CoastAdapt

Case Study

Defence climate change risk assessment

Overview

This case study describes the process used by the Australian Department of Defence to undertake climate risk assessments and adaptation planning at some of its coastal sites. It shows how an Australian government agency is taking into account the impacts of climate change on its assets and planning to adapt. The approach included the development of a Site Assessment Methodology and Framework (SAMF), which focusses on the assessment of risk for existing assets including the following steps:

1. Establish risk context
2. Identify risks
3. Assess risks
4. Evaluate risks
5. Develop a list of possible risk treatment
6. Communicate risks.

The application of the SAMF methodology is described through two examples: Royal Australian Air Force (RAAF) Base Townsville and the Horn and Yorke Islands facilities.

Background

The Department of Defence (Defence) has the most extensive land and property holding in Australia, comprising more than 3 million hectares of land and 25,000 buildings, with a replacement value in excess of $32 billion. Defence also has large training areas and bases close to the coastline.

These coastal sites and assets are likely to be affected by sea-level rise and changes in storm surge and king tides. In 2011, Defence initiated a two-stage climate change risk assessment process.

The first stage involved a high level assessment of likely risk exposure to climate change at each coastal site. This first pass assessment, *Assessment of the Impact of Climate Change Induced Sea Level Change on Significant Defence Bases*, focused on sea-level rise and coastal flooding. While the scope was not detailed enough to plan for adaptation, it enabled Defence to decide which sites required more detailed investigations.

The second stage involved a more in-depth study aiming to help Defence take the next step. This was to understand in more detail the actual risk exposure of the sites identified as at-risk in the first stage, and which adaptation measures would be likely to minimise these future risks. Changes in fluvial flooding and coastal erosion were also considered in this stage. This approach will enable investment and planning decisions to be made with greater confidence.

Risk Assessment

A Site Assessment Methodology and Framework (SAMF) was developed to guide the second stage of more detailed assessment. The key steps in the SAMF are described below.

1. Establish risk context

The SAMF defines the following factors when undertaking a detailed climate risk assessment for a coastal site identified as at risk:

Objectives and scope

The objective in this study was to enable Defence to understand and manage the risks associated with climate hazards of fluvial flooding, coastal flooding and coastal erosion. The assessment was informed by projected changes to sea-level rise and extreme rainfall and made across three timeframes: 2040, 2070 and 2100.

Stakeholders to be engaged or consulted

The SAMF suggests that Defence operational managers, base managers and personnel who operate or reside at the site should provide input into the data collection process, risk identification and adaptation planning components of the assessment. In addition, external stakeholders including technical experts and local or state government agencies could assist in provision of data, identification of risks and technical reviews of findings.

Key risk dimensions used to guide the assessment

To efficiently identify and analyse the risks, a set of risk dimensions were identified outlining Defence's key organisational, base and activity-related concerns. These were designed to prompt expert and stakeholder input and make sure that all important issues were raised. The dimensions were: capability, occupational health and safety, legislative compliance, environment and heritage, financial efficiency, personnel, and reputation.

Evaluation criteria

The SAMF based its risk assessment framework on the following three documents:

- Climate Change Impacts and Risk Management: A guide for Business and Government (Australian Greenhouse Office 2006)
- AS-5334-2013: Climate Change Adaptation for Settlements and Infrastructure: A risk based approach (Standards Australia 2013)
- Estate Risk Assessment Guidance: For Estate Maintenance (Department of Defence 2012).

Climate change scenarios

The 'A1F1' greenhouse gas emissions scenario was selected as the basis for consideration in the SAMF. This is a set of future emission scenarios identified by the Intergovernmental Panel on Climate Change (IPCC) in its Special Report on Emissions Scenarios (SRES). The A1F1 is the highest emissions growth scenario of the SRES family.

