Guidance on undertaking a second-pass risk assessment

What is a second-pass risk assessment?

Using the knowledge gained through a first-pass risk screening and overall understanding of the adaptation planning cycle, a second-pass assessment can focus on specific sectors, areas or aspects that were identified as being at-risk. A second-pass assessment can be undertaken using national data products and relevant local information from any previous studies and reports. Importantly, it can be used in combination with local expert knowledge to identify the likelihood of a given climate change risk and its consequence.

Definition of risk

A number of definitions of risk are available in the literature (Brooks 2003; Downing et al. 2005; Haimes 2009; IPCC 2014; Sarewitz et al. 2003). We adopted the following definition of risk presented in the 5th assessment report of IPCC WGII.

> *(risk is) the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events (likelihood) or trends multiplied by the impacts (or consequences) if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard* (IPCC 2014).

What can a second-pass risk assessment achieve?

Many organisations use a standard risk-based approach to report and manage their risks. Here a standard risk-based approach refers to a systematic risk assessment process following either International Standard Organization (ISO) guidelines or an industry specific modified version of it (i.e. AS/NZS-ISO31000:2009, AS5334:2013). Using a risk-based approach for the second-pass assessment allows organisations to use their existing risk management framework and associated familiar terminologies to assess their climate change risk. This approach can use national, state, regional and

local information and expert knowledge to determine the likelihood and possible consequences of any risk, and therefore these assessments are a good point to commence climate change risk related discussions among stakeholders within and outside the organisation.

A second-pass risk assessment can

a. help start discussion about climate change risks among stakeholders inside and outside an organisation
b. help identify broader climate change risks to an organisation. It can also help users to determine when or where they need any further detailed data to develop a better understanding of risks and management responses
c. enable an organisation to conduct a climate change risk assessment using the existing risk management framework
d. provide information to identify adaptation options and form the basis of a plan
e. support ongoing engagement with stakeholders.

How to undertake a second-pass climate change risk assessment?

The four steps of second-pass risk assessment are shown in Figure 1. The process should involve engaging with stakeholders inside and outside the organisation, as expert and local knowledge is required to understand possible consequences of climate change impacts. Therefore, before beginning a second-pass risk assessment, you should be familiar with relevant content from CoastAdapt that can support your efforts, for example, *Getting organisational buy-in*, *Engaging the community*, and *Information Manual 9: Community engagement*.

Step-1: Establish the context (scope)

1.1 Objective

Most of the basic processes for scoping a second-pass risk assessment are quite similar to those for first-pass risk screening. However, for a second-pass assessment your objective should be more specific about the **areas, system/s or assets** (after this, collectively referred to as systems) that you want to include in the assessment. This may be a coastal community, an infrastructure system (e.g. water supply system), a piece of infrastructure (a water pump), an environmental asset (wetland or beach) or ecosystem goods and services etc.

Using the results from the first-pass assessment, the first step is to shortlist the hazards to be included in the second-pass assessment. This can help start a discussion among stakeholders of your organisation about climate change risk, without overwhelming them with information. You should establish mechanisms to enable you to work effectively with internal and external stakeholders through the risk assessment and beyond.

Step 1

Establish the context (scope)

- Objective/goal
- Timeframe
- Climate change scenario (for variables that are relevant to the decision areas under investigation)
- System under analysis (e.g. public infrastructure, private properties, ecosystems)
- Scale of analysis (e.g. entire council, a single beach community, a single infrastructure etc.)
- Identify relevant stakeholders and establish mechanisms to involve them in the process.

Step 2

Identify your existing climate risks (past and current)

- Identify whether any record of occurrence of climatic hazard in the past in the area? Use findings of first-pass screening to narrow down the list of hazards(relevant to your decision area)
- What was the consequence of that event (identify systems that were affected)?
- Are there any risk management strategies in place to protect previously affected systems from future occurrence of that hazard?
- Understand and identify residual risk of a given system (i.e. risk that remains even after putting a risk management strategy in place)

Step 3

Identify your future climate change risks and opportunities

- Explore climate change projections for the selected timeframe/s and emission scenario/s
- Understand whether a change in climate variable or sea level in future will lead to hazards that can pose risks to any systems (i.e. assets).
- Investigate whether any existing risk (from step 2) can increase under future climate change projections?
- Identify new risks that can emerge under future climate change projections.
- Identify possible consequences of a given risk and the likelihood of that occurring (also consider system interdependencies).

Step 4

Analyze and evaluate risk

- Identify your risk evaluation criteria (e.g. maintain public infrastructure, protect private properties, minimise impact on environment, ensure business continuity etc.)
- Adopt scales for rating consequence of a risk (i.e. impact of a risk on risk evaluation criteria) and likelihood of that happening
- Take one risk at a time and using adopted scales, rate the consequence of climate change impact for your area. Also rate the likelihood of that happening. Repeat this step for each risk evaluation criteria
- Adopt a risk rating scale (e.g. high, medium, low etc.)
- Using information generated above, identify the rating of the risks
- Using the risk rating identify the risks that may cause you most problems in future which should be investigated further

Figure 1: Second-pass risk assessment process.

