

Report of the Independent Review into the Tasmanian Floods of June and July 2016



Shared responsibility, resilience and adaptation

June 2017

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1 June 2017

Honourable Rene Hidding
Minister for Police, Fire and Emergency Management
Level One, Franklin Square
Hobart TAS 7000

Dear Minister,

Independent Review into the Tasmanian Floods of June and July 2016

I attach my Report into the above.

Yours faithfully

A handwritten signature in black ink, appearing to read 'M Blake', with a horizontal line extending to the right.

Mike Blake
Lead Investigator

Foreword

In this report of my Review of the Tasmanian Floods of June and July 2016 I note that, "... during this event it didn't just rain: the rain experienced was extreme in the Tasmanian context and so the fact that it led to flooding was not just unsurprising, it was to be expected. These totals, that would be significant in any environment, were particularly so for Tasmania."

Also most evident was the need for me, as my team and I went about our work, to be very conscious of the benefits of hindsight and to regularly pose the question – "how might I have responded to these incidents at the time?" Perhaps in answering this question as we went along, I observed examples of entities that had learnt more from past experiences than may have others. While I am not saying this happened on this occasion, there is a risk with natural hazards like floods, that communities and emergency authorities forget when floods do not occur for many years, resulting in lower awareness and preparedness. Communities change and age and perhaps forget. We need systems that regularly test and constantly remind all of us without being alarming.

Much good work is done both nationally and in Tasmania on natural hazard risk assessments and, in doing so, there were high levels of engagement between numerous relevant parties. Less effective was communication of these risks, and actions needed, with communities, although an exception to this is how our State has recently managed fire risks. There is much that our fire services can share with other emergency services authorities although always remembering that fire is, currently, more frequent.

I was surprised by the very high costs associated with floods and by finding that floods are not infrequent in Tasmania. Also noted from more than one authoritative source was the view that Australia as a nation, and I suspect this similarly applies to Tasmania, underinvests in natural disaster mitigation. Government¹ and local authorities need to examine and address this.

This Review identified many emergency management related reviews occurring and completed in recent years in Tasmania and nationally. Submissions made to us identified many good suggestions. Government and local governments are urged to review these ideas and to invest resources in addressing them. Hopefully some suggestions will be addressed by proposed planning laws which, at the time of preparing this Report, have still to be finalised.

However, it is not just the State (collectively Government and local governments) that needs to have regard to risks associated with flood and other hazardous events. We all must. We have a shared responsibility in doing this. So, when advice is provided, or training offered, by our emergency management authorities, we all need to listen and, when relevant, take up opportunities offered to learn so as to be more aware, better prepared and to build our collective resilience. This is particularly so as the make-up of our communities and businesses change. With floods in mind, perhaps what is also needed is heightened awareness when flood watch notices are issued by the Bureau of Meteorology rather than waiting for flood warnings.

¹ Throughout this Report Government refers to the Tasmanian Government unless specified otherwise.

Finally, and I raise this with no particular view about the causes, perhaps greater attention may be needed to agencies we establish or why bother to set them up? I refer to agencies like the Tasmanian Climate Change Office. Its research indicates temperatures will rise and rainfall will remain unchanged but there will be more intense rainfall events. The implications of this research need to be considered for the benefit of all Tasmanians.

It is incumbent on emergency management authorities to work together more to better inform all Tasmanian communities about the dangers of floods, in which parts of the State flood risk is the highest and how we can all, not just governments, better prepare. Without this, there is a real risk that the June 2016 experience will be forgotten. Some councils clearly demonstrated what they had learnt from past events; it is up to all of us similarly to do so.

I acknowledge and thank my Review Team members, Mr Paul Considine from the National Aerial Firefighting Centre in Melbourne and Inspector Brian Edmonds of Tasmania Police, for their expert emergency management advice, experience and insights. Also thanked are each of the 54 submitters to this Review and the many parties we interviewed and engaged with during our work; your views and suggestions were in all instances helpful.

Mike Blake
Lead Investigator
1 June 2017

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Executive summary

Background

The June floods in 2016 affected many Tasmanian communities and businesses, resulting in the Honourable Rene Hidding, Minister for Police, Fire and Emergency Management, announcing to Cabinet the intention to undertake a strategic review into this event.

This Report is the result of that decision.

Part A of this Report outlines more about this Review including the Terms of Reference, the structure of this Report and how we went about our work.

Part B outlines our findings and conclusions.

The remainder of this executive summary lists the Terms of Reference for convenience, then records our conclusions in relation to each section followed by our recommendations.

Terms of Reference

The Terms of Reference for this review were that the Review would consider all aspects of the flood event; acknowledging the range of individual and agency inquiries and/or reviews already addressing many of these issues. The Review was to build upon and complement existing learnings, and report on the following matters:

1. The effectiveness of the strategies, preparedness and plans related to managing flood risk in Tasmania that were in place prior to the June 2016 floods occurring; including existing and potential levee systems.
2. Community preparation, resilience and awareness, including awareness of insurance matters, relating to major flood events in Tasmania.
3. The causes of the floods which were active in Tasmania over the period 4 - 7 June 2016 including cloud seeding, statewide water storage management and debris management.
4. The use and efficacy of forecasting, community alerts, warnings and public information by authorities in responding to flood events.
5. The effectiveness of transition from response to recovery in the week following the June floods; including capacity and priorities for infrastructure repair, and immediate assistance payments.
6. Consideration of the detrimental environmental effects of the flooding upon the landscape, and what effective mitigation measures may be necessary to avoid similar events.
7. Any other matters relevant to the Terms of Reference.
8. The Huonville flood event on 15 July 2016.

The Terms of Reference are further contextualised in Section 1.3 of Part A of this Report.

Conclusions and recommendations

Effectiveness of strategies, preparedness and plans (Section 1)

The State's emergency management planning and risk management strategies, structures and related arrangements, as these related to floods, have a sound basis, are in line with national frameworks and are well articulated and understood by the relevant parties.

However, we observed gaps in flood studies and flood plans, both in comprehensiveness and currency of plans. Flood studies, associated flood mapping and flood planning are inconsistent, may be not contemporary, use different methodologies and there were questions as to access, data ownership and regular review. This led to more than one recommendation, including that policy settings, coordination and completion of flood plans and flood studies would be best managed centrally, preferably in an all-hazards emergency management agency or division.

When assessing how well planning worked in practice we concluded that, in the case of the Launceston flood event, emergency planning arrangements were activated as expected and operated effectively.

This was not the case at Latrobe where we noted that appropriate plans existed but may not have been acted on. Contributing to this was that the Bureau of Meteorology (BoM)'s flood watch and flood warnings were focused on the North as opposed to the North-West Region, resulting in the State Emergency Service (SES) deciding to manage coordination of warnings and responses, including requests for assistance, for both the North and North-West Regions, from the Northern Regional Operations Centre (ROC).

Reasoning behind these decisions was understandable but were not in accordance with a predefined plan. The disadvantages of this arrangement became apparent as the situation in the North-West deteriorated and the relevant manager found himself without access to key documents or a dedicated incident management team to focus on this Region.

In the event that a similar situation arises again, contingency planning for the activation of a second ROC, or at least an incident management team, including surge capacity for staffing, should be in place.

With the benefit of hindsight, activation of the State Flood Operations Centre (SFOC) on the evening of 5 June, rather than at 6 am on 6 June, would have added value and provided significant support to the Regional Manager North-West as he endeavoured to deal with the emerging situation. Some consideration needs to be given to identifying trigger points for the timely activation of an SFOC.

Past decisions to invest in flood levees at Launceston City and Northern Midlands Councils worked on this occasion. However, any further investment in levees as a flood-risk mitigation tool may require significant investment requiring thorough and publicly transparent cost-benefit studies.

Regulation of the construction of levees requires better understanding and enforcement.

Agencies with roles to play in emergency management have embarked on numerous internal reviews which, in many cases, have identified worthwhile improvements to emergency management in our State. These reviews need to be progressed and acted on.

There is value in establishing an Exercise and Lessons Management unit responsible for managing recommendations from reviews, lessons learned from exercises and the outcomes of debriefs from major operations.

| Recommendation | | See Report | |
|----------------|---|------------|------|
| | | Section | Page |
| 1. | <p>That in flood-prone municipalities, the respective Municipal Committee develops or reviews flood-related sub-plans within a Municipal Emergency Management Plan at least every two years and submits each sub-plan to the Regional Controller for approval.</p> <p>In addition, that each Municipal Committee maintains a current flood plan, in a standardised format, which at least identifies:</p> <ul style="list-style-type: none"> • flood-prone parts of their locality, particularly those where lives may be at risk; • required actions to be taken in the event of a flood threat, especially timely evacuation; • trigger points for taking required actions and how those trigger points will be monitored; and • how the community can access flood-plan information. | 1.2.4 | 24 |
| 2. | That all councils include an easily identifiable website link for the public to locate their Municipal Emergency Management Plan and community safety information. | 1.2.4 | 25 |
| 3. | That SES uploads current flood studies and plans to the Common Operating Platform as a flood plan layer and that councils, subject to resolving licence restrictions, arrange to have appropriate access. | 1.2.4 | 25 |
| 4. | That agencies undertaking flood studies adopt a standardised approach, based on Australia Handbook 7, maintain public ownership of underlying data sets to support future modelling, and ensure open access to these studies. | 1.2.6 | 26 |
| 5. | <p>That Government:</p> <ul style="list-style-type: none"> • undertakes a comprehensive assessment of flood mapping in Tasmania with a view to identifying data gaps, quality and currency, and works collaboratively with councils to identify funding to improve current statewide flood data; and • explores the feasibility of undertaking a comprehensive flood mapping of Tasmania, using LiDAR or other contemporary technology, with the objective of identifying which parts of our State are, and are not, prone to riverine flooding. | 1.2.7 | 26 |
| 6. | That Government establishes a central flood policy unit responsible for coordinating flood policy across all government agencies, including Government Businesses, and ensures that such a unit has a whole-of-government and community focus. | 1.2.9 | 28 |

Community awareness, preparation and resilience (Section 2)

In this Section we considered the sources of information that exist to support the community to be aware and prepared for flood risk; evidence we encountered of whether communities did appear to have an appropriate level of awareness; and some broader concepts of resilience at national, state and community levels to provide context.

Frameworks in place for SES and councils to facilitate community awareness, preparedness and resilience are reasonable, although inclusion of information about floods on council websites should be standard practice and the adequateness of SES' resources might be hindering their capacity to develop and deliver education to communities about dangers associated with floods. This is likely to be addressed to an extent as SES and Tasmania Fire Service progress sharing resources and aligning education programs, particularly if an all-hazards approach is adopted in doing so.

As far as awareness by communities is concerned, we noted that awareness has to come from a combination of effective education and willingness to be educated regarding flood risk and that such education must be made available at appropriate intervals, because there is a very real risk that governments and communities, due to the passage of time, forget.

We identified examples demonstrating both lack of awareness, such as where:

- despite repeated public advice not to do so, a vehicle was driven through floodwaters and swept away resulting in the loss of a life;
- 'do not enter' signs on a road were removed and deposited on the side of the road;

and actual awareness, such as where:

- communities were warning each other; and
- people were sandbagging to reduce inundation.

In any event, there is a need for education to be provided at appropriate intervals.

Resilience is also built on by experiences, and there was evidence that emergency management agencies, councils, government and the community all learnt valuable lessons from the 2011 and 2016 flood events.

Much academic research on the question of resilience has been, and continues to be, done. Emergency management authorities are urged to keep up-to-date with this research and to adapt policies where relevant.

On the whole, insurers followed mandated legislative provisions and mechanisms are in place for people to challenge refusal to pay out. The relevant legislation is only four years old and this experience, together with more recent flooding in Queensland and New South Wales, is likely to provide further evidence from which governments and the insurance industry can assess whether anything needs to change. In any event, there is a need for insurers to ensure their policies are understood, in particular as this relates to the difference between flood and storm cover. Similarly, parties taking out insurance must ensure they understand levels of cover, if any.

| Recommendation | | See Report | |
|----------------|---|------------|------|
| | | Section | Page |
| 7. | That SES and Tasmania Fire Service share resources and align their community education programs and adopt an all-hazards approach to awareness. | 2.3.1 | 40 |

Causes of the floods (Section 3)

During the period 2 to 6 June, it didn't just rain: the rain experienced was extreme in the Tasmanian context and so the fact that this led to flooding was not just unsurprising, it was to be expected. These rainfall totals would be significant in any environment, particularly Tasmania. This situation was exacerbated by soil moisture levels in most catchments across the State being close to saturation.