2. Identify risks

The SAMF provides guidance on collating risk identification information and compiling a list of base-specific risks. A variety of spatial, climatic and site information is required to identify and inform the analysis of risks posed by fluvial flooding, coastal flooding and coastal erosion. Risks were documented in a table against a set of risk themes, specifically: buildings, site access and internal roads, pier and marine infrastructure, runways and aviation infrastructure, utilities, environmental assets, contamination and heritage.

3. Assess risks

This step of the SAMF guided the assessment of the identified risks by:

- undertaking detailed site assessment
- identifying and reviewing the current controls
- rating the consequences and likelihood of each risk to determine the risk level and rating.

4. Risk evaluation

This stage determines which risks require treatment as a priority. Those risks identified as medium, high and very high in 2040 were deemed to require the development of risk treatments.

5. Develop a list of possible risk treatment

The aim of the risk treatment step is to identify solutions to reduce the identified risks at each site. However, having a list of adaptation solutions is not enough to enable decision making, even when supported by a robust risk assessment process—solutions must also be prioritised for implementation. To do this, the SAMF provides the framework for a multi-criteria analysis (MCA) including criteria, scores and definitions (Table 1).

For each adaptation solution or option, the scores for each criteria were added to reach an overall priority rating score, with the 'urgency' criteria weighted (x2) to add emphasis to the most urgent actions to reduce risk. Consistent with the Defence risk rating process, the lower the score, the higher the priority for implementation.

The overall priority rating score was used as a first filter to rank and assess the potential timing for implementation of adaptation options. The SAMF indicates that Defence should consider existing programs and budgetary commitments before finalising the timing for implementation of each adaptation option.

6. Communicate risks

The SAMF outlines methods of communication to ensure the findings are accessible to support decision making, including provision of information for both technical and non-technical audiences (e.g. workshops, reports, animations, summary sheets and fact sheets).

Table 1: Adaptation prioritisation criteria and weighting for MCA. Source: Department of Defence.

	High (1)	Medium (2)	Low (3)
Effectiveness to reduce risk	High potential to reduce risk to multiple Defence operations and/or asset types and/or to reduce multiple risks	Moderate potential to reduce risk to a Defence operation and/or asset	Potential to reduce risk is low or uncertain
Cost	Cost is minor ($0-$500 K)	Cost is moderate ($500-$15 M)	Cost is major (>$15 M)
Significance of action	Several adaptation actions rely on this being done first or they will no longer be required if this action is implemented or is the primary treatment of risk to a critical asset	Another adaptation action relies on this being done first or implementation means another adaptation action may no longer be required	Does not influence
Community acceptance	Potentially no conflict with communities for implementation and/or will provide broader social and environmental benefits	Possible conflict with communities for implementation and/or may provide broader social and environmental benefits	Likely conflict with communities for implementation and/or may generate negative social and environmental impacts
Urgency (x2 weighting)	Should be completed within the next 10 years to avoid current risk	Should be completed before 2040 to avoid risk	Should be completed before 2070 to avoid risk

Example 1: **RAAF Base Townsville**

RAAF Base Townsville is a major Defence base in Northern Australia and a joint user facility with the Townsville Airport Pty Ltd (Figure 1). It is located north-west of the city of Townsville. This example outlines the investigation undertaken by Defence in relation to coastal risks and potential impacts of climate change (steps 1 and 2 of the SAMF). For more information about the city of Townsville and its exposure to coastal hazards see Snapshot: Townsville coastal hazard assessment.

The analysis included using climate projections to develop updated flood hazard maps for the site. These maps identify which parts of the base may be subject to future inundation due to sea-level rise and increased rainfall and runoff. The project also developed a list of possible adaptation options for further discussion, prioritization and possible implementation (steps 3 and 4 of the SAMF).

Establish risk context (SAMF's step 1)

Townsville airport is a joint user facility operated by both Defence, and Townsville Airport Pty Ltd (Figure 2). Hence both the civilian facility and the Defence facility— which share operational infrastructure including runways and taxiways— are potentially increasingly subjected to potential loss of service as a result of more frequent flooding associated with sea-level rise.