1.2 Timeframe of the risk assessment and selecting scenarios

The first-pass risk assessment identified the relevant timeframes and climate change scenarios for your context. As these have been documented, you can use the same information in the second pass provided it remains current. It may be advisable to add a wider range of climate change scenarios to better understand how your system may respond under different evolutions of future climate change. For more information see *Using climate scenarios*. The choice of timeframe is dependent on factors such as the lifetime of the asset being evaluated (see Figure 2) but in general at a minimum a scenario for the mid-century and for the end of century should be considered.

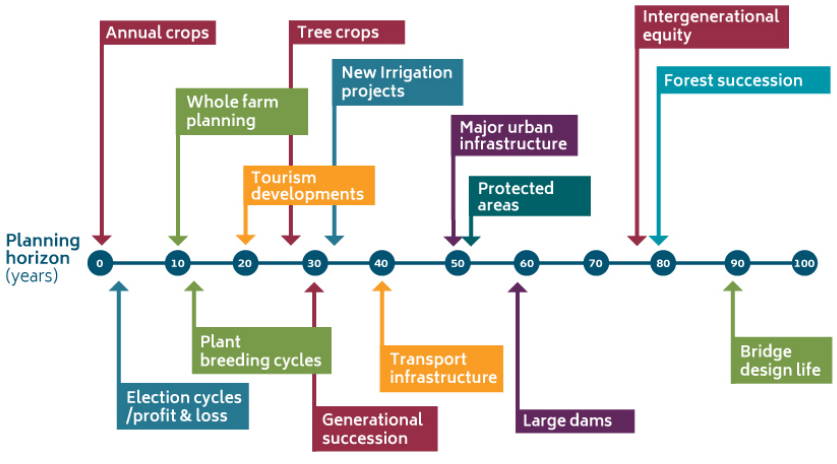

Figure 2: Typical planning horizon (years) for different areas of decision-making. Source: Jones and McInnes 2004.

1.3 System under analysis (e.g. public infrastructure, private properties)

Identify the systems to be included in the risk assessment (a coastal community, an infrastructure system (e.g. water supply system), a given infrastructure (a water pump), environmental assets etc.). This selection will help to determine the process (i.e. impact of which sector to explore, which stakeholders should be engaged etc.).

1.4 Scale of analysis (e.g. entire council, a single beach community, a single infrastructure etc.)

Selection of scale is important as it guide the steps of risk assessment. For example, the information requirement and involvement of stakeholders differs according to the scale (e.g. entire council vs a single piece of infrastructure). Having defined the focal scale (e.g. risks to one beach community), it is important to look up (e.g. risk to entire council) and down (e.g. risk to a particular segment within the focal beach) scales, as some issues will emerge from or only be managed at different scales from the focal scale.

Step 2: Identify existing climate risks

2.1 Identify any record of occurrence of any climatic hazard in the past in your area?

On the basis of the findings of first-pass assessment, you have been able to frame/scope the second-pass assessment and possibly narrow the list of systems to be considered. The lifetimes associated

with these systems will help to decide which hazards should be included. As an example, a first-pass screening may have confirmed that a local government area includes coastline where inundation is going to matter for private housing and key council services infrastructure before the end of the 21st century, but ruled out any serious issues from inland flooding or bushfires. The second-pass can therefore apply available local information to concentrate on the sections of coast where there is private housing or infrastructure, and where coastal inundation is an issue now or within their respective (different) lifetimes.

You should seek the best available local information (studies, expert knowledge etc.) for this step. CoastAdapt provides a guide on selecting appropriate *scale of mapping products to understand coastal hazards*. There are some national information sources that can be useful to understand some of the historical record of climate hazards for an area. A source of information on past flooding is Water Observations from Space (WOfS), a dataset developed by Geoscience Australia which shows surface water observations derived from satellite imagery for all of Australia from 1987 to 2014. It shows where water is usually present, where it is seldom observed, and where inundation of the surface has been occasionally observed by satellite. An example output is shown in Figure 3. If water was observed infrequently in an area, and there is high confidence in that information, then the area is likely to be at some risk of flooding. WOfS is available from CoastAdapt at *Shoreline Explorer*.

The Australian Flood Risk Information Portal is relatively new and at present only contains limited information. It was established following the devastating floods across Eastern Australia in 2011 and aims to provide access to Australian flood data, mapping and reports. For more information please see *Information Manual 3: Available datasets*.

A worked example on *Climate observations to identify hazards* is available in CoastAdapt

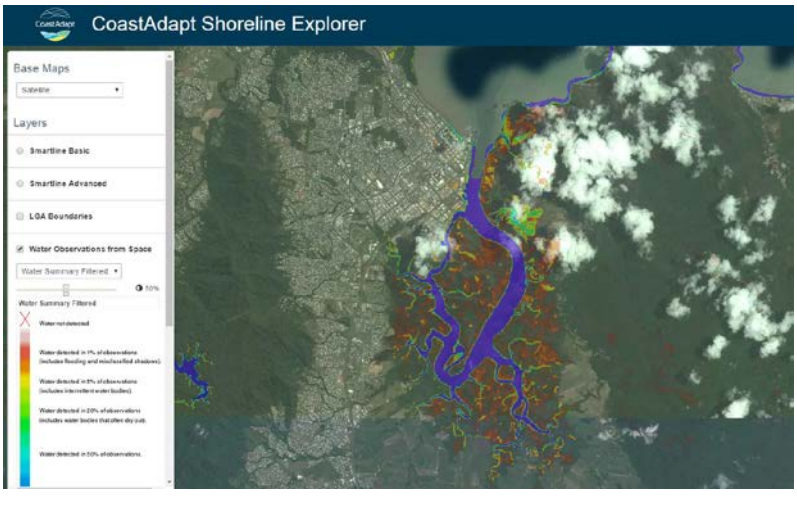

Figure 3: Water Observations from Space, Cairns. Source: CoastAdapt Shoreline Explorer.