Hydro Tasmania (HT)'s cloud seeding activities on 5 June had no impact on precipitation, with this conclusion having a solid scientific basis, and conditions on this date were not suitable for rainfall enhancement by cloud seeding. In the event HT decides to restart its cloud seeding program, improvements are needed to its quality control and assurance processes, there is a need for it to review its cloud seeding decision criteria, and the results of its internal review of its cloud seeding activities should be independently reviewed.

HT's dam network was not designed as a flood mitigation measure, is not suitable in its current configuration for effective flood mitigation, and there would be limited scope to construct new flood mitigation dams due to the significant cost.

Action is needed by Department of Primary Industries, Parks, Wildlife and Environment (DPIPWE) to ensure private landowners who construct dams and levees are fully aware of their legal obligations, including the need for hydrological assessments.

The failure of the Kimberley Railway Bridge did not make the flooding along the Mersey River downstream of the bridge significantly worse.

Debris, in the form of fallen livestock, trees, logs, gravel and silt caused significant damage to riverbanks, bridges and farmland during the June floods. What caused trees and logs to be caught up in floodwaters is unclear and requires further review, as does responsibility for clean-up and riparian restoration and management.

| Recommendation | | See Report | |
|----------------|---|------------|------|
| | | Section | Page |
| 8. | That in the event that Hydro Tasmania decides to start cloud seeding again, water managers, represented by DPIPWE, work with Hydro Tasmania to ensure appropriate, best practice application of the guidelines issued by the Agricultural and Resource Management Council of Australia and New Zealand. | 3.2.3 | 54 |
| 9. | That DPIPWE examines the WMAwater report along with its own, analyses the differences, consults with the Forest Practices Authority and Environment Protection Authority, and proposes an appropriate course of action to Government. | 3.5.2 | 59 |
| 10. | That DPIPWE examines the <i>Forest Practice Code 2015</i> for relevance of its concepts to farming and other business activities near rivers, streams and naturally occurring dams and makes recommendations to Government accordingly. | 3.5.2 | 60 |
| 11. | That DPIPWE clarifies responsibility for river restoration and riparian management and, having done so, communicates this to councils, landowners and other owners of relevant infrastructure. | 3.5.5 | 62 |

Forecasting, alerts and information (Section 4)

BoM's forecasting and warning products were within the bounds of what could be reasonably expected. There may be additional work to do to engage with the community to explain that a forecast can never be relied on as a 100% accurate prediction.

It is not BoM's role to warn communities of impacts: they only identify forecast river levels and whether predetermined minor, moderate or major triggers have been reached.

It is the responsibility of local authorities to plan for flood impacts in their areas, including defining triggers for action. It is the responsibility of SES to disseminate community warnings about impacts.

There is a need for heightened awareness by communities and emergency management authorities on actions needed when flood watch and other warnings are issued by the BoM.

The need for flood mapping of the Ouse River is supported, as is the need for this river to be delineated as a catchment in its own right.

An effective flood intelligence system is integral to BoM providing accurate and timely warnings to emergency management agencies and communities. A foundation for such intelligence is reliable and suitably located rainfall and river gauges. Additional gauges would improve flood intelligence in Tasmania, which should be considered in conjunction with BoM and would be best coordinated through the Flood Warning Consultative Committee (FWCC). Where additional gauges are sought, clear responsibilities for funding, ownership and maintenance should be developed and agreed.

In line with developments interstate, much work has been done locally to develop a revised State Flood Warning System aimed at improving public warnings. This work is supported, and needs to be concluded and actioned.

BoM was only able to provide advice that identified the flood at the Latrobe Bridge as "expected to reach minor flood level" on Sunday 5 June even though the flood classification upstream at Liena to Kimberley was at major. BoM and SES have since taken steps to define moderate and major classifications at the Latrobe Bridge.

There would be merit in reviewing classifications of all gauges across the flood warning system to ensure they are relevant, and developing a program to update data used to support hydrological modelling including gauge maintenance both before and after flood events.

| Recommendation | | See Report | |
|----------------|--|------------|------|
| | | Section | Page |
| 12. | That heightened awareness and action is needed by communities when BoM issues flood watches and related warnings. Councils and SES need to facilitate this. | 4.1.4 | 69 |
| 13. | That the Flood Warning Consultative Committee considers the merits of delineating the Ouse River as a separate catchment from the Derwent River Basin. | 4.1.5 | 71 |
| 14. | Subject to funding, that the Flood Warning Consultative Committee investigates the hydrological matters and advice received during this Review and detailed in this Report in Sections 4.1.9 and 4.1.11. | 4.1.6 | 72 |

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| 15. | That the Flood Warning Consultative Committee reviews flood classification levels in the Service Level Specifications with BoM specifically relating to flood level triggers on gauges. | 4.1.8 | 74 |
| 16. | That BoM and the Flood Warning Consultative Committee, in consultation with gauge owners, review flood gauges and develop a program to update data used to support hydrologic modelling. This should include reviewing gauge maintenance before and after floods. | 4.1.9 | 75 |
| 17. | That Government supports the anticipated SES State Flood Warning proposals aimed at improving public warnings and communication, and that the proposed warning system is consistent with the National Frameworks. | 4.2.4 | 79 |
| 18. | That emergency management authorities react with heightened awareness and action when BoM issues flood watches and related warnings. | 4.3.3 | 81 |

From response to recovery (Section 5)

Lessons identified from the recovery processes after the 2013 bushfire appear to have been applied to support effective recovery arrangements.

Prompt action was taken to appoint a State Flood Recovery Coordinator with the only delay being in announcing the appointment, which had to wait for Cabinet approval.

The Tasmanian Emergency Management Plan does not provide for a single management authority for recovery with the Departments of Premier and Cabinet, Police, Fire and Emergency Management, and Health and Human Services and the Office of Security and Emergency Management all having different but important roles. This could be streamlined by establishing the Department of Premier and Cabinet (DPAC) as standing Recovery Management Authority for emergencies in Tasmania to provide a single point of contact.

Better appreciation by emergency management authorities of what non-government organisations can offer, their roles, functions and associated costs, would benefit early engagement and more effective service delivery during emergency events.

No single agency currently oversees, having regard to the broader public interest, prioritisation of infrastructure repair and awareness of resource capability. Despite this, there was evidence of some collaboration between entities, and of widespread efforts to assess damage and provide resources to repair damaged or replace destroyed infrastructure.

Overall, there was a good focus on recovery and, where some elements of recovery appeared to have taken a long time to swing into action, this can likely be explained by limitations on the funds available, which will always be a challenge after a major event.

Emergency assistance payments were processed in a timely and efficient manner, providing relief and assistance to those most in immediate need. However, decisions about who is eligible for assistance payments inevitably involve questions of how best to allocate limited funds and what the underlying rationale for making these payments is. Consideration should be given well in advance of any future event as to how eligibility for assistance payments to hobby farmers and any other members of the community should be determined.

The Tasmanian Relief and Recovery Arrangements and the jointly funded Commonwealth–State Natural Disaster Relief and Recovery Arrangements provided a process for emergency assistance payments to individuals and households affected by the floods.

| Recommendation | | See Report | |
|----------------|---|------------|------|
| | | Section | Page |
| 19. | That DPAC becomes the Management Authority for recovery in Tasmania. | 5.1 | 87 |
| 20. | That Government engages with non-government organisations that may provide services during emergency events to clarify the terms and conditions for support through a written arrangement (MOU or similar). | 5.3 | 88 |
| 21. | That, in the event of a major emergency such as the June floods, a government department (DPAC or State Growth) be appointed to coordinate infrastructure repair, to the extent that funding allows, for the whole state. Individual entities will still have the right and responsibility to repair and maintain their own assets, but some central oversight and coordination is, in our view, likely to be beneficial. | 5.4.1 | 89 |
| 22. | That the organisations responsible for construction, maintenance and ownership of bridges review their design guidelines and, if necessary, update them to specifically include consideration of debris and flood impacts on bridge design. A review of existing bridges by the responsible organisations could also be undertaken to highlight any potential issues. | 5.4.3 | 92 |

Environmental effects (Section 6)

The June floods were significant, with many rivers exceeding record levels, causing widespread environmental damage to rivers and catchments that included erosion of riverbanks by scouring, mobilisation and deposition of vegetation, logs, rock and soils, and downstream debris accumulations.

Possible approaches to mitigating the harmful effects of flooding can include riparian management, riparian vegetation and broader application of forest practices. However, we identified a number of complexities regarding this, including uncertainty as to ownership of land and associated titles including rivers on that land. This complexity has arisen through inconsistency in the issue of titles between municipalities and over time since settlement, which has resulted in variations in property boundaries being at, near to, or including rivers. These complexities and uncertainties need resolution.

In any event, landowners, land managers and Government need to take responsibility for the appropriate management of rivers. This might, for example, include leaving buffer vegetation zones alongside rivers and revegetating native species where land clearing has been detrimental to riparian health. Relevant to this is timely completion of the proposed revised Tasmanian Planning Scheme including a relevant Riverine Flood Hazard Code.

| Recommendation | | See Report | |
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| | | Section | Page |
| 23. | That, to provide greater clarity for building development, design and approval within tolerable risk levels, the Tasmanian Planning Scheme, including a relevant Riverine Flood Hazard Code, is finalised and approved as soon as practicable. | 6.2.3 | 100 |

Other matters (Section 7)

Research by the Climate Change Office and nationally notes a growing climate change risk and need for adaptive strategies and investment in flood mitigation infrastructure to deal with resilience, particularly in flood-prone areas. DPAC is encouraged to explore this further.

Based on studies read as part of this Review, it may be that Government underinvests in flood mitigation, which may contribute to higher direct and indirect response costs. Should this be a fair conclusion, the question is how much, and on what, mitigation investment is needed especially for irregularly occurring events. We did not set out to answer this question but it needs to be considered, as does the extent to which Government should manage its natural resources and natural disasters from a fiscal perspective.

Government may be exposed to key-person dependency risk in its emergency management arrangements. This must be managed, as must the need to ensure ongoing reminders of the relevance and application of knowledge management systems.

Government's emergency management and natural disaster risk assessment documentation is suitable, but there are aspects that need to be addressed as it updates these. Gaps identified include articulation of roles played by Government Businesses, and informing communities about behaviours expected of them and obtaining their 'buy-in'.

Emergency management authorities might benefit from reviews conducted by third parties like the Productivity Commission. Doing so would enhance accountability to communities.

Better resourced councils, and those with stronger experience in flood management, should share these resources and experiences with their colleagues, and better coordination of the many useful flood-related activities undertaken by multiple agencies is needed.

The June floods resulted in significant damage to road, rail and bridge infrastructure and we urge Government, businesses and communities to invest in resilience in relevant infrastructure. In this regard, consideration could be given to a review of all critical flood-related infrastructure, including infrastructure managed by local government, to assess that infrastructure's capacity to withstand and recover from flood (and other hazardous) events.

| Recommendation | | See Report | |
|----------------|---|------------|------|
| | | Section | Page |
| 24. | That the State Emergency Management Committee allocates resources to reviewing all findings and recommendations in the Productivity Commission Report No. 74 relevant to Tasmania and, for those identified as relevant, actions taken and, if none, why not. | 7.8 | 112 |

Huonville floods (Section 8)

The preceding snow melt, saturated soils and heavy rainfall provided conditions for a more rapid river rise in the Huon catchment than is usually experienced. The Huon River rose quickly causing Huonville to flood in the early hours of Friday 15 July 2016.

Emergency management agencies, including the Huonville Council, responded effectively to this flood event because:

- the Huon Flood Warning System has rainfall and river height gauges that provide timely data for BoM to model and predict flood extent;
- lessons had been learnt from previous flood events, resulting in heightened awareness, including by members of the community, and prompt action;
- flood planning, inundation and evacuation documentation facilitated prompt and appropriate action; and
- debriefs indicated a willingness to learn from the July 2016 event, and gaps were identified for continuous improvement.