Many municipal airports were developed during the 20th century in response to increasing demand for air transportation. A key requirement in selecting sites for municipal airports has been the availability of a large area of flat land in close proximity to major cities and centres. Safety concerns have also led to many airports being located at sites that minimise overflying of urban areas.

In an effort to meet these criteria, and keep land acquisition land costs minimal, many airports were developed in flat lowland regions that had not yet been developed. By following these criteria the sites selected were often wetland, marsh or poorly drained regions on coastal floodplains. It is also common for a large number of airports around the world to be located on the foreshore of coastal embayments with runways abutting the very edge of the shore.

Sea-level rise was not a major global or local concern when many of these major airports were developed. This lack of awareness of sea-level rise, combined with the coastal location, is likely to result in increasing exposure to inundation for many major and minor airports worldwide.

The Townsville RAAF Base falls into this category. The joint facility is in a location that is low-lying and will be increasingly exposed to flooding as a result of sea-level rise. At present, inundation is primarily associated with the monsoon wet season and the passage of tropical cyclones. Like other commercial airports in Northern Australia, the Townsville civilian airport has well-developed and well-practiced procedures that ensure that airport operations are curtailed as soon as a cyclone warning is in place.

Under the *Townsville Airport Disaster Management Plan September 2012*, when the Bureau of Meteorology issues a cyclone warning, the airport advises commercial flight operators to relocate aircraft and restrict landings at the airport. Therefore, in terms of commercial and private aviation, having the commercial airport facility temporarily inundated during cyclone events does not generally lead to loss of service as the airport is closed for operations anyway. By contrast, during extreme events such as tropical cyclones, there is an expectation that Defence will provide support services. This can mean that Defence may require a higher level of service for operations at the airport compared to the civilian facilities. In recognition of possible future more frequent inundation events that may lead to additional loss of service, Defence has investigated the risk profile of the facility at RAAF Base Townsville.

Identify, assess and evaluate risks (SAMF's steps 2, 3 and 4)

Townsville airport presently suffers loss of service during tropical cyclones. The critical constraint is the ability of aircraft to land and take off in cyclonic conditions and there is little that can be done to allow service to be delivered during cyclones. Climate projections suggest that the number of cyclones may decrease as a result of climate change, although the intensity of those tropical cyclones that do occur is expected to increase (see Cyclone and ECL impacts).