2.2 What was the consequence of the past hazard on your business (identify systems that were affected)?

If you have identified that your system has been impacted in the past by climatic hazards then you need to rate (qualitatively) how that past event translated into a consequence. For example, a

particular asset might have been impacted during a flood event but the consequence to your business may have been insignificant. If appropriate, you can apply any qualitative scale that you use for organisational risk management. However, if these do not allow for climate risks, we provide example scales in Appendix Table B-1. These are used in the *CoastAdapt risk assessment templates*.

2.3 Are there any risk management strategies in place to protect previously affected systems from future occurrence of that hazard?

If your system has suffered some degree of consequence in the past from climate related hazards, then you should identify any risk management strategies that have been put in place to address future occurrences of the hazard. This will allow you to understand the residual risk to your system (see Section 2.4 for details).

2.4 Identify the residual risk for a given hazard

According to AS/NZS-ISO31000 (2009), residual risk is 'the risk remaining after risk treatment'. Residual climate risks are the risks that your system faces today regardless of future climate change. Using gathered information you should now be able to identify the residual climate risks of your business. If your business has been affected by climate hazard in the past but still has no risk mitigation strategy in place, regardless of climate change, some degree of climate related risk already exists in your business. Figure 4 shows an example of using the CoastAdapt template to identify residual risk.

List your systems	*Existing* Risk			
	Past recorded events	***Past*** consequences to your business	***Present*** control in place	***Existing*** or Residual risk
Water supply system	Yes	Insignificant	Yes	Low
XXX beach community	Yes	Moderate	No	High
Tourism in general	No	No impact	Unknown	No Risk

Figure 4: Example of identifying residual risk using CoastAdapt risk assessment template.

Step 3: Identify future climate change risks and opportunities

3.1 Explore climate change projections for the selected timeframe/s and emission scenario/s

In first-pass risk screening, you identified appropriate sources of climate change projections for your area. You can use the same sources to access climate change and sea level projections. But, in this

case, you should list the specific variables relevant to each system you have identified as important, on the specific timeframes appropriate to that system. Then, using the projection data, you should aim to respond to the question, 'How is a given variable (e.g. temperature, precipitation, sea level etc.) projected to change (decrease, increase or no change) during the selected time scales (e.g. near- to mid-term, long-term)?'

3.2 Understand whether a change in a climate variable in future will lead to hazards that can pose risks to the system under consideration.

This is one of the most critical parts of the second-pass risk assessment. A change in climate variable or sea level in future can lead to potential hazards which pose risks to the system under consideration. Therefore, you need available information and/or expert judgement to determine how a future change in a certain climate variable (as shown by your climate change scenario) may translate into a hazard and associated risk and possible future consequences or opportunity.

The process is done by taking one system at a time and developing an understanding of hazard and risk impact/opportunity. As an example, if the first-pass screening identified that there is critical infrastructure located in low lying areas and sea level rise is projected for that area (the hazard), this can put the infrastructure at risk.

CoastAdapt provides impact sheets with high level descriptions of how climate change and sea level rise may impact different sectors in the coastal zone – see an *Overview of impacts*. Relevant experts or consultants could shed further light on these impacts.

CoastAdapt provides several national data sources that can be used to support part of your risk assessment (see Appendix A). Other information can be obtained from state and local governments and from regional groups and local universities.

3.3 Can existing risk get worse/new risks emerge under future projected changes?

Existing risk may worsen under climate change. To evaluate the likelihood, you should consider how your existing risk management strategies may perform under future projected climate change. If you have identified in Step 2 that you have residual risk for a given system, you should now explore the possibility of this risk being compounded by future climate change.

The absence of any hazard in your area in the past does not necessarily guarantee that it will not happen in future. Therefore you should consider whether the change in a given climate variable in future can result in a new risk for your system. For example, a storm water system near the coast may not be threatened under current sea level but if sea level increases to a certain level, it is possible that the ability of the system to discharge storm water into the sea will be reduced.

3.4 Understand possible consequences of a given risk and the likelihood of that occurring.

Potential risks to your business operation and their consequences can be identified at a risk workshop with stakeholders and experts (with expertise relevant to the systems identified as at risk) within and outside the organisation.

While determining possible consequences it is useful to explore how sensitive your system is to climate change and the system's capacity and/or the capacity of the organisation managing the system to tackle those changes. This will help you to understand the vulnerability of your system to climate change and will provide you with an understanding of the potential severity of any consequences.

As an example, an assessment of risk to a stormwater system close to the coast finds that the intensity of rainfall is projected to increase. The current capacity of the storm water system may be exceeded and be unable to handle the resultant run-off, leading to the likelihood of localised flooding during storms. This shows that the storm water system has some degree of sensitivity to future climate change. If it is too expensive for the organisation to upgrade the storm water system (indicating low organisational capacity), then in future storm events localised flooding can be expected, suggesting a 'moderate' consequence.

