analysis, or one using multiple scenarios, could yield a more robust assessment.

If after considering these issues a council decides that detailed analysis is required, there are several actions that can be taken to increase the robustness of the initial analysis:

- consider multiple or more detailed climate change scenarios
- undertake a quantitative risk assessment
- analyse the council's climate change vulnerability.

Develop more detailed/regionally specific scenarios

Councils may wish to commission work to provide more detailed or regionally specific scenarios. Different parts of NSW are expected to experience different climatic changes. When developing these scenarios, it is recommended that councils complete a thorough literature review to identify any locally or regionally specific research or information that may be relevant.

To develop a climate change scenario, councils will need to select:

- a global greenhouse gas emissions scenario (as described in Nakicenovic et al. 2000)
- a time scale (for example, changes between now and 2030, 2050 or 2100) which is consistent with the time scale selected for the initial assessment.

For comparison with the initial risk assessment outlined in this guide, it is recommended that councils adopt a worst-case emissions scenario for the year 2050 such as A1F1.

When choosing a time frame, it may be worthwhile to consider looking at both shorter and longer periods. A 2030 time frame is a current planning horizon for asset managers and land-use planners. Looking at risks for this shorter time period may be a means of getting climate change actively considered within these planning processes. Longer time horizons are also important, particularly in the case of sea level rise. Based on current projections the

extent of sea level rise will double between 2050 and 2100. It is therefore beneficial to consider risk beyond 2050, as the actual impacts beyond this time increase exponentially as sea levels increase and actions can be taken now to reduce longer term exposure.

Councils can refer to the list of references in this guide for other sources of climate change information. Climate change information is updated regularly so councils should check the websites for the relevant organisations including:

Department of Climate Change and Energy Efficiency: www.climatechange.gov.au/

CSIRO: www.csiro.au/

Intergovernmental Panel on Climate Change: www.ipcc.ch/

Office of Environment and Heritage: www.environment.nsw.gov.au/

Undertake a quantitative risk assessment

To perform a quantitative climate change risk assessment, councils may need to engage experts in climate modelling and risk assessment because:

- it may be challenging to obtain detailed climate change projections that give specific values to the likelihood and intensity of changes in the climate
- putting monetary values on the consequences of climate change risks could be difficult when considering environmental or social outcomes.

Quantitative risk assessment involves using a process similar to what has been outlined in this guide, but discrete values are assigned to the:

- uncertainty
- likelihood (probability)
- consequence (usually financial cost of the event)
- magnitude of the risk (often also a financial cost).

Quantitative risk assessment should allow councils to better understand the sources of uncertainty, the factors that influence probability and the magnitude of the risk in terms that can be more easily related to council decision-making processes. It will also allow councils to:

- address uncertainty in the likelihood of change to climate variables
- increase comparability between different levels of consequence affecting the various key areas of council operations
- address sensitivity of risk to different levels of climate change.

AS/NZS Risk Management Guidelines (AS/NZS 2005) and *Climate Change Impacts and Risk Management: A guide for business and government* (AGO 2006) have more information on how to perform a quantitative risk assessment.

Vulnerability assessment

While improved climate change projections are the focus of many research agencies, they may still not meet the needs of councils. Vulnerability assessment could offer a way to circumvent the absence of detailed climate change projections at the council scale.

In addition, if a council wishes to explore the climate change risks to the community or analyse climate change risks in cooperation with other councils in the region, a vulnerability analysis could assist. It can facilitate analysing the more complex and socially driven elements of climate change risk that will exist in a regional assessment.

Vulnerability assessment and risk assessment can be complementary processes, with each enhancing a council's understanding of the risks it faces due to climate change as well as its capacity to address them. 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.

It may be possible to apply vulnerability as an additional layer or filter on top of the results of a risk assessment. Councils could compare areas of risk and vulnerability in order to further prioritise their response. For example, there may be areas where a council faces medium risk but has high vulnerability, in which case action may be more urgent.

Alternatively, it could be useful for a council to conduct a vulnerability assessment and then use a risk assessment framework to analyse the areas of key vulnerability. For example, if the council identified that its water supply is vulnerable under climate change, it may be worthwhile to conduct a quantitative risk assessment to analyse how much supply will change so that it can better plan to augment supply.

What is important in comparing and contrasting vulnerability and risk is that vulnerability does not predict explicit outcomes. Rather it reflects where the greatest potential for harm lies, the various factors that may contribute to that harm, and how these things interact.