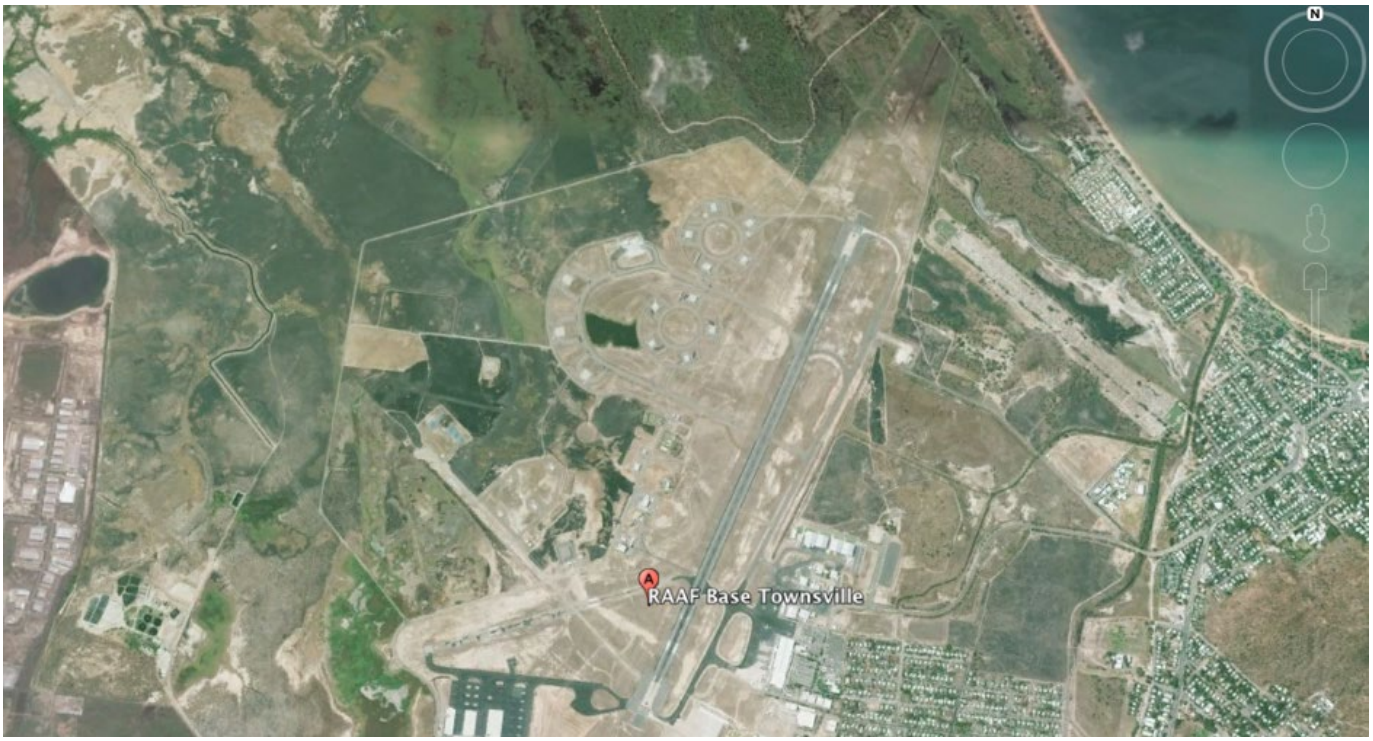

Figure 1: Aerial view of RAAF Base Townsville site. Source: © Google Earth.

Figure 2: Townsville Airport at RAAF Base Townsville. Source: © Department of Defence.

Whilst the winds associated with cyclones commonly abate within hours once the system has passed, surface water can take days to drain away and hence prevents recovery from loss of service events. Reducing the time that the facility takes to return to service is a key consideration.

Defence commissioned a risk assessment to analyse the likelihood of increased inundation resulting from sea-level rise and increased rainfall and runoff. This involved updating existing flood maps. The outcomes from these updated, climate-informed, flood maps was an assessment of the assets that may be at risk in the future, and a profile of the increase in risk over time. This understanding was used to detect possible impacts on the delivery of key services (risk evaluation).

A list of possible options to reduce impacts on service delivery was developed:

- Adjust the design specifications for any new works or development of buildings, aviation infrastructure and utilities to incorporate greater allowance for marine and estuarine flooding
- Ensure any future redevelopments of the site accommodate changes in capability and consider future flood and inundation maps
- Review maintenance specifications and monitoring to account for increased damage and corrosion
- Review existing emergency management plans
- Review guidance for storage of critical and/or hazardous materials
- Determine the vulnerability of key utilities supplied to the site
- Isolate electrical and communications systems
- Accept flooding in low lying areas and move activity and function to higher parts of the site
- Build protection works.

With these options in mind Defence engaged in a dialogue with Townsville City Council to discuss the planning of risk mitigation measures.

Example 2: **Horn Island (Ngurupai) and Yorke Island (Masig) facilities**

The Torres Strait archipelago is Australia 's northernmost jurisdiction, and lies in close proximity to South-east Asia. Defence has had a presence on the islands since World War II and presently occupies multiple facilities including Horn Island (Ngurupai in the local language) and Yorke Island (Masig) (see Figure 3).

The Yorke Island facility in particular experiences on-going coastal erosion issues that are likely to be exacerbated over future decades. This example illustrates the situation and describes the key climate change hazards that may impact upon both island's facilities (steps 1 and 2 of the SAMF). It also describes the pros and cons of potential coastal adaptation strategies (steps 3 and 4 of the SAMF).