However, an important lesson learnt was the need for ongoing community awareness, in particular for households and businesses who are new to the area.

The manner in which the Huonville flood event was managed provides an example of effective planning, preparation and collaboration that other flood management authorities should learn from.

We make no recommendations about the Huonville floods.

PART A

INTRODUCTION AND

BACKGROUND

1. About this Review

1.1 Context

In September 2016, the Honourable Rene Hidding, Minister for Police, Fire and Emergency Management, announced to Cabinet the intention to undertake a strategic review into the Tasmanian floods of June 2016 that affected many Tasmanian communities and businesses, and he tabled the Terms of Reference.

Mr Mike Blake was appointed as the Review Lead Investigator in October 2016. His role was to coordinate the independent Review Team. The Review was also to consider the Huonville floods that occurred in mid-July 2016.

The other team members were Mr Paul Considine, an emergency services expert working as Manager of the National Aerial Firefighting Centre in Melbourne, and Inspector Brian Edmonds who was seconded from Tasmania Police.

It was anticipated that the Review would take at least eight months and would cost \$400,000 (see Appendix E).

1.2 Purpose

The purpose of this Review was to consider all aspects of the flood event. As a range of other individual and agency inquiries and reviews were also instigated, the Review Team's conclusions and recommendations in this Report should not be considered in isolation.

This Report to the Tasmanian Government builds upon, and complements, existing learnings. It is expected to be used to guide policy reform, improve operating procedures and, where appropriate, inform legislative change. This Report is also designed to inform non-government organisations and the public on the Review's findings and recommendations.



Flooding at Latrobe

1.3 Scope (Terms of Reference)

The scope of this Review was defined in the Government's Terms of Reference tabled in Parliament on 13 September 2016 as outlined below:

Terms of Reference

The Review will consider all aspects of the flood event; noting it is important to acknowledge that a range of individual and agency inquiries and/or reviews are addressing many of these issues and they should not be considered in isolation.

The independent Review will build upon and complement existing learnings, and report on the following matters:

1. The effectiveness of the strategies, preparedness and plans related to managing flood risk in Tasmania that were in place prior to the June 2016 floods occurring; including existing and potential levee systems.
2. Community preparation, resilience and awareness, including awareness of insurance matters, relating to major flood events in Tasmania.
3. The causes of the floods which were active in Tasmania over the period 4 - 7 June 2016 including cloud seeding, statewide water storage management and debris management.
4. The use and efficacy of forecasting, community alerts, warnings and public information by authorities in responding to flood events.
5. The effectiveness of transition from response to recovery in the week following the June floods; including capacity and priorities for infrastructure repair, and immediate assistance payments.
6. Consideration of the detrimental environmental effects of the flooding upon the landscape, and what effective mitigation measures may be necessary to avoid similar events.
7. Any other matters relevant to the Terms of Reference.
8. The Huonville flood event on 15 July 2016.

In undertaking this Review, appropriate regard will be had to ensuring all relevant stakeholders are appropriately engaged to provide input.

The Review will consider the fact that one or more Coronial Inquests will likely be ongoing throughout the same time period; and be sensitive to those requirements.

The Review will also consider the research and projects already initiated by the State Emergency Service in relation to flood warnings and take them into account in making any recommendations.

Similarly the Review may consider the insights, observations and findings individual agencies and Services in relation to the June floods; and also the report expected to be generated by the Tasmanian Flood Recovery Taskforce.

The Review shall report by 1 June 2017.

1.4 Approach

The eight specific Terms of Reference listed above in 1.3 are dealt with in separate sections in this Report. The Terms of Reference also required us to address the following:

- Ensuring all relevant stakeholders are appropriately engaged to provide input. In responding to this, we called for public and private submissions through advertisements in each regional Tasmanian newspaper in October 2016. Fifty-four submissions were received from affected home owners, farmers, government agencies and various non-government organisations. In addition, we held a number of face-to-face interviews with emergency management responders, affected councils and government agencies who contribute to prevention, preparedness, response and recovery activities. The interviews focused on the Review's Terms of Reference.
- Consideration of the fact that one or more Coronial Inquests will likely be ongoing throughout the same time period; and be sensitive to those requirements. We were mindful of these issues throughout the course of our work and engaged with the Coroner's Clerk to ensure the Coroner was apprised of our Review.
- Consideration of research and projects already initiated by the State Emergency Service (SES) in relation to flood warnings and take them into account in making any recommendations. We engaged closely with the SES, obtained briefings regarding the work being undertaken and took these into account during the course of our work and in preparing this Report.
- Consideration of the insights, observations and findings of individual agencies and Services in relation to the June floods; and also the report expected to be generated by the Tasmanian Flood Recovery Taskforce. In the course of receiving submissions from, and discussions with, individual agencies and services, we were provided with a range of findings and conclusions that they had reached as a result of their own reflections on these flood events. We identify in the body of this Report the way in which we took these into account. We also had direct engagement with the Tasmanian Flood Recovery Taskforce and were provided with a copy of its report.

In December 2016, we visited some of the affected areas in North and North-West Tasmania where damaged roads, bridges and farmland were still evident.

We undertook a literature review of numerous documents, plans and flood-related reports from Tasmania and other jurisdictions that related to the Terms of Reference and many of the issues raised through the submissions.

Two community forums were held in February 2017, one in Latrobe and the other in Burnie. At these, we presented initial key findings and sought further community input to the Review.

We sought the consultancy services of an expert atmospheric scientist with experience in cloud seeding who was engaged to undertake a scope of works that included reviewing Hydro Tasmania's cloud seeding report and that prepared by an independent expert it engaged on this subject. The outcome from this work is dealt with in Section 3.2 of this Report.

In addition, we engaged WMAwater, an engineering firm specialising in hydrological work, to provide expert hydrological advice on a scope of works related to technical flood issues. These included dam networks as mitigation, river and rainfall gauges, weather radars, flood mapping/planning, bridge design, warning systems, levees and debris management. Outcomes from their work are included in relevant sections of this Report.

2. Structure of this Report

The Review recommendations are included in the Executive Summary and detailed in Part B which is structured to reflect the Terms of Reference as follows:

| | |
|------------------|--|
| Section 1 | Effectiveness of strategies, preparedness and plans The effectiveness of the strategies, preparedness and plans related to managing flood risk in Tasmania that were in place prior to the June 2016 floods occurring; including existing and potential levee systems. |
| Section 2 | Community awareness, preparation and resilience Community preparation, resilience and awareness, including awareness of insurance matters, relating to major flood events in Tasmania. |
| Section 3 | Causes of the floods The causes of the floods which were active in Tasmania over the period 4 - 7 June 2016 including cloud seeding, statewide water storage management and debris management. |
| Section 4 | Forecasting, alerts and information The use and efficacy of forecasting, community alerts, warnings and public information by authorities in responding to flood events. |
| Section 5 | From response to recovery The effectiveness of transition from response to recovery in the week following the June floods; including capacity and priorities for infrastructure repair, and immediate assistance payments. |
| Section 6 | Environmental effects Consideration of the detrimental environmental effects of the flooding upon the landscape, and what effective mitigation measures may be necessary to avoid similar events. |
| Section 7 | Other matters Any other matters relevant to the Terms of Reference. |
| Section 8 | Huonville floods The Huonville flood event on 15 July 2016. |

The Report also includes a list of commonly used abbreviations (see Appendix A) and glossary of terms (see Appendix B).

3. Agency debriefs and acknowledgments

Before finalising this Report, we discussed key findings and recommendations with the following:

- Department of Police Fire and Emergency Management
- Department of Premier and Cabinet
- Department of Primary Industries, Parks, Water and Environment
- Department of Justice
- Department of State Growth
- State Emergency Service
- Local Government Association of Tasmania
- Bureau of Meteorology
- Tasmanian Flood Recovery Taskforce
- Latrobe Council
- Hydro Tasmania

We acknowledge the input and constructive approach taken by everyone who took part in the Review.

PART B

REVIEW FINDINGS

AND CONCLUSIONS

Section 1 Effectiveness of strategies, preparedness and plans

The effectiveness of the strategies, preparedness and plans related to managing flood risk in Tasmania that were in place prior to the June 2016 floods occurring; including existing and potential levee systems.

1.1 National, state and regional plans prior to² the June 2016 floods

1.1.1 National plans and frameworks

We begin this Report by discussing the effectiveness of strategies and plans that were in place before the June 2016 floods. Tasmania's flood planning frameworks, including funding arrangements, are to an extent driven by national arrangements including:

- National Partnership Agreements (NPAs)³;
- The *National Strategy for Disaster Resilience*^{4 5}, Council of Australian Governments (COAG) 2011;
- *Handbook 7 – Managing the Floodplain: a guide to best practice in flood risk management in Australia*⁶, Australian Institute for Disaster Resilience 2013 (republished in May 2017); and
- various funding arrangements (dealt with in Section 5.5.1).

At a local level, the State Government has entered into a *Service Level Specification for Flood Forecasting and Warning Services for Tasmania* (SLS) with the Bureau of Meteorology (BoM). The SLS identifies a number of respective responsibilities regarding:

- the role of the Flood Warning Consultative Committee (FWCC);
- rainfall and river level data;
- monitoring flood potential;
- flood modelling and prediction;
- issuing alerts, watches and flood warnings;
- BoM operations;
- stakeholder roles in planning, liaison and emergency management training;
- list of forecast locations;
- list of rainfall and river gauges ownership;
- flood classification for each gauging station; and
- river and rainfall alert criteria.

In theory, the SLS is aimed at comprehensively providing a sound mechanism for services that BoM is to provide. State and local government are represented on the FWCC.

The FWCC, chaired by BoM, comprises representatives including SES, councils (currently Launceston City, Northern Midlands and Huon Valley) and emergency management

² Review Team's emphasis by underlining

³ NPAs are arrangements between the Australian Government and the states and territories. A number of such agreements exist. Generally they deal with service delivery expectations, clarity about respective roles and responsibilities including reporting, and, where relevant, funding arrangements.

⁴ COAG, 2011. *National Strategy for Disaster Resilience*. Australian Government.

<https://www.ag.gov.au/EmergencyManagement/Documents/NationalStrategyforDisasterResilience.PDF>

⁵ The *National Strategy for Disaster Resilience* is referenced in the Tasmanian Emergency Management Plan.

⁶ Handbook 7 is referenced in the State Special Emergency Management Plan – Flood.

stakeholders. The overall role of the Committee⁷ is to coordinate the development and operation of flood forecasting and warning services in Tasmania, acting as an advisory body to BoM and participating agencies. Therefore, it is well placed to consider rainfall and river gauge matters raised by this Review.

1.1.2 State plans and frameworks

At a state level, the *Emergency Management Act 2006* (the EM Act) provides authority for high-level government leadership and response functions by management authorities. It covers all emergencies and disasters in an all-hazards approach to managing emergencies.

The guiding documents that underpin the strategic emergency management framework that were in place before the floods occurred include the *Tasmanian Emergency Management Plan, Issue 8* (TEMP) and the *State Special Emergency Management Plan – Flood*. Both documents provide guidance to Government and emergency management agencies through the State Emergency Management Committee (SEMC) on strategies for prevention, preparedness, response and recovery. However, each guiding document is currently under review.

The SEMC is established with powers and functions under the EM Act, and it operates under Terms of Reference that mandate coordination roles across agencies and all hazards. Under the Act, the SEMC is required to prepare the TEMP and review it at least every two years for approval by the Minister. SEMC is also guided by the *SEMC Strategic Directions Framework 2013-18*.

Additionally, work has been done by the University of Tasmania with the Antarctic Climate and Ecosystems Cooperative Research Centre and RMIT to review the 2012 *Tasmanian State Natural Disaster Risk Assessment (TSNDRA)* and develop a revised 2016 TSNDRA, which was endorsed by SEMC in June 2016. The TSNDRA helps guide strategic policy for dealing with, and provides operational guidelines for, a number of risks including flood.

Importantly, this work clearly recognises risks associated with agreed scientific evidence supporting climate change. In this regard, the TSNDRA identifies that, in relation to future flood risk in Tasmania, there are likely to be fewer rainy days but more frequent intense rainfall events, which is likely to increase the risk of flooding, particularly flash flooding⁸. Climate change is discussed further in Section 7.2.