Reasons for undertaking a vulnerability assessment include:

- the varying capacity of people to cope with and adapt to climate risk, which is a critical element in understanding the context in which climate hazards occur, and hence the ability of a council to respond to those hazards
- reduced vulnerability contributes to a reduction in risk, but the reverse is not necessarily true
- attempts to assess risk (predict outcomes and their likelihood) often neglect the complex social context of risk
- irreducible uncertainty makes any quantitative risk assessment results questionable.

Vulnerability is the result of exposure to climate change effects, sensitivity to change and adaptive capacity to that change. In the context of climate change vulnerability assessment:

Sensitivity is the degree to which a built, natural or human system is directly or indirectly affected by changes in climate conditions.

Exposure describes whether a built, natural or human system is susceptible to the impacts of climate change.

Adaptive capacity is the ability of built, natural and human systems to accommodate changes in climate with minimum disruption or additional cost.

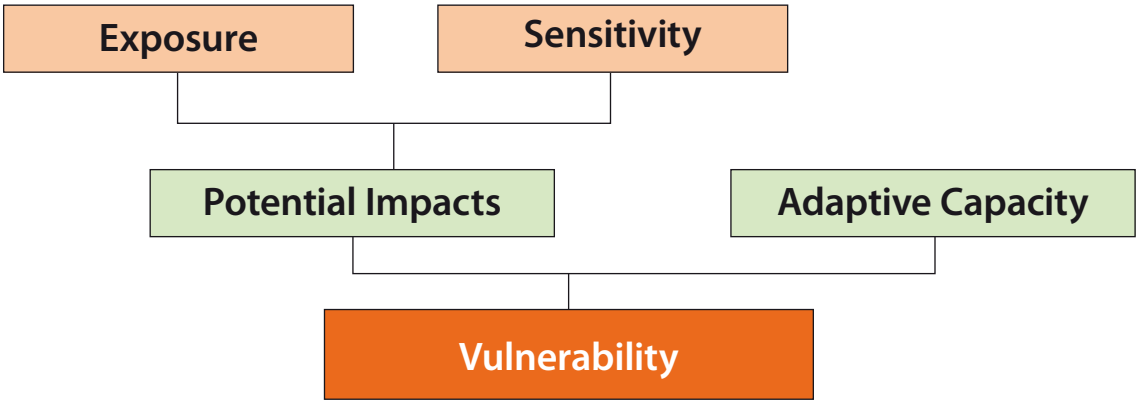


Figure 2 The components of vulnerability

Systems that are highly exposed, sensitive and less able to adapt are vulnerable. It is important to understand this relationship, as it helps in appreciating that communities most vulnerable to climate risk are not necessarily those most exposed to it. A key element of vulnerability is the community's ability to adapt in the face of a given risk. Understanding these elements can help identify the threat or risk from climate change, and action in these areas can reduce or manage that risk.

Further information on how to conduct a vulnerability assessment is available in *Preparing for Climate Change: A guidebook for local, regional and state governments* (ICLEI 2008). There are also examples of local councils, and regional organisations of councils, such as the System Approach to Regional Climate Change Adaptation Strategies in Metropolises on the Sydney Coastal Councils Group website at www.sydneycoastalcouncils.com.au/Project/Systems_Approach_Climate_Change_Adaptation_Strategies

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	Team 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: not a prediction about the future, but rather a means of understanding the potential impacts of climate change
Consequence	Outcome of an event affecting objectives
Event	Occurrence of change of a particular set of circumstances
Key element	Topics that may be considered by workshop participants during risk identification: may be based on organisational functions, geographical areas, or service or product types
Likelihood	Chance of something happening, generally described in terms of probability or frequency and can be expressed qualitatively or quantitatively
Risk	Effect of uncertainty on objectives
Risk analysis	Systematic process to understand the nature and level of risk, based on the consequence of an event and the likelihood of that consequence
Risk assessment	Overall process of risk identification, analysis and evaluation
Risk evaluation	Process of comparing the level of risk identified in risk analysis against risk criteria in order to inform decisions about risk treatment
Success criteria	A council's long-term objectives which have two roles: • used when identifying risks to clarify exactly what council values are at risk as a result of climate change hazards • allow the development of meaningful descriptions of consequence ratings, which ensure all participants have a shared understanding of what each level of consequence means.
Vulnerability	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.

References

AGO 2006, *Climate Change Impacts and Risk Management: A guide for business and government,* Australian Greenhouse Office, Canberra: www.climatechange.gov.au/community/~/media/publications/local-govt/risk-management.ashx

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