While thinking about organisational capacity it is worth exploring any specific barriers to adaptation (e.g. legal, policy, design standards, financial). For example, if assessing whether an at-risk road can deal with an increased height of storm inundation, you should consider organisational capacity to manage such an event (e.g. possibility of diverting traffic, availability of emergency workers, capacity to coordinate with other agencies during a disruption etc.). If the system is more complex so that any disruption can impact surrounding communities, then you should also consider the capacity of those communities to deal with any possible disruption of the service. Understanding the demographic and socioeconomic status of the affected users can provide a broad idea about this. Detailed social vulnerability studies should be conducted if this information appears critical for decision-making.

Consider whether your system is already designed to accommodate some degree of climate change (flexibility). Examples of coastal systems that are flexible to change include: animal or plant communities that are able to move easily or modify their behaviour in response to external changes; infrastructure that is designed to accommodate a range of future climate conditions, such as a water supply system that has been expanded with reclaimed water. If your system has flexible characteristics then its adaptive capacity is high and it is likely to suffer fewer consequences.

You should take one system at a time and list the possible risks and respective consequences. This information will be used in the next step (Step 4) to qualitatively rate these consequences and their likelihood of occurrence (to be discussed later in the document).

It is useful to think about the primary and secondary impacts of a risk by identifying interdependencies among different parts of your business or infrastructure. These interdependencies may affect supply chains and business continuity. As an example, infrastructure systems (water, electricity, transport, telecommunication etc.) are often interdependent and the performance of one system (e.g. electricity) can affect the rest (e.g. water supply, telecommunication etc.). These interdependencies are often not clear under normal circumstances but may become evident in an extreme event. There are now emerging tools for value chain analysis of risks (see Climate Risk's tools at http://www.climaterisk.com.au/; and CSIRO's Climate Chains at https://adaptivevaluechains.com/ accessed 16 June 2016). A list of tools relevant to adaptation decision support is available in CoastAdapt (see *Catalogue of adaptation support tools*).

Step 4: Analyse and evaluate risk

In the previous step, the possible consequences of climate change impacts to systems have been explored. Step 4 qualitatively rates those consequences to understand which systems are more at risk than others. This helps to qualitatively prioritise risks.

In general, you should use existing organisational criteria and their associated scales (consequence and likelihood) to evaluate climate risks. These should be agreed among stakeholders. However, if you find that existing scales are unable to properly evaluate climate change risks, you can chose example scales provided in Appendix B. These are also used in the CoastAdapt *Risk assessment templates*.

4.1 Identify your risk evaluation criteria (e.g. maintain public infrastructure, protect private properties, minimise impact on environment, ensure business continuity etc.)

Climate change risks need to be evaluated against some criteria. In general, these criteria should be based on the objectives of the risk assessment (defined in step 1). Selection of criteria also needs to address long-term corporate objectives. For example, if you are a coastal local council and want to assess how climate change and sea level may affect some of the broader issues of your council such as public safety, local economy and growth, community and lifestyle etc. then these should be your risk assessment criteria.

4.2 Adopt scales and rate risk consequence and likelihood

Once the risk evaluation criteria are established, take one risk at a time and, using the consequence information developed in step 3, rate how much each criterion will be affected by the perceived consequence of that risk. This can be achieved by using your chosen consequence scale. Similarly you also need to describe how likely a given consequence is to happen. This can be achieved by using your chosen likelihood scale. Here, likelihood refers to the likelihood of a given hazard under the chosen climate change scenario. In other words, the likelihood of the risk is contingent on this scenario occurring. Repeat this rating of consequence and likelihood for each risk evaluation criteria.

4.3 Adopt a risk rating scale (e.g. high, medium, low etc.) and rate the risks

Risk rating scales are qualitative descriptions of the severity of risks. Severity is determined by the potential consequence of a future risk and the likelihood of that event happening. Take one risk at a time and use the information generated above to come up with a final risk rating. As an example, if a risk (e.g. destabilisation of foundation of a coastal infrastructure) arising from a hazard (e.g. increased erosion due to sea level rise) has a consequence rating of ‘insignificant’ and a likelihood rating of ‘rare’ then using the example risk rating table (Appendix B, Table B-6), the risk should have a ‘low’ rating.

4.4 Using the risk rating, identify the risks that may cause you most problems in future and which therefore should be investigated further

The risk rating will determine what type of response is required. Simple examples of the type of response required for different risk types are listed below.

- Extreme risk: urgent attention is required at a senior level. Action plans and management responses are required. Needs further detailed risk assessment to identify specific risks so that they can be prioritised.

- High risk: needs further detailed vulnerability assessment to identify specific risks to the system so that they can be prioritised for risk treatment. Needs an adaptation plan to be developed.
- Medium risk: keep a watching brief and revisit next year.
- Low risk: keep a watching brief and revisit in five years.

4.5 How to present the results

For all three levels of risk assessments you can choose to assess your risks at multiple timeframes (i.e. short-term, mid-term and long-term) and using the results you can create a simple graph showing time and risks on the x and y axes respectively. This type of graph provides a visual representation of risks over time (Figure 5).

Figure 6 shows the example outcome of a second-pass risk assessment using the CoastAdapt *Risk assessment template*.