1.1.3 The State's approach

At the time of the June floods, Tasmania's approach to emergency management was governed by requirements in the EM Act, the TEMP and associated Special Emergency Management Plans, as well as various inter-agency agreements and protocols⁹. Under these arrangements:

- The State Controller (Commissioner of Police), supported and advised by the SEMC, sets policy in the prevention and preparedness phases of emergency management.
- Response is led by a Management Authority (MA) as identified in the TEMP. During significant emergencies, the State Controller may assume overall control. The SEMC supports the MA and State Controller in the discharge of their obligations but has no operational role.

⁷ Refer to the Service Level Specifications between BoM and the State of Tasmania.

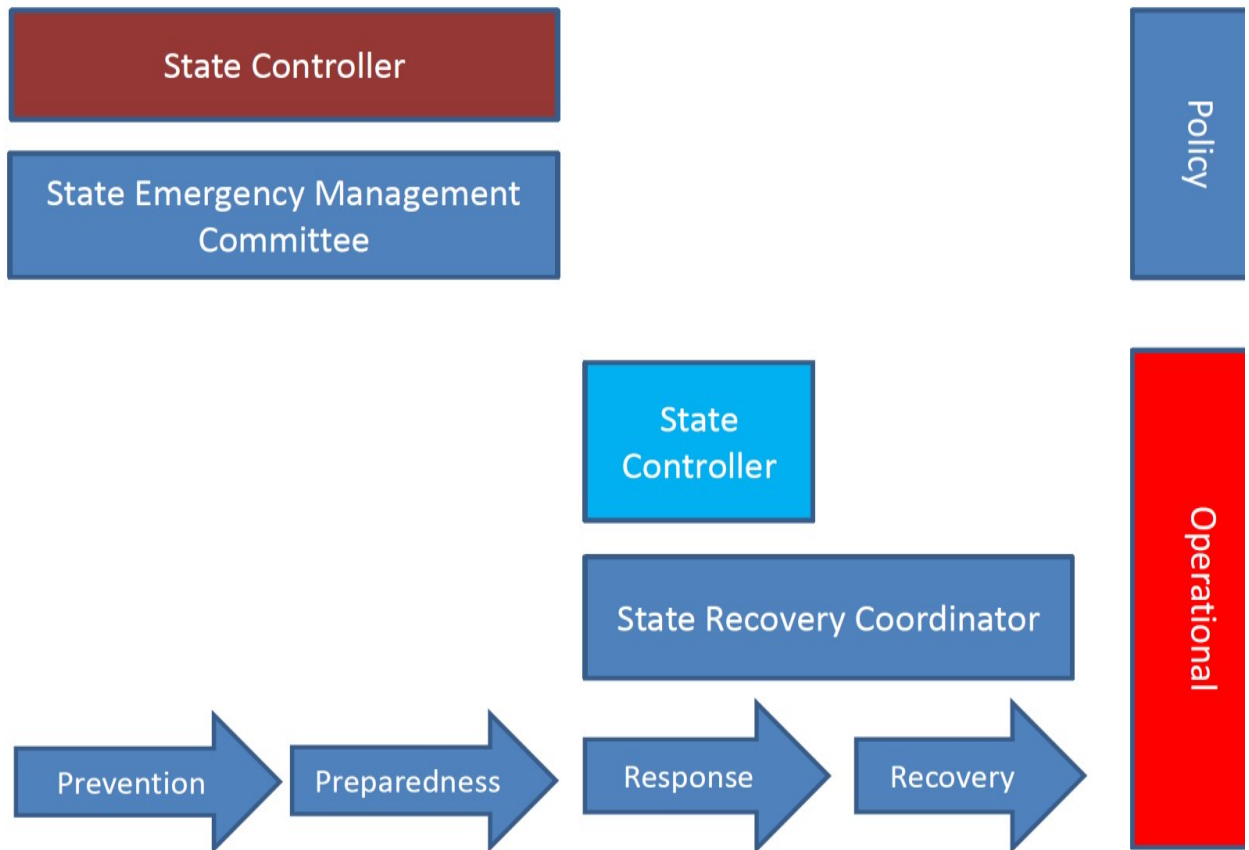
⁸ 2016 *Tasmanian State Natural Disaster Risk Assessment*, Section Seven – Flood risk assessment, page 79

⁹ DPAC Submission

- The option exists for a State Recovery Coordinator to be appointed to implement and oversee recovery arrangements (this is dealt with further in Section 5).

These arrangements are described in Figure 1 below.

Figure 1: Emergency management (including floods) in place at the time of the June 2016 floods



1.1.4 Regional arrangements in Tasmania

Tasmania is divided into three emergency management regions, South, North and North-West. Each emergency management region is managed by a Regional Controller (Police Commander) who is assisted by a Regional Emergency Management Committee (REMC). The REMC is responsible for the development of a Regional Emergency Management Plan which is approved by the State Controller and subject to review every two years.

The EM Act requires the establishment of a Municipal Committee. Its role is to institute and coordinate emergency management in a municipal area, or in a combined area of more than one municipality where one had been established. Committee functions include preparing the Municipal Emergency Management Plan for that area or combined area, which are all-hazard plans that detail the arrangements for governance and coordination of an emergency. These are required to be reviewed every two years and submitted to the Regional Controller and State Controller for approval.

Respective councils nominate each committee's Municipal Chairperson and Municipal Coordinator, and these committees usually also include a regional SES representative.

While all 26¹⁰ municipal areas have all-hazard plans in place, and each of the Regional Emergency Management Plans had been reviewed, six Municipal Emergency Management Plans were overdue for review and approval at the time of writing.

1.1.5 Requirements of the State Emergency Service

The SES is the MA for flood as specified in the TEMP. Its roles include interpreting BoM warnings for the community in relation to flood consequences; this is usually done in conjunction with flood watches and warnings issued by BoM. SES issues media releases with safety advice for the public, and BoM also uses safety messages in their media releases.

Other requirements as they relate to flood management include:

- operational response with SES staff and volunteers managing on-ground operations; and
- an overseeing function under which the SES Emergency Management Unit oversees the coordination of flood policy and plans at municipal and state levels.

1.2 Preparedness

1.2.1 Overview

The TEMP defines preparedness as “planned and coordinated measures so safe and effective response and recovery can occur”. However, the focus of this section is on preparedness prior to a flooding event including:

- adequacy of flood planning¹¹ arrangements – see 1.2.2 below;
- adequate/comprehensive flood studies – dealt with in 1.2.3 below;
- adequate river and rainfall gauges and access thereto – dealt with in Section 4.1.6; and
- appropriate use of levees – dealt with later in this Section.

1.2.2 Flood planning arrangements

As this relates to preparedness at the time of the June floods, these arrangements were outlined in the *State Special Emergency Management Plan – Flood* (Draft¹² O.A April 2016), referred to hereafter as Emergency Management Flood Plan.

In summary, the Emergency Management Flood Plan requires the following:

- Consultation occurs at a national level including through Australasian Fire and Emergency Service Authorities Council (AFAC); at State level through the SEMC and the FWCC; and at regional and municipal levels through Regional and Municipal Emergency Management Committees.
- Each management authority and support agency maintains its respective capabilities including workforce planning, development and training programs, and asset management.
- Capacity for sustained activation is recognised as limited.

¹⁰ There are 29 local councils in Tasmania; for the purposes of the Emergency Management Act, municipal areas may include more than one council in a combined area.

¹¹ Use of the word ‘planning’ here does not refer to flood ‘plans’ but to planning for floods in a broader sense.

¹² This was the most up-to-date planning document at the time of the June floods.

- SES maintains a 24/7 contact telephone service (13 25 00), handles social media, and manages regional incident control facilities, 26 municipal volunteer units and stockpiles of response equipment such as sand and sandbags.
- BoM provides staffing for weather forecast and warning services.
- Police provides search and rescue, evacuation, traffic management and investigative services.
- Department of Police, Fire and Emergency Management (DPFEM) manages radio networks to support SES, TFS and Police.
- Department of Premier and Cabinet (DPAC) manages the government telephone, email and data networks.
- Department of Primary Industries, Parks and Wildlife and Environment (DPIPWE) manages limited river gauge calibration, the Common Operating Platform (COP) and GIS capability.
- Tasmania Fire Service (TFS) maintains rapid impact assessment teams.
- Councils manage recovery services under Municipal Emergency Management Plans.
- Dam operators provide dam safety plans and response capabilities.
- Support agencies maintain capabilities under various plans and agreements.
- Government agencies prepare an annual state-of-readiness report.
- Dam owners manage water levels.
- BoM provides a flood forecasting and warning service as specified in the SLS, including severe weather and heavy rainfall prediction.
- Launceston, Hobart and Glenorchy Councils operate flood warning systems.
- SES has access to most flood evacuation plans and flood studies.
- Public communication includes BoM warnings, SES advice and DPAC maintaining TasAlert.
- TFS maintains Emergency Alert for targeted public telephone messaging.
- DPAC maintains the Tasmanian Emergency Information Service.
- The following plans may be maintained for areas of known flood risk:
 - Flood Response Plan – SES
 - Flood Action Plan – councils
 - Evacuation Plan – Police
 - Dam Safety Plan – dam owner
 - Community Flood Response Plan
- Flood response, recovery and plans are exercised and validated routinely.

1.2.3 Current flood planning

Flood studies generally detail the nature of flood extent and include flow rates, flood heights, peak travel times and peak heights. Flood studies in Tasmania have been commissioned by councils, Hydro Tasmania (HT) and DPIPWE. The SES maintains copies of all flood studies and currently has 57 listed; the SES submission to this Review lists each study (see Appendix D).

However, these are not accessible other than from respective councils (accessibility is discussed in 1.2.5 below) and we also noted that some studies could be improved with updated data to reflect changes in topography and the built environment. And, some catchments, such as the Emu River at Burnie, do not appear to have been studied, as noted in the Burnie Council submission (see Appendix D).

The SES has identified areas in Tasmania that would benefit from updated data to support flood studies and floodplain management. They are outlined in the Tasmanian Community Flood Resilience Project as being:

- primary focus on the populated areas along the South Esk River, North Esk River, Macquarie River, Meander River, Leven River, Redwater Creek, St George River, River Derwent, and Mountain River; and
- a secondary focus on the Jordan River, Kermantie River, Coal River, Ouse River, and Clyde River.

1.2.4 Plans

Flood plans may be developed from a flood study and provide more specific detail on the management of a flood in a particular area. This may include, for example, response actions to be taken and evacuation procedures in a floodplain area. SES maintains copies of 18 flood plans for Tasmania, which were also commissioned by councils, HT and DPIPWE.

These 18 flood plans are noted in the SES submission¹³. Access to these plans is currently via their owners – respective councils, HT or DPIPWE. See Recommendation 4.

Where a municipality is prone to flooding, it should include flood studies and flood plans as sub-plans¹⁴ in its emergency management plan. All municipal emergency management plans are held centrally by the SES, reviewed every two years and approved by the State Controller. However, this requirement does not extend to sub-plans. Greater awareness of and accountability for sub-plans, including flood-related plans, could be achieved if a similar review and approval process was adopted.

Recommendation 1

That in flood-prone municipalities, the respective Municipal Committee develops or reviews flood-related sub-plans within a Municipal Emergency Management Plan at least every two years and submits each sub-plan to the Regional Controller for approval.

In addition, that each Municipal Committee maintains a current flood plan, in a standardised format, which at least identifies:

- flood-prone parts of their locality, particularly those where lives may be at risk;
- required actions to be taken in the event of a flood threat, especially timely evacuation;
- trigger points for taking required actions and how those trigger points will be monitored; and
- how the community can access flood-plan information.

¹³ Submissions to the Review are at http://www.dpac.tas.gov.au/government_flood_review. For a full list see Appendix D.

¹⁴ Sub-plans are plans that provide additional information related to the Emergency Management Plan, including information like Evacuation Plans, Flood Studies and Flood Plans.

Recommendation 2

That all councils include an easily identifiable website link for the public to locate their Municipal Emergency Management Plan and community safety information.