Establish risk context (SAMF's step 1)

The Torres Strait group of Islands features over 100 islands, reefs and cays. While the eastern group of islands are volcanic in origin and feature high relief, many of the other islands are low lying. Furthermore, on many of the islands that feature elevated landforms, the island communities have established themselves on the low-lying foreshore as a result of their strong dependence on the sea for subsistence and more recently commercial food resources, and transport. Some of these communities experience flooding several times a year as a result of king tide events. The impact of elevated sea levels is likely to lead to an increasing frequency of inundation events. In addition, as a result of the strong tidal flows and occasional cyclones, many locations in the island group have been exposed to ongoing coastal erosion issues (see Case study: Adapting to sea level rise in the Torres Strait).

Defence presently manages a number of assets within the island group, including facilities on Horn Island and Yorke Island, with the main facility located at Thursday Island (Waiben). The Horn Island and Yorke Island facilities are used as depots and training facilities and are not permanently occupied.

Figure 3: Aerial view of Horn (left) and Yorke Islands (right). Source: © Google Earth.

The Defence facility on Horne Island is located alongside the airport, which is now the major airport for Torres Strait and Australia's busiest regional airport. The present day facility at Horn Island is used as a depot and training area and features store, toilet blocks, kitchen and general purpose spaces. A smaller depot facility exists at Yorke Island.

Identify, assess and evaluate risks (SAMF's steps 2, 3 and 4)

Defence has identified that there are two key climate change hazards that may impact the facilities at Horn Island and Yorke Island. These hazards are sea-level rise, which will increase the likelihood of inundation events even if the frequency and intensity of cyclones does not change, and coastal erosion.

Coastal erosion is an ongoing problem in a number of locations in the Torres Strait for three main reasons:

- Torres Strait communities are often situated on the low-lying foreshore locations
- Torres Strait features fast tidal flows and high tidal excursions
- on average, two cyclones pass through the Gulf of Carpentaria/Torres Strait region each year.

The Horn Island facility is located near the centre of the island, alongside the airport. Hence erosion has not been identified as a risk. By contrast, Yorke Island is a long (2.7 km), narrow (800 m) low lying coral cay, the shores of which are subjected to both ongoing recession in some places and sporadic erosion events.

Similarly, inundation of the Horn Island facility itself has not been identified as a risk, although part of the facility abuts against an inland wetland, but access by sea through the Horn Island harbour has been identified as vulnerable to sea-level rise.

Coastal adaptation strategies are commonly categorised into: protect, retreat or accommodate.

In the case of the Yorke Island facility:

- The protect approach would involve developing and implementing hard or soft engineering solutions. Given the small size of the island, coastal protection measures applied to the facility would most likely have flow-on impacts to other locations on the island. Therefore, if this solution was deemed optimal, consideration would need to be given to an island-wide protection approach.
- The retreat approach would have the facility relocated landwards.
- The accommodate approach would entail ongoing management, such as relocating fences and other structures landwards, but on the same site.

Over recent years the default strategy has been to accommodate erosion through the shoreward relocation of structures such as fences. For this reason, Defence has considered undertaking an options assessment process in order to develop an adaptation strategy for this facility.

References

Australian Greenhouse Office, 2006: Climate change impact and risk management - A guide for business and government. Department of Environment and Heritage. Accessed 25 May 2017. [Available online at https://www.environment.gov.au/climate-change/adaptation/publications/climate-change-impact-risk-management].

Standards Australia, 2013: AS-5334-2013 Climate change adaptation for settlements and infrastructure: A risk based approach. ISBN 978 1 74342 480 3.

This Snapshot was prepared by the Australian Department of Defence. Please cite as: Department of Defence, 2016: Defence climate change risk assessment. Snapshot for CoastAdapt, National Climate Change Adaptation Research Facility, Gold Coast.

CoastAdapt

NCCARF National Climate Change Adaptation Research Facility

Australian Government
Department of the Environment and Energy