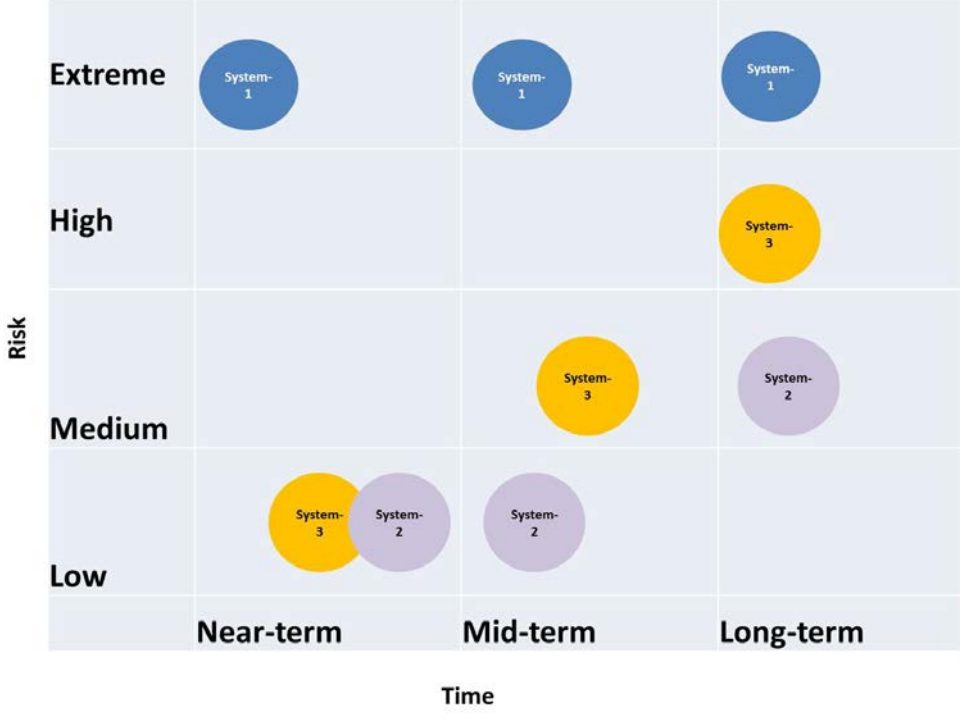

Figure 5: Example presentation of risk assessment results.

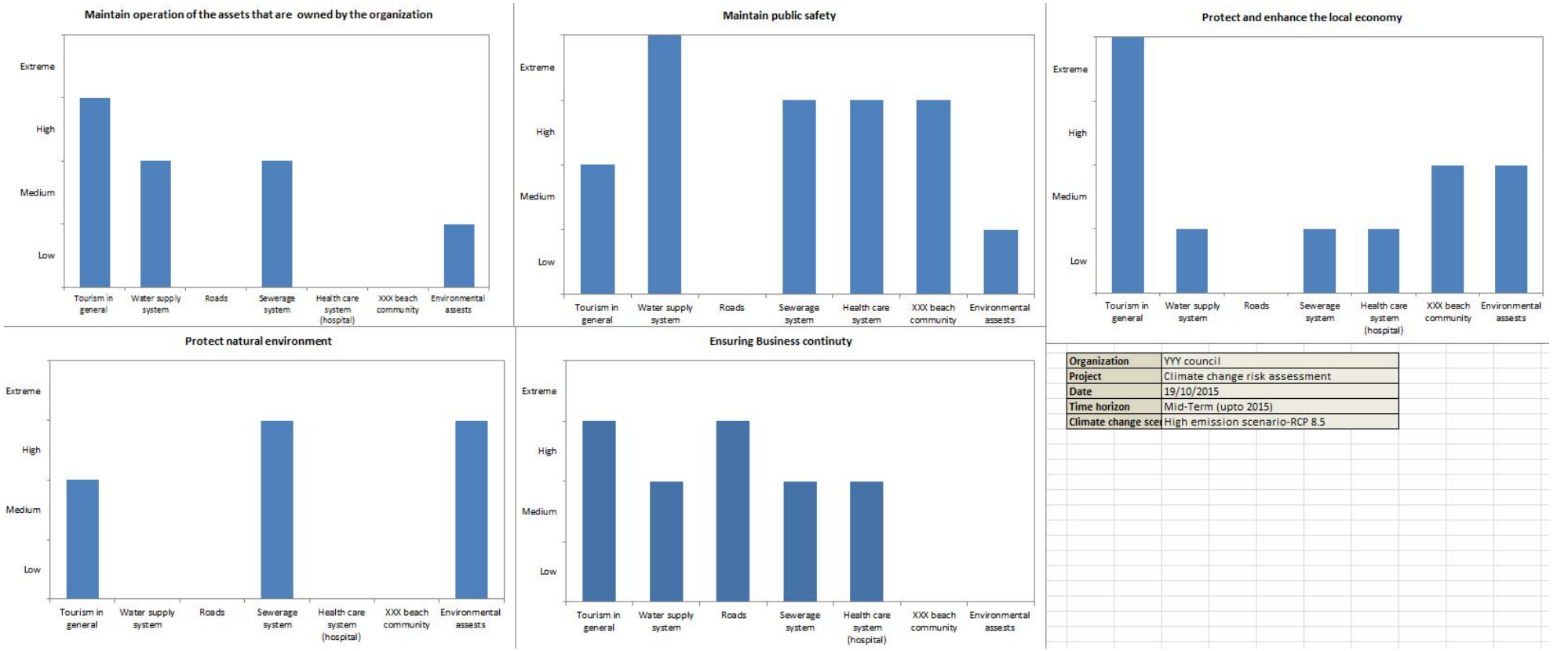

Figure 6: Example output of the second-pass risk assessment using CoastAdapt risk assessment Tool. Heading of each graph shows risk evaluation criteria used in the assessment. X axis shows the systems included in the risk assessment. Users can modify this in the spreadsheet based on their requirement.