1.2.5 Access to flood studies

An issue raised with us in a number of public submissions was timely access to flood studies, plans and documents. In this regard, an Australian Flood Risk Information Portal has been developed by Geoscience Australia as a repository for flood data nationally. However, this portal includes very few Tasmanian flood studies.

Because a number of flood studies in Tasmania were commissioned from a variety of sources and arrangements, Geoscience Australia have had to work through issues related to data access and copyright, resulting in not all Tasmanian flood studies being placed on its portal. Unfortunately, it is anticipated that it may take some months before these matters are fully resolved in Tasmania and flood information becomes available on the Geoscience Australia portal.

While there may be difficult legal matters to be addressed, communities are disadvantaged by lacking access to flood studies and related documents, and the Government is urged to address these matters promptly, having regard to flood study ownership and copyright.

As an alternative, in Tasmania the COP, developed by Government and based on the Land Information Services Tasmania (LIST) mapping system, has some flood data available for access by emergency management agencies. However, some councils have identified access restrictions to this site, arising from licence limitations, and not all flood studies and plans are currently available.

Recommendation 3

That SES uploads current flood studies and plans to the Common Operating Platform as a flood plan layer and that councils, subject to resolving licence restrictions, arrange to have appropriate access.

1.2.6 Flood study methodologies

We identified that agencies and councils commissioning flood studies used a variety of consultants, and there is variation in methodology, data management and data ownership.

There are considerable advantages if studies are undertaken applying a consistent methodology and compatible data sets. The Australian Government Attorney General's Department, through Emergency Management Australia, compiled *Managing the floodplain: a guide to best practice in flood risk management in Australia Handbook 7*.¹⁵ One aim of this comprehensive document on floodplain management is to provide consistency in approach.

¹⁵ Now owned and being reviewed by the Australian Institute for Disaster Resilience (AIDR).

Recommendation 4

That agencies undertaking flood studies adopt a standardised approach, based on Australia Handbook 7, maintain public ownership of underlying data sets to support future modelling, and ensure open access to these studies.

1.2.7 Contemporary flood modelling

The June flood broke many BoM records for rainfall and river heights. The Upper North Esk River rose to levels of a 200-year annual recurrence interval (ARI), while the Tamar River rose to levels around 50 ARI.

A number of public submissions to this Review identified the need for more comprehensive flood studies, accompanied by flood modelling, including the need for a range of inundation maps to predict flood extent at varying levels.

Contemporary flood modelling and inundation maps are more accurate when using light detection and ranging (LiDAR) technology, which is a remote-sensing method used to examine the surface of the earth. While some of Tasmania has been mapped using LiDAR and the data is available, there would be benefits to communities if more accurate flood modelling across Tasmania, using LiDAR imagery, was prepared.

During the Review, we met with managers and an independent hydrologist at Mineral Resources Tasmania, a division of the Department of State Growth. We were presented with a project proposal that outlined the potential for a statewide flood modelling exercise. While this concept has not been tested, advances in LiDAR technology and contemporary computer-based flood-predictive modelling may make it feasible. Their reasoning for this suggestion included inconsistencies:

- between council briefs;
- between the approach of different consultants; and
- due to changes in underlying data.¹⁶

Recommendation 5

That Government:

- undertakes a comprehensive assessment of flood mapping in Tasmania with a view to identifying data gaps, quality and currency, and works collaboratively with councils to identify funding to improve current statewide flood data; and
- explores the feasibility of undertaking a comprehensive flood mapping of Tasmania, using LiDAR or other contemporary technology, with the objective of identifying which parts of our State are, and are not, prone to riverine flooding.

¹⁶ Presentation by Mr Ted Rigby dated January 2017.

1.2.8 Hydrological advice¹⁷

We engaged a hydrological consultant to review the adequateness of flood mapping in Tasmania. To a large extent their conclusions were similar to ours, but in addition they noted:

- The current status of flood mapping in Tasmania is not adequate for use in emergency management or planning in many areas. It is “haphazard, of mixed geographic coverage and age, and without a standardised approach methodology” (White et al. 2016).
- A coordinated statewide approach to flood mapping is recommended. The Victorian Floodplain Management Strategy provides an excellent approach to a coordinated statewide approach to flood mapping as a component of floodplain management.
- The information required from flood mapping for emergency management during a flood event is not available in many areas of the State, is unsuitable for purpose, or is difficult to access in current formats.
- To inform emergency management, flood-extent mapping should provide information related to that available during a flood, such as river levels at key gauges or BoM warning levels.
- A full audit of all available flood information, including spatial data and study documentation, should be considered to ensure that all available information is provided for inclusion in the existing COP.
- Consideration should be given to expanding the COP, or integrating the outputs within a flood information system such as FloodZoom that includes data from gauges and flood warnings.

1.2.9 Findings on flood studies

We found:

- inconsistency in flood mapping across municipalities, due in part to an ad-hoc approach by councils who have undertaken flood studies using a variety of different consultants, standards and criteria;
- uncertainty regarding ownership of underlying data supporting flood studies and maps, making it difficult to keep these documents up-to-date and/or to share them;
- many flood studies and associated plans require updating and/or validation to reflect an accurate contemporary assessment of likely inundation;
- flood studies and maps were not centrally located or accessible;
- 58% of flood studies/maps were dated. We regarded studies completed before 2006 as dated, of which there were 33 out of 57; and
- criticism by the Insurance Council of Australia (ICA)¹⁸ and by Insurance Australia Group¹⁹ that, in their view, the quality of flood mapping in Tasmania was inferior to those in other Australian jurisdictions.

In view of these factors, we concluded that relevant policy settings, coordination and completion of flood plans, and flood studies, for the benefit of government and all communities, would be

¹⁷ See WMAwater report page xii

¹⁸ Insurance Council of Australia (ICA) submission http://www.dpac.tas.gov.au/government_flood_review

¹⁹ Insurance Australia Group submission http://www.dpac.tas.gov.au/government_flood_review

best managed centrally. This could be achieved by establishing a dedicated flood policy unit, which could be embedded in an all-hazards emergency management unit within a department.

Roles for such a unit may include policy, planning (including policy and planning as it relates to, for example, flood studies and mapping and regular review thereof, the number and location of river and flood gauges, and the number and location of weather radars), ownership of underlying data (this could include handling copyright related matters), education/community engagement, public information, media management, exercise/lessons management, geospatial data capability and ownership, relevant information technology, and repository for flood plans accessible by the public and SEMC secretariat.

We consider that introduction of such a unit is likely to improve strategies and preparedness by government, councils and the broader community for future flood events. It will also facilitate an all-hazards approach to emergency management.

Recommendation 6

That Government establishes a central flood policy unit responsible for coordinating flood policy across all government agencies, including Government Businesses, and ensures that such a unit has a whole-of-government and community focus.

1.3 Were these plans effective?

We considered this in the context of two case studies, Launceston and Latrobe.

1.3.1 Launceston

From our discussions with Launceston City Council (LCC) it was evident that substantial thought and resources had gone into planning for a major flood event. This is exemplified by the levees that had been constructed in Launceston to protect low lying areas of the city from flooding. Planning, however, went significantly beyond the construction of the levees themselves, and involved detailed written procedures for how LCC as a body would respond to a threatened flood and the roles and responsibilities of key personnel.

The effort and financial resources that had gone into this planning appears to us to have paid dividends when it came to the June 2016 events. Even though, as is inevitable in a major emergency, not everything operated entirely as expected, the fact that LCC had an effective incident management structure in place meant that problems could be solved as they arose.

When it became apparent that a significant flood event threatened, regional planning frameworks were implemented under which the SES activated a Regional Operations Centre (ROC) at the SES Youngtown office on Saturday 4 June. A Regional Emergency Coordination Centre (RECC) was established in Youngtown on 6 June, led by the Regional Controller and staffed by members of the Regional Emergency Management Committee (REMC).

From our discussion with parties involved in the Launceston flood event, our conclusion was that the emergency planning arrangements were activated as expected and operated effectively.

1.3.2 Latrobe

As mentioned in Section 1.2.4, flood studies for catchments that are known to be prone to flooding underpin municipal emergency planning for flood. They may provide valuable information about how floods in a catchment may behave, and specifically how communities may be affected. For these reasons it is desirable for up-to-date flood studies to be available in areas of flood risk and for them to be used to support flood action plans for those areas.

In the course of our work, we were provided with the *Mersey River Flood Study*²⁰ prepared by Entura for Latrobe Council. We have reviewed this study and note it provides information about the nature of flooding in the Mersey catchment including at Latrobe. It also contains detailed flood report tables that can be used in the event of flood to identify threatened buildings for the purposes of evacuation planning. The study also provided information about the evacuation zones for major floods.

A notable feature of this study is that it related inundation extents in the Mersey catchment to gauge heights at the Kimberley Bridge. Although we have received negative feedback about the lack of a defined major flood height at the Latrobe Bridge (which is discussed further in Section 4), the intent appears to have been to provide triggers for action based on Kimberley Bridge gauge heights, not gauge height at the Latrobe Bridge.

This suggests to us that a plan existed that correctly linked major flood levels at the Kimberley Bridge with the threat of significant flooding in Latrobe; however, the major flood warning at the Kimberley Bridge issued at 4.16 pm on 5 June may not have resulted in timely and accurate warning of the anticipated impacts for the community of Latrobe.

The need for appropriate actions in response to major flooding is, in our view, a shared responsibility, particularly, for those agencies with EM responsibilities. These include SES as the management authority, police who assist with traffic control and evacuation, and council who provide resources to manage the emergency in accordance with the Municipal Emergency Management Plan. For example, in the case of flooding at the Latrobe Bridge, and in view of the warning of major flooding at the Kimberley Bridge, with the benefit of hindsight, SES might have alerted the Latrobe community earlier using Emergency Alert. See Section 4.2.2.

Recognising the BoM's flood watch and flood warnings were focused on the North as opposed to the North-West Region, the SES made a decision to manage coordination of warnings and responses, including requests for assistance, for both the North and North-West Regions from the Northern ROC. Contributing to, but by no means the main reason for, this decision was that the North-West SES staff and volunteers were already engaged in a search for a missing person at Bakers Beach. At this time, the North-West Regional Manager was in Launceston on a day off and was recalled to duty in the Northern ROC.

Reasoning behind the decision is understandable but were not in accordance with a predefined plan. The disadvantages of this arrangement became apparent as the situation in the North-West deteriorated and the relevant manager found himself without access to key documents or a dedicated incident management team to focus on this Region.

In the event that a similar situation arises again in the future, contingency planning for the activation of a second ROC, or at least an incident management team, including surge capacity for staffing, should be in place.

²⁰ Mersey River Flood Survey, issued May 2011

1.3.3 State Flood Operations Centre

An SES State Flood Operations Centre (SFOC), set up in Hobart, was activated from 6 am on Monday 6 June to provide statewide coordination, support to regions and advice to the State Controller. This was the first time in Tasmanian history that an SFOC had been activated. This was done because the floods were impacting all three regions across the State, and the need for this action to be taken became evident to State level emergency management authorities at this time.

Given the discussion in Section 0 about staffing in the North and North-West Regions, it appears to us with the benefit of hindsight that activation of the SFOC on the evening of 5 June would have added value and provided significant support to the Regional Manager North-West as he endeavoured to deal with the emerging situation. We suggest that some consideration be given to identifying trigger points for the timely activation of the SFOC.

1.4 Potential risk mitigation using flood levees

There are currently two major levee systems used for flood mitigation in Tasmania, one in Launceston and the other in Longford. There are other publicly and privately owned levees, but these are not discussed here.

1.4.1 Launceston City Council levee

The Launceston levee system was commissioned by LCC after the 1929 floods, and a 10-kilometre levee system was built in the 1960s. This was improved in design and upgraded in 2010. The \$58 million upgrade was managed by the Launceston Flood Authority (LFA), funded by LCC and the State and Australian governments. The LFA is a separate legal entity established by the LCC under the *Local Government Act 1993*.

Geoscience Australia (GA) was recently commissioned by LCC to examine the costs and benefits of the upgraded levee after the June 2016 floods. GA identified, based on the 2016 floods (a 50-year ARI event) in Launceston, that estimated avoided losses of business and residential properties was about \$216 million, and it concluded that the upgrade was a sound economic investment.²¹

1.4.2 Longford levee

The Longford levee was built in 2007 by the Northern Midlands Council at a cost of \$5.5 million based on a business case that suggested the benefits totalled \$13.5 million. It was designed to protect sections of Longford from a 100-year ARI event and was considered by the Council to have successfully protected the community during the 2016 floods.

This levee was funded by the Council and State and Australian governments, with local ratepayers contributing to the Council's share through a separate levy.

These two circumstances suggest that appropriately researched, funded and constructed levees can provide flood mitigation for flood-prone areas, providing protection for existing properties and development opportunities.

²¹ Launceston Flood Risk Mitigation Project, BNHCRC, February 2017

Other benefits include potentially lower insurance premiums for properties protected. Another, perhaps more difficult to quantify, benefit is greater awareness by communities of flood risk in their township and associated preparedness to respond appropriately when floods threaten.

1.4.3 Would Tasmania benefit from the construction of more levees?

The hydrologist we engaged was asked to assess the usefulness of levees as a flood mitigation measure. Their report noted:

- Levees are generally considered a good tool for protecting existing development, but not suitable as a protection to allow new development on a floodplain.
- The levees in Launceston and Longford performed well and protected the targeted areas during the 2016 flood event.
- There are a number of towns in Tasmania where levee projects have been proposed. A high-level study to identify areas where levees could be constructed to provide flood protection, and prioritise these based on a cost-benefit basis, would be worthwhile, but levees should be considered as one of a number of possible flood-mitigation options.
- The process for applying for a permit to construct a new levee (as distinct from a dam), or upgrading an existing levee, should be made clear on DPIPWE's website and in associated brochures and forms – see Section 0 below.

Any agencies considering the construction of levees should take into account these observations, along with learnings experienced by LCC and Northern Midlands Council, and prepare transparent business cases.

During our work, our attention was drawn to an article titled 'Central Highlands says no to levees' on the website of Central Highlands Regional Council²², a council in Queensland. Following a lengthy study, this Council concluded that:

“Levees are not a financially viable flood mitigation option for Emerald”

In summary it also concluded (relevant to this Review), that:

- the cost outweighs the benefit;
- indirect benefits, such as reduced insurance premiums and improved property values, while identified as marginal, are unproven;
- public safety was this Council's highest priority, above property protection;
- Council can assure the safety of its community without a levee system;
- other flood mitigation projects will continue; and
- there will be an ongoing concentrated effort to ensure people are well-informed about flood safety and well-prepared in advance.

This article is timely and useful for Tasmanian councils in flood-prone areas to consider.

²² <http://www.centralhighlands.qld.gov.au/about-council/news/central-highlands-says-no-to-levees/>

1.4.4 Regulation of levees

The construction of dams and levees is regulated under the *Water Management Act 1999* and the *Water Management (Safety of Dams) Regulations 1995*. DPIPWE has responsibility for licensing and regulation under this Act and may require a hydrological assessment before a dam or levee is approved for construction, removal or modification to meet safety and environmental concerns.

A number of the public submissions to this Review referred to levees constructed around Tasmania which may or may not comply with the regulations. DPIPWE is encouraged to review the construction of current levees with a view to ensuring legislative compliance.

1.5 Reviews underway prior to the June floods

Reviewing is an important part of emergency planning. Emergency management doctrine often refers to the principle of Plan – Do – Check – Adjust, so in assessing the strength of the planning process, it is relevant for us to consider what provisions for review are built into current arrangements. We identified a number of previously initiated emergency management reviews that were underway at the time of the June floods, and we note these reviews here.

Department of Justice review

Recommendations from the *2013 Bushfires Inquiry*, led by Malcom Hyde AO, initiated an *Independent Review of Tasmania's Emergency Management Arrangements* by the Department of Justice (DoJ). DoJ's review specifically addresses emergency management strategies, preparedness and plans in a number of its 52 recommendations.

In relation to flood emergency management these include:

1. an amended role for the State Controller;
2. support for a sustainable funding model for SES to better assist councils in emergency management planning;
3. a State Recovery Coordinator be identified as a standing position; and
4. establishment and funding of an all-hazard exercise and lesson management unit (discussed further in Section 1.6).

Item 2 above led to the Emergency Management Reform Project for SEMC, led by the Director SES. This project addresses many of the DoJ recommendations, including the development of a business case for three additional SES staff to better support emergency management planning at the municipal level across the State.

The business case proposes the need for these three staff to be regionally based, to work with local councils and to coordinate community education, council emergency management planning and community protection planning. We support the intention behind this proposal.

Other reviews and relevant projects

In addition to the review and business case referred to above, Tasmania's emergency management arrangements have been the subject of a number of other reviews and projects in recent years. These include:

- Review of Railton Flood Mitigation Options;
- Tasmanian Flood Extent Project;
- Tasmanian Emergency Management Plan; the TEMP was approved in 2014 and a review of it was commissioned prior to the June floods;
- Tasmanian Community Flood Resilience Project;
- Review of SEMC Terms of Reference;
- Proposed new Ministerial Emergency Management Committee;
- Review of State Control Centre Guidelines and control arrangements;
- SES review of the primary flood classification levels statewide;
- SAS review of statewide flood inundation for contemporary relevance due to infrastructure/housing changes in impact areas;
- SES review of power systems in flood zones to increase flood resilience;
- Office of Security and Emergency Management (OSEM) review of recovery arrangements – structural arrangements for recovery from natural disasters;
- DPAC project to develop a framework re planning and building mitigation for impact of natural hazards;
- OSEM project piloting an internet site, linked to TasAlert, showing natural disaster risks to property;
- DPAC review of Tasmania's emergency management arrangements which will consider the Flood Recovery Taskforce report;
- SES Flood Warning System project; and
- A series of projects to:
 - strengthen exercise and lessons management arrangements;
 - amend emergency management legislation;
 - boost emergency management support to local government – likely to address community preparedness;
 - strengthen disaster recovery arrangements – likely to result in an amended/renewed State Recovery Plan; and
 - enhance communications and information systems support by SEMC.

These reviews and projects, along with the DoJ Review referred to above, demonstrate that the risk posed by flood was receiving attention at local and State levels. However, we noted some reviews had been underway for some time or were incomplete caused by resource constraints. Other than recommendations arising from the reviews referred to above, we did not seek to establish the extent to which recommendations arising from those reviews had been either made or actioned.

However, in our view, the State is potentially exposed if valid findings and recommendations are or were made in these reviews, and we urge Government to complete and prioritise actions needed.

1.6 Exercise and lessons management unit

The Emergency Management Reform Project also identified the need, and proposes a business case, for enhanced exercise and lessons management arrangements through establishment of an exercise and lessons management unit (ELM).

We consider that, particularly in view of the number of reviews concluded and underway, there is value in establishing an ELM that would be responsible for managing recommendations from these reviews, lessons learned from exercises and the outcomes of debriefs from major operations as well as overseeing the treatment of lessons learned/implementation of recommendations across Government. Such a unit could also have regard to relevant findings from reviews and inquiries in other jurisdictions.

An example of how this might work is the SES review of the primary flood classification levels statewide. The need for such a review is evident from gaps in classification levels we identified (see Sections 4.1.6 and 4.3.2).

An ELM is well placed to review outcomes and recommend actions needed to advise local and State Government. Such a unit could also add value to Tasmania's emergency management arrangements by supporting a consistent approach to the assessment, implementation and ongoing management of the investment made by the State in reviewing its performance in responding to, and recovering from, significant emergencies like the June 2016 floods. We therefore support establishment of an ELM.

1.7 Conclusions

The State's emergency management planning and risk management strategies, structures and related arrangements, as these related to floods, have a sound basis, are in line with national frameworks and are well articulated and understood by the relevant parties.

However, we observed gaps in flood studies and flood plans, both in comprehensiveness and currency of plans. Flood studies, associated flood mapping and flood planning are inconsistent, may be not contemporary, use different methodologies and there were questions as to access, data ownership and regular review. This led to more than one recommendation including that policy settings, coordination and completion of flood plans and flood studies would be best managed centrally, preferably in an all-hazards emergency management agency or division.

When assessing how well planning worked in practice we concluded that, in the case of the Launceston flood event, emergency planning arrangements were activated as expected and operated effectively.

This was not the case at Latrobe where we noted that appropriate plans existed but may not have been acted on. Contributing to this was that the BoM's flood watch and flood warnings were focused on the North as opposed to the North-West Region resulting in SES deciding to manage coordination of warnings and responses, including requests for assistance, for both the North and North-West Regions, from the Northern ROC.

Reasoning behind these decisions was understandable but were not in accordance with a predefined plan. The disadvantages of this arrangement became apparent as the situation in the North-West deteriorated and the relevant manager found himself without access to key documents or a dedicated incident management team to focus on this Region.

In the event that a similar situation arises again, contingency planning for the activation of a second ROC, or at least an incident management team, including surge capacity for staffing, should be in place.

With the benefit of hindsight, activation of the SFOC on the evening of 5 June, rather than at 6 am on 6 June, would have added value and provided significant support to the Regional Manager North-West as he endeavoured to deal with the emerging situation. Some consideration needs to be given to identifying trigger points for the timely activation of a SFOC.

Past decisions to invest in flood levees at Launceston City and Northern Midlands Councils worked on this occasion. However, any further investment in levees as a flood-risk mitigation tool may require significant investment requiring thorough and publicly transparent cost-benefit studies.

Regulation of the construction of levees requires better understanding and enforcement.

Agencies with roles to play in emergency management have embarked upon numerous internal reviews which, in many cases, have identified worthwhile improvements to emergency management in our State. These reviews need to be progressed and acted on.

There is value in establishing an ELM responsible for managing recommendations from reviews, lessons learned from exercises and the outcomes of debriefs from major operations.

1.8 Summary of recommendations in this Section

| | Recommendation | See |
|----|---|-------|
| 1. | <p>That in flood-prone municipalities, the respective Municipal Committee develops or reviews flood-related sub-plans within a Municipal Emergency Management Plan at least every two years and submits each sub-plan to the Regional Controller for approval.</p> <p>In addition, that each Municipal Committee maintains a current flood plan, in a standardised format, which at least identifies:</p> <ul style="list-style-type: none"> • flood-prone parts of their locality, particularly those where lives may be at risk; • required actions to be taken in the event of a flood threat, especially timely evacuation; • trigger points for taking required actions and how those trigger points will be monitored; and • how the community can access flood-plan information. | 1.2.4 |
| 2. | That all councils include an easily identifiable website link for the public to locate their Municipal Emergency Management Plan and community safety information. | 1.2.5 |

| | | |
|----|--|-------|
| 3. | That SES uploads current flood studies and plans to the Common Operating Platform as a flood plan layer and that councils, subject to resolving licence restrictions, arrange to have appropriate access. | 1.2.4 |
| 4. | That agencies undertaking flood studies adopt a standardised approach, based on Australia Handbook 7, maintain public ownership of underlying data sets to support future modelling, and ensure open access to these studies. | 1.2.5 |
| 5. | <p>That Government:</p> <ul style="list-style-type: none"> • undertakes a comprehensive assessment of flood mapping in Tasmania with a view to identifying data gaps, quality and currency, and works collaboratively with councils to identify funding to improve current statewide flood data; and • explores the feasibility of undertaking a comprehensive flood mapping of Tasmania, using LiDAR or other contemporary technology, with the objective of identifying which parts of our State are, and are not, prone to riverine flooding. | 1.2.7 |
| 6. | That Government establishes a central flood policy unit responsible for coordinating flood policy across all government agencies, including Government Businesses, and ensures that such a unit has a whole-of-government and community focus. | 1.2.9 |

Section 2 Community awareness, preparation and resilience

Community preparation, resilience and awareness, including awareness of insurance matters, relating to major flood events in Tasmania.

2.1 Definitions

This aspect of the Terms of Reference reflects three issues – awareness, preparation (referred to in an emergency management context, and throughout this Report, as preparedness) and resilience. For the purpose of this Report, and in an emergency management setting, we have defined them as:

- **Awareness** – a body of knowledge encompassing roles to be played by governments, local government and the community when flood and other hazardous events are forecast.
- **Preparedness** – the TEMP outlines its principle regarding preparedness as “maintaining appropriate standards of preparedness to optimise interoperability in response and recovery”. This section deals with community preparedness, while Section 1 dealt with preparedness at a more systemic level.
- **Resilience**²³ – the ability to bounce back. For example the ability of communities to withstand impacts and recover more rapidly following an emergency.