Where to go from here

So far you have identified the organisation-wide climate change risks and prioritised the at-risk areas/systems/assets. It is now possible to start risk management by exploring mitigation options, evaluating options and their costs, and building an adaptation plan. You may choose to take an adaptation pathways approach, see *Pathways approach* which will help to identify the trigger points that require action. C-CADS steps 3, 4, 5 and 6 provide further guidance on developing an adaptation plan (*C-CADS*).

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Appendix A

Use of some CoastAdapt resources in second-pass risk assessment

In general, the extent to which future sea-level rise will translate into a risk for your business largely depends on geomorphology and sediment dynamics as well as the land use pattern of your coastal zone. CoastAdapt provides data and information to understand these issues, which can be useful for a second-pass risk assessment.

Geomorphology

Shoreline Explorer in CoastAdapt provides access to *SmartLine data* created by Geoscience Australia showing broad erodibility of a coastline around Australia (Figure A-1). In general, the erosion of a highly erodible coastline is more likely to increase if sea level increases further. Therefore, if your assets are located within or close to an erodible coast then those assets should be investigated further. Read *guideline of interpretation of SmartLine data* for more detail.

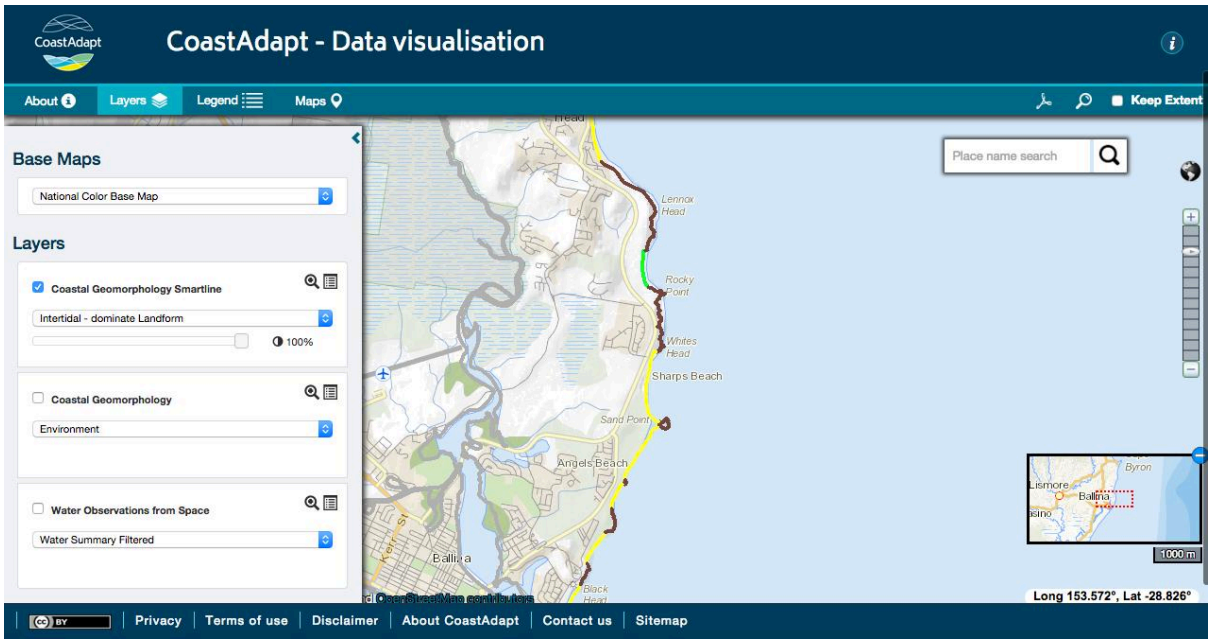

Figure A-1: Example of national visualisation data products: SmartLine information showing landform types and erodibility. In this example, brown coloured line is showing highly erodible cost. Source: CoastAdapt.

Sediment dynamics

Shoreline Explorer also contains *Coastal compartment mapping.* The Australian coast has been divided into 359 units, or sediment compartments, within which there are broadly homogeneous features that may include geology, landform types, near-shore currents and sediment availability and movement (see Figure A-2 for an overview of different types of coastal compartments). A compartment might be, for example, a bay lying between two headlands. CoastAdapt provides descriptions and information for each sediment compartment around Australia.

Understanding the general dynamics of the coastal system (e.g. sediment movement, eroding or accretion of beaches) can help to understand the sensitivity of your shorelines to future sea level rise

(for more information on sediment compartments read *Sediment compartments for coastal management*, as well as help you investigate how your existing shoreline management strategy (e.g. continue to nourish a beach) may perform under future sea level changes.