2.2 Relationships between awareness, preparedness and resilience

In considering this part of the Terms of Reference we focused on the community’s awareness, preparedness and resilience. It appeared to us that these concepts were linked. As discussed in Section 2.1 above, resilience may be seen as the ability to bounce back and, based on submissions received by us, we concluded that a significant factor in people being able to resume a state of normality following this flood event was an existing awareness that they might be at risk of flood and related mental preparedness to cope with a flood event if it happened.

When we talk about preparedness in this context, we are not talking about physical actions such as having emergency kits, prepare-to-go bags and the like. It is more about the mental state of preparedness that can only be achieved if it is based on realistic information about flood risk and how to manage it.

For these reasons, in this Section we have given consideration to the sources of information that exist to support the community to be aware and prepared for flood risk, and also evidence we encountered of whether communities did appear to have an appropriate level of awareness.

We also discuss some broader concepts of resilience at national, state and community levels to provide context.

2.3 Awareness

2.3.1 Responsibility for awareness

All levels of government in Australia have a role to inform citizens of impending natural disasters. This includes raising awareness and the need for communities to prepare in advance for flood events. The Tasmanian Government has recognised this role, as outlined in Section 1.

Under the principle of shared responsibility set out in the *National Strategy for Disaster Resilience*, the community similarly has a role to play and this is dealt with in this Section.

²³ The Productivity Commission, in its report into Natural Disaster Funding Arrangements referred to in Section 7 of this Report, defines resilience as “The ability of communities to continue to function when exposed to hazards and to adapt to changes rather than returning to the original pre-disaster state.”

State Government has a legal responsibility, established under the EM Act, to provide for the protection of life, property and the environment in the event of an emergency, to establish emergency management arrangements and to provide for certain rescue and retrieval operations²⁴. Under Section 26 of the EM Act, the SES provides advice and services relating to emergency management.

The EM Act also describes administrative responsibilities at a State, Regional, Combined and Municipal level. The TEMP specifies that the SES is the SEMC advisory agency with responsibility for preparedness and response for flash floods and river floods, while councils are the Management Authority for prevention and mitigation in these areas.

Under these arrangements, councils undertake risk assessments and provide mitigation strategies for communities; SES interprets flood warnings and provides community consequence advice. These arrangements are consistent with the *National Strategy for Disaster Resilience* and the *SEMC Strategic Directions Framework 2013-2018*.

However, under these arrangements there is potential for tension between requiring councils to have responsibility for a municipal emergency management plan while, at the same time, requiring that SES is responsible for flood preparedness and response. This could lead to a lack of clarity as to who is accountable for having up-to-date flood plans in place.

We found no evidence that this tension existed, but suggest it is a matter for Government and councils to examine and clarify.

SES

The SES promotes awareness by:

- providing information from the national *FloodSafe* program on its website;
- having staff who provide flood management training to regional staff and other emergency management agencies;
- developing Flood – Community Education and Awareness training materials for use by councils and emergency management agencies;
- providing media releases with information about specific floods and advice from BoM, which detail consequences and actions to be taken (see Section 4); and
- giving advice that interprets flood warnings.

We noted from the SES submission to this Review that it currently has one Senior Planning and Education Officer allocated to the development and dissemination of flood advice information at the council and community level. This submission noted a lack of resources as a barrier to better community education. We make no conclusions about resourcing and did not set out to identify whether or not SES is or was appropriately resourced.

However, we noted in Section 1.5, the proposal made in the current Emergency Management Reform Project and accompanying business case to address better community education and planning by recommending additional staff to support this at local council and regional levels. While we support this initiative, we have no view as to whether the proposed resourcing will be suitable.

²⁴ As per *Emergency Management Act 2006*

Also in our view, it is relevant that the TFS has developed a successful model for delivery of community education through its Community Education and Development Section, details of which are available on the TFS website.²⁵ This model, sufficiently resourced, may best serve the community if expanded to an all-hazards approach, and we noted that SES and TFS are working towards aligning community education programs. For example, when TFS runs community education forums about fire, SES personnel would be expected to participate by providing information about flood awareness. Similarly, SES or another suitable agency could discuss other hazards already identified in TSNDRA 2016.

Recommendation 7

That SES and Tasmania Fire Service share resources and align their community education programs and adopt an all-hazards approach to awareness.

Councils

Information about flood awareness provided by councils to the community differs. This is not unexpected because their flood risks are not the same. Some councils have extensive information, including inundation maps published on websites, whereas others have less flood advice.

For example:

- Huon Valley Council has a section on its website that details emergency management advice, maps and a copy of their Emergency Management Plan.
- LCC has a website with links to emergency management including flood information, emergency contacts, recovery and a copy of the Emergency Management Plan.
- Latrobe Council does not have a specific section on its website dedicated to flood information, but can make the Emergency Management Plan available on request or post advice online as required.
- Central Coast Council does not have any specific section on its website regarding flood advice, nor does its website include its Emergency Management Plan.

We noted some councils do, and some don't, include flood information on their websites. In our view inclusion on websites should be standard practice.

During our discussions with LCC, we noted well-developed systems and procedures regarding flood awareness, including educational material. While we make no recommendation, our view is that LCC is well placed to support smaller regional councils in the North and North-West by sharing or developing suitable community awareness material.

²⁵ <https://www.fire.tas.gov.au>

The community

Community awareness of flood risk is a significant issue where long intervals of time can pass between floods and people can simply forget the nature and extent of the risk. This is not an easy problem to resolve, but could be addressed by better and more regular education programs for both councils and their respective communities as identified above and leading to Recommendation 7 above.

2.3.2 Ensuring communities are better informed

Awareness has to come from a combination of effective education and willingness to be educated regarding flood risk, which is an aspect of shared responsibility. Also, such education must be made available at appropriate intervals, because there is a very real risk that governments and communities, due to the passage of time, forget. See Recommendation 7 above.

Unfortunately, evident from this Review were examples of actions taken, demonstrating lack of awareness, by members of the public contrary to advice provided by the SES and police. This included a tragic example during the June floods where a vehicle was driven through floodwaters and swept away resulting in the loss of a life. This occurred despite repeated advice from emergency management agencies about the dangers of driving in floodwater. Another example noted was evidence of 'Do not enter' signs on a road being removed and deposited on the side of the road. Such action risks the lives of other road users.

These incidents reinforce the need for education programs at appropriate intervals.

2.4 Community preparedness

We hoped to find in the course of our work evidence of community awareness having led to better preparedness and positive outcomes.

There were examples in the public submissions made to the Review where people had undertaken mitigation strategies, heeded warnings and taken proactive action to reduce the impacts of the June floods. For example, submissions noted:

- construction of a levee on a private property aimed at minimising flood damage;
- communities warning each other; and
- sandbagging to reduce inundation.

We concluded from this that the efforts made so far to promote community awareness had measurable beneficial effects. However, we suggest that preparedness continue to be advanced by activities such as:

- SES and/or council engaging with communities at forums aimed at raising awareness and communicating the steps needed to properly prepare;
- SES and/or councils demonstrating how communities can avail themselves of flood advice currently available on SES and council websites;
- farming communities in flood-prone areas exploring flood-resilient fencing and identifying advance plans for moving stock from low lying areas to safer havens; and
- households developing a flood plan, including an emergency kit of equipment, alternative evacuation routes and a communication plan.

Advice on these activities is available on the SES website or the national *FloodSafe* program.

2.5 Resilience

2.5.1 National guidance

The *Natural Disaster Resilience Statement* (COAG 2009)²⁶ highlights that, at a national level, coordinated and cooperative effort is needed to enhance Australia's capacity to withstand and recover from emergencies and disasters. In 2011, the Council of Australian Governments (COAG) adopted the *National Strategy for Disaster Resilience* (COAG 2011), which promotes a 'resilience' based approach to natural disaster policy and programs. The strategy recognises that disaster resilience is a shared responsibility for individuals, businesses and communities, and involves activities as diverse as risk assessment, legislation, community development, emergency response, urban development and land-use management, and community recovery.

In 2014, the Law, Crime and Community Safety Council tasked the Australia-New Zealand Emergency Management Committee to review implementation of the strategy, to conduct a critical evaluation of progress and to identify future priority areas of focus (COAG 2015).

The Tasmanian Government has responded to COAG and other initiatives by considering studies, reports and advice at SEMC, which disseminated this information among emergency management partners and used it in formulating policy as outlined in the *SEMC Strategic Directions 2013-18* and in the TSNDRA.

2.5.2 State resilience

SEMC advises State Government regarding emergency management policy including resilience. It developed the *Tasmanian Strategic Directions Framework 2015-18*, which identifies in Strategic Direction 2 – Recovery and Building Resilience, a number of initiatives:

- educate people about risks and the mitigation of hazards through community awareness and education programs to local communities and key stakeholders;
- support the recruitment, retention and training of emergency management volunteers;
- assist in the development and promotion of State, regional and local recovery strategies; and
- support programs and strategies that work to deliver the Priority Outcomes of the *National Strategy for Disaster Resilience*.

Resilience is also built on by experiences. Evident from this Review is that emergency management agencies, councils, Government and the community all learnt valuable lessons from the 2011 and 2016 flood events, which would be expected to assist with putting strategies in place to better prepare for, cope with and recover from future flood events.

This is illustrated by the following:

- An outcome from the 2011 floods was the initiation of the Wet Feet Flood multi-agency exercise which is coordinated by SES, includes Police and TFS participants, and has been run annually in Launceston over the past three years.
- Positive actions have been taken by Central Coast Council as outlined in Section 4.1.
- Positive actions have been taken by Huonville Council as outlined in Section 8.

²⁶ <https://www.coag.gov.au/meeting-outcomes/coag-meeting-communiqu%C3%A9-7-december-2009>

- Actions have been taken as a result of the 2016 floods, including the SES After Action Review, the review titled *From Floods into Recovery* by the Tasmanian Flood Recovery Taskforce, and operational debriefs by Police, SES and councils.

However, we noted, from all the documentation examined, no reference to infrastructure capacity, both before and after, a flood or other hazardous event. In our view this is a gap in the emergency management literature and is explored further in Section 7.11.

2.5.3 Academic guidance

Discussions with an academic led us to explore research, both completed and underway, on the question of 'resilience' and what this means in a flood setting.

We noted:

1. One of the angles looked at was that disaster resilience policies tend to reinforce status quo solutions, which may not be adaptive over the longer term. We can no longer rely on climate stability, so resilience definitions need to encompass transition as well – ability to move to a more desirable 'resilience' regime. Levees (usually seen as an undesirable feedback loop / path dependency) can be used to aid transition.
2. Also looked at were the links between disaster resilience and the prevention, preparedness, response and recovery (PPRR) framework, how resilience was 'superimposed' on the pre-existing PPRR framework without being reassessed, so that any activity can be said to contribute to resilience. PPRR is not sufficiently discriminatory. Therefore, the paper proposes a revised PPRR framework that can better distinguish 'stability-resistance' type solutions (primarily engineering type solutions which lead to risk accumulation and loss of ability to cope with disruption) and 'accommodation' type solutions (eg flood-compatible land planning, reserving floodable land for future changes in flood risk, ecosystem-based solutions, preparedness). It also includes an 'anticipation' category that aligns better with the risk-based approach²⁷.
3. Figures from the UN Office for Disaster Risk Reduction show that, on average, 250 million people globally are affected by floods each year²⁸.
4. There are a host of ways in which we can enhance flood resilience. Improved assessment and communication of the risks would help people make better choices and take mitigating actions. Better preparedness and community planning would lessen the cost in human lives. Investments in infrastructure can help disperse floodwaters and prevent secondary events like a dam bursting. Warning systems can help get people to safety, and so on.
5. To help develop a better understanding of these challenges and develop strategies to build community resilience, Zurich launched a dedicated flood resilience program in 2013. It includes the International Federation of Red Cross and Red Crescent Societies, Practical Action, the Wharton School of the University of Pennsylvania, and the International Institute of Applied Systems Analysis in Austria.