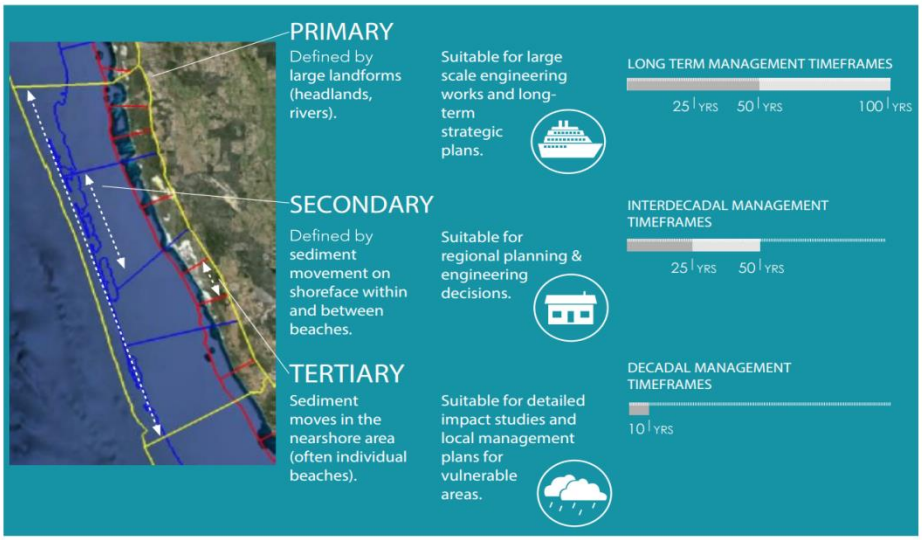

Figure A-2: Overview of different types of Coastal Compartment. Source: Thom 2015 © Commonwealth of Australia 2016.

As an example, Figure A-3 shows the boundary of a secondary compartment. This map will link to a table with information such as 'Geological type of the compartment' (sandy, rocky, mixed sand and rock coast, coastal lowland, estuaries etc.), 'Susceptibility rank' from 1 to 5 (where 1 suggests 'accreting at present, and likely to continue in future' and 5 suggests 'receding and likely to continue eroding in future'), and the 'confidence' in the data. Using this information you can understand the sensitivity of your coastal area to future changes. Some of the compartments will have detailed information (depending on the information availability of the region) with arrows indicating the direction of sediment movement within the compartment. For further guidance on interpretation of coastal compartment data of CoastAdapt, see *Guidance material on interpreting coastal compartment information*.

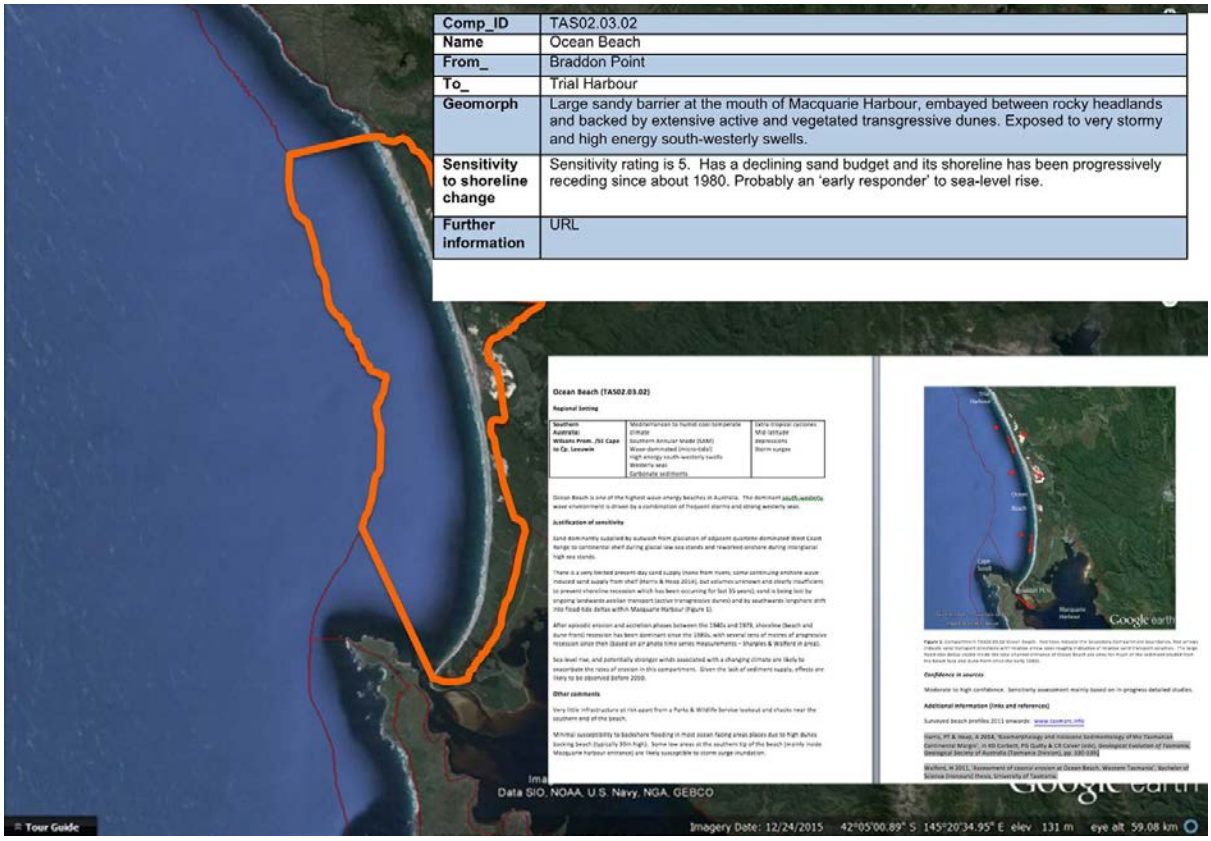

Figure A-3: Example from CoastAdapt's sediment compartment datasets. Source: CoastAdapt.

Inundation risk

Inundation mapping for each coastal council is available in CoastAdapt at CoastAdapt datasets-Future, for a mid-level and high sea level rise scenario for 2050 and 2100. Those wishing to examine a wider range of sea-level rise scenarios should explore the Coastal Risk Australia tool at http://www.coastalrisk.com.au. Guidance on appropriate values of sea-level rise to use can be obtained from *Guidelines on using Sea-level rise projections* in CoastAdapt, as well as from the Climate Change in Australia website. Broadly, your choice depends on your timescales of interest and your appetite for risk.

Mapping of areas prone to inundation is also available from some state governments (see Table 6.3 of *Information Manual 3: Available Datasets* .

More information is available in *National mapping and coastal risks*.

Note that, apart from these coastal specific risks, you also need to think about some of the other risks that may arise in the coastal zone under future climate change. As an example, increased temperature may cause problems in operation of some infrastructures that provide services to coastal communities.

Appendix B

Table B-1: Example of a scale for rating the consequences of coastal climate related hazards on your business. Modify based on your business requirement.

Qualitative scale	Description
No impact	No assets were affected. Overall no impact on the organisations business process
Insignificant	No assets were affected, however organisations business process was slightly hampered which resulted in insignificant monetary loss.
Minor	Minor impact on assets (no structural damage). Minor impact in business operation as disruption mostly can be managed through standby or alternate options. However, some loss of revenue or cost incurred.
Moderate	Moderate damage to some part of the structure of the asset(s). Considerable impact in business operation with loss of revenue
Major	Extensive structural damage to the asset(s) requiring significant engineering stabilisation work. Major disruption in business operation with significant loss of revenue and market reputation
Catastrophic	Some of the asset(s) completely damaged. Significant disruption in business operation (virtually dysfunctional)

Table B-2: Example of risk evaluation/success criteria (adopted from AGO 2006).

Sector	Example of evaluation/success criteria
Local government authorities	• Maintain public safety • Protect and enhance the local economy • Protect existing community structures and the lifestyle enjoyed by the people of the region • Sustain and enhance the physical and natural environment • Ensure sound public administration and governance
Public utility	• Maintain service quality • Ensure reliable service delivery • Manage interaction with other providers to achieve cost-effective operation • Ensure that community and regulatory standards of administration are met • Maintain and strengthen community confidence in the organisation
A business	• Build shareholder value • Achieve planned growth • Protect the supply chain • Maintain required human resources • Ensure regulatory and legislative compliance

Table B-3: Example of consequence scale.

Consequence	Criteria-1	Criteria-2	Criteria-3	Criteria-4
	Assets that are owned by the organisation assessing risk	Community Asset (infrastructure and services)	Environmental assets	Business continuity (capacity of the organisation to manage a disruption)
Catastrophic	Asset(s) completely damaged and/or large scale engineering works required for reinstating.	Community assets and private properties completely damaged with irreversible loss	Irreversible loss of environmental assets	Significant disruption in business operation (virtually dysfunctional)
Major	Extensive structural damage to the asset(s) requiring significant engineering stabilisation work. Major disruption in the asset's service	Extensive damage to community assets with wide spread impacts. Long-term loss of private property	Extensive damage to environmental assets with long-term effects and that can have impact in local economy and life style. High cost involve to recover using management efforts	Major disruption in business operation with significant loss of revenue and market reputation
Moderate	Moderate damage to some part of the structure of the asset(s) and require large engineering stabilisation work. Moderate disruption in the asset's service	Considerable impact upon access to community assets. Major long-term impact upon private property.	Considerable impact on environment but with no long-term effects and can be recovered with moderate management efforts	Considerable impact in business operation with loss of revenue
Minor	Limited damage to some part of the asset(s) and require some small scale stabilisation work resulting in minor service disruption	Minor short-term impacts (mainly reversible) on community assets and services. Minor long-term impacts to private property.	Limited impact on the environment but can be recovered using minimum management efforts	Minor impact in business operation as disruption mostly can be managed through standby or alternate options. However, some loss of revenue or cost involved
Insignificant	Little disruption in service but no structural damage to the asset(s)	Little disruption of non-critical community assets	Little impact on environment and recovery occurs without management efforts	Little impact in business operation.
No risk	No assets are at risk	No community assets and/or private property are at risk	No environmental assets are at risk	No impact on business operation

Table B-4: Example likelihood scale.

Likelihood	Description
Almost certain	You expect it will almost definitely be a regular or repeated feature of the project life
Likely	You expect it is likely to occur during the project life
Possible	You will expect it will occur more likely than not occur during the project life
Unlikely	You would expect it will more likely not occur than occur during the project life
Rare	You don't expect it to occur during the project life

Table B-5: Example likelihood scale (adopted from 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

Table B-6: Example risk ratings scale (adopted from AGO 2006).

	Consequences				
Likelihood	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

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