²⁷ Points 1 and 2 were noted from work underway by Wenger, C. (*forthcoming*). 'The oak or the reed: how resilience theories are translated into disaster management policies'. *Ecology and Society*.

²⁸ Points 3 to 7 were extracted from an article by Gavin Montgomery which was published in collaboration with Zurich and can be located at <https://www.weforum.org/agenda/2015/07/how-to-improve-flood-resilience/>. Inclusion of this article on the World Economic Forum website does not imply endorsement by it.

6. The program, which was chosen by the UN's Momentum for Change initiative as an exemplary Lighthouse Activity in 2014, is developing a tool to measure community flood resilience to provide a baseline for enhancing resilience in future. Part of its aim is to identify and cost measures to enhance flood resilience, which would identify the best ways to maximise investment in resilience and also, ultimately, help policy makers calculate the potential return on investment in flood resilience and the potential impact of commercial activity and development.
7. The bigger challenge, however, is in developing consensus and cooperation across a wide range of stakeholders and interests, from individuals and communities, to corporations, national government, and global partnerships.
8. From a 2012 article²⁹ by Kuei-Hsien Liao titled 'A theory on urban resilience to floods – A basis for alternative planning practices', we noted a distinction between engineering resilience and ecological resilience and that "Discerning their fundamental differences is important because they lead to divergent problem definitions, focuses, and approaches when applied to flood hazard management."
9. Essentially, engineering resilience is the ability to maintain stability – remaining unchanged in system state or having minimum fluctuation; whereas ecological resilience is the ability to survive, regardless of the state. They are two different, even contradictory, system properties. Systems with high engineering resilience may have low ecological resilience; low engineering resilience may introduce high ecological resilience (Holling, 1996)³⁰.
10. Overall, resilience theory suggests a paradigm shift in flood hazard management that should focus on building resilience as opposed to maintaining stability. Because flooding is inherently a part of the normal urban dynamics, resilience is neither flood resistance nor recovery to pre-disaster conditions – both are simply means to an end of stability. Here, resilience is the tendency to survive, which is itself an end.

We also located a Flood Resilience Checklist³¹ developed by the United States Environmental Protection Agency (USEPA), from which we noted that "This checklist can help communities identify opportunities to improve resilience...".

Our references here are not intended to be conclusive, simply to highlight that much work on the question of resilience has been, and continues to be, done. Emergency management authorities are urged to keep up-to-date with this research and to adapt policies where relevant. Consideration could also be given to having the USEPA checklist reviewed by our Environmental Protection Authority and the SEMC and, having done so, to have it completed by appropriate levels of government, businesses and communities.

²⁹ Points 8 to 10 refer to <https://www.ecologyandsociety.org/vol17/iss4/art48/> · Liao, K. 2012. A theory on urban resilience to floods—a basis for alternative planning practices. *Ecology and Society* 17(4): 48. <http://dx.doi.org/10.5751/ES-05231-170448>

³⁰ Holling, C.S. 1996. Engineering resilience versus ecological resilience. Pages 31-44 in P. Schulze, editor, *Engineering within ecological constraints*. National Academies Press, Washington, D.C.

³¹ <https://www.epa.gov/sites/production/files/2014-07/documents/flood-resilience-checklist.pdf>

2.6 Flood insurance

2.6.1 Introduction

Evident from media reports and submissions received was that some members of the Tasmanian community believed their insurance policies covered them for damage caused by the June 2016 floods but their insurer declined claims made on their policies.

2.6.2 Submissions from the insurance industry

The Insurance Council of Australia (ICA)³² reported in its submission to the Review that insured losses in Tasmania as a result of the June 2016 flood were around \$45 million and that only 0.9% of residential and 1.9% of business claims were denied.

The ICA advised that the national definition of flood for insurance purposes is prescribed by the *Insurance Contracts Act 1984 (Cth)* as follows:

'flood' means the covering of normally dry land by water that has escaped or been released from the normal confines of any of the following: (a) a lake (whether it has been altered or modified); (b) a river (whether it has been altered or modified); (c) a creek (whether it has been altered or modified); (d) another watercourse (whether it has been altered or modified); (e) a reservoir; (f) a canal or (g) a dam

This definition had resulted from debate about the cause of property damage by either storm or flood and was a national initiative aimed at clarifying what was meant by flood insurance.

The Financial Ombudsman Service³³ has provided related information in its *Fact Sheet – Flood and storm insurance claims*, which notes that:

... the general view taken by the general insurance industry is that flooding of a property by rain water would normally be regarded as storm damage.

Similarly, a local insurer, the RACT, provided us with its own 'fact sheet'³⁴.

In its submission, the ICA:

- estimated that 91.5% of insured properties in Tasmania are covered for flood and that all insurers are bound to abide by the legislated definition;
- indicated that in Tasmania there is significantly less complete and lower quality flood mapping data as compared to other states (this observation was also made by the Insurance Australia Group in its submission); and
- noted that where insurers have less certainty about risk, including flood risk, this would generally translate into higher premiums.

The ICA also submitted that:

- during the 2016 flood, it had representatives in Tasmania and engaged with the community regarding flood risk and insurance issues; and

³² ICA submission, http://www.dpac.tas.gov.au/__data/assets/pdf_file/0020/313139/Insurance_Council_of_Australia_-_Nick_Wiesener.pdf

³³ http://www.fos.org.au/custom/files/docs/fact_sheet_natural_disasters_flood_and_storm_insurance_claims.pdf

³⁴ <https://www.ract.com.au/SiteCollectionDocuments/Key%20Facts%20Sheet%20BLD.pdf>

- where a risk is identified, and appropriate mitigation measures are put in place, a reduction in risk and insurance premiums will follow.

Reliable flood mapping is a vital first step in identifying flood risk to enable individuals to make decisions about where they live, invest in property and what level and type of insurance cover they may choose. Reliable flood mapping also informs what mitigation measures may be required to reduce risk to tolerable levels, and for governments and communities to make a range of land-use planning, mitigation investment and emergency management decisions. Flood mapping is dealt with in Section 1 and reflected in Recommendation 3, Recommendation 4, and Recommendation 5.

2.6.3 Shared responsibility

Consumers have a responsibility to decide what type of insurance to buy, if any, and at what price. There is a clear obligation that anyone purchasing a product, including an insurance policy, understand what they are buying, including the policy 'fine print'. This includes being aware of what is, and is not, covered in an insurance policy and at what cost.

While the national legislation defines 'flood' in respect to insurance policies, insurance companies and policy holders are expected to have a clear understanding of how terms like 'flood' and 'storm' are defined. There are differences in how storm and flood damage is assessed by insurance companies, and this should be clearly understood by policy holders.

Similarly, insurance brokers and insurance providers have a responsibility to advise their customers what is and is not included in a policy with respect to flood and storm protection.

Based on submissions we received and discussions with insurers, we concluded that, on the whole, insurers followed the mandated legislative provisions and there are mechanisms in place for people to challenge refusal to pay out. The relevant legislation is only four years old and this experience, together with more recent flooding in Queensland and New South Wales, is likely to provide further evidence from which parties responsible can test if the law is working as intended.

2.7 Conclusions

In this Section we considered the sources of information that exist to support the community to be aware and prepared for flood risk, evidence we encountered of whether communities did appear to have an appropriate level of awareness, and discussed some broader concepts of resilience at national, state and community levels to provide context.

Frameworks in place for SES and councils to facilitate community awareness, preparedness and resilience are reasonable, although inclusion of information about floods on council websites should be standard practice and the adequateness of SES' resources might be hindering their capacity to develop and deliver education to communities about dangers associated with floods. This is likely to be addressed to an extent as SES and TFS progress sharing resources and aligning education programs, particularly if an all-hazards approach is adopted.

As far as awareness by communities is concerned, we noted that awareness has to come from a combination of effective education and willingness to be educated regarding flood risk and that such education must be made available at appropriate intervals, because there is a very real risk that governments and communities, due to the passage of time, forget.

We identified examples demonstrating both lack of awareness, such as where:

- despite repeated public advice not to do so, a vehicle was driven through floodwaters and swept away resulting in the loss of a life;
- 'do not enter' signs on a road were removed and deposited on the side of the road;

and actual awareness, such as where:

- communities were warning each other; and
- people were sandbagging to reduce inundation.

In any event, there is a need for education to be provided at appropriate intervals.

Resilience is also built on by experiences and there was evidence that emergency management agencies, councils, government and the community all learnt valuable lessons from the 2011 and 2016 flood events.

Much academic research on the question of resilience has been, and continues to be, done. Emergency management authorities are urged to keep up-to-date with this research and to adapt policies where relevant. On the whole, insurers followed mandated legislative provisions and there are mechanisms in place for people to challenge refusal to pay out. The relevant legislation is only four years old and this experience, together with more recent flooding in Queensland and New South Wales, is likely to provide further evidence from which governments and the insurance industry can assess whether or not anything needs to change. In any event, there is a need for insurers to ensure their policies are understood, in particular as this relates to the difference between flood and storm cover. Similarly, parties taking out insurance must ensure they understand levels of cover, if any.

2.8 Summary of recommendations in this Section

| Recommendation | | See |
|----------------|---|-------|
| 7. | That SES and Tasmania Fire Service share resources and align their community education programs and adopt an all-hazards approach to awareness. | 2.3.1 |

Section 3 Causes of the floods

The causes of the floods which were active in Tasmania over the period 4 - 7 June 2016 including cloud seeding, statewide water storage management and debris management.

3.1 The weather and rainfall

From September 2015 to April 2016 Tasmania generally experienced very dry conditions, with a record dry spring³⁵. The exception was at the end of January 2016 when a low pressure system brought heavy rainfall to the north of the State that led to widespread flash flooding down the East Coast and parts of the central north.

Heavy rainfall in January 2016 also resulted in moderate flooding in the South Esk River and over 100 calls for assistance to the Northern Region SES. However, this rain was not enough to counteract low long-term rainfall and, by the end of April 2016, water storage levels across the State had reached record lows.

An extended period of rain started in May 2016, with the south, central, and north-east parts of the State receiving in excess of 200% of their average monthly rainfall. Sites in the Huon catchment experienced minor flooding and sites along the North Esk River approached their minor flood levels on several occasions. Soil moisture levels increased during this period, approaching normal levels for this time of year in the west and north of the State.

The Soil Dryness Index (SDI), a measure of soil moisture deficit, is commonly used for fire danger assessment and is an estimation of the amount of rainfall necessary to saturate the soil. The rainfall in May 2016 resulted in most catchments across the State being close to saturation as measured by the SDI. This meant that when more rain fell in early June 2016, it did not take long for saturation levels to be reached, resulting in increased runoff.

During June 2016, a strong moisture-laden weather system brought exceptional flooding to several catchments in Tasmania. Several hundred millimetres of rain fell over the 72 hours to 9 am on Tuesday 7 June. The rain was particularly heavy in the 24 hours to 9 am on Monday 6 June.

BoM identified that the intensity of the rainfall in the north of the State was the result of a combination of three factors:

- Firstly, the moisture feed into the system extended across the Tasman Sea from as far north as the central Coral Sea. The sea surface temperatures over these waters were very much above average for June, continuing the record temperature trend observed over autumn. This increased the amount of moisture available for evaporation into the atmosphere.

An estimate of moisture in the atmosphere, measured by precipitable water, was close to the highest on record for June at several measurement locations along the east coast of Australia. A new June record was reported at Hobart Airport on the evening of Monday 6 June.

- Secondly, this moisture was driven on to the northern and eastern parts of the State in strong north-easterly winds that the synoptic situation produced.
- Finally, the low level winds were lifted by the topography over Northern Tasmania to reinforce the upward motion present in the rainband, making a very efficient precipitating synoptic system.

Major flood levels were exceeded at numerous flood forecasting locations, and several river level measurement stations experienced the highest water level on record.

³⁵ Information on flood causes and rainfall taken from the BoM submission to the Review

The map in Figure 2 shows the three-day (72-hour) rainfall totals across the State ending at 9 am on 7 June 2016.

Figure 2: Three-day rainfall totals across Tasmania ending at 0900 on 7 June 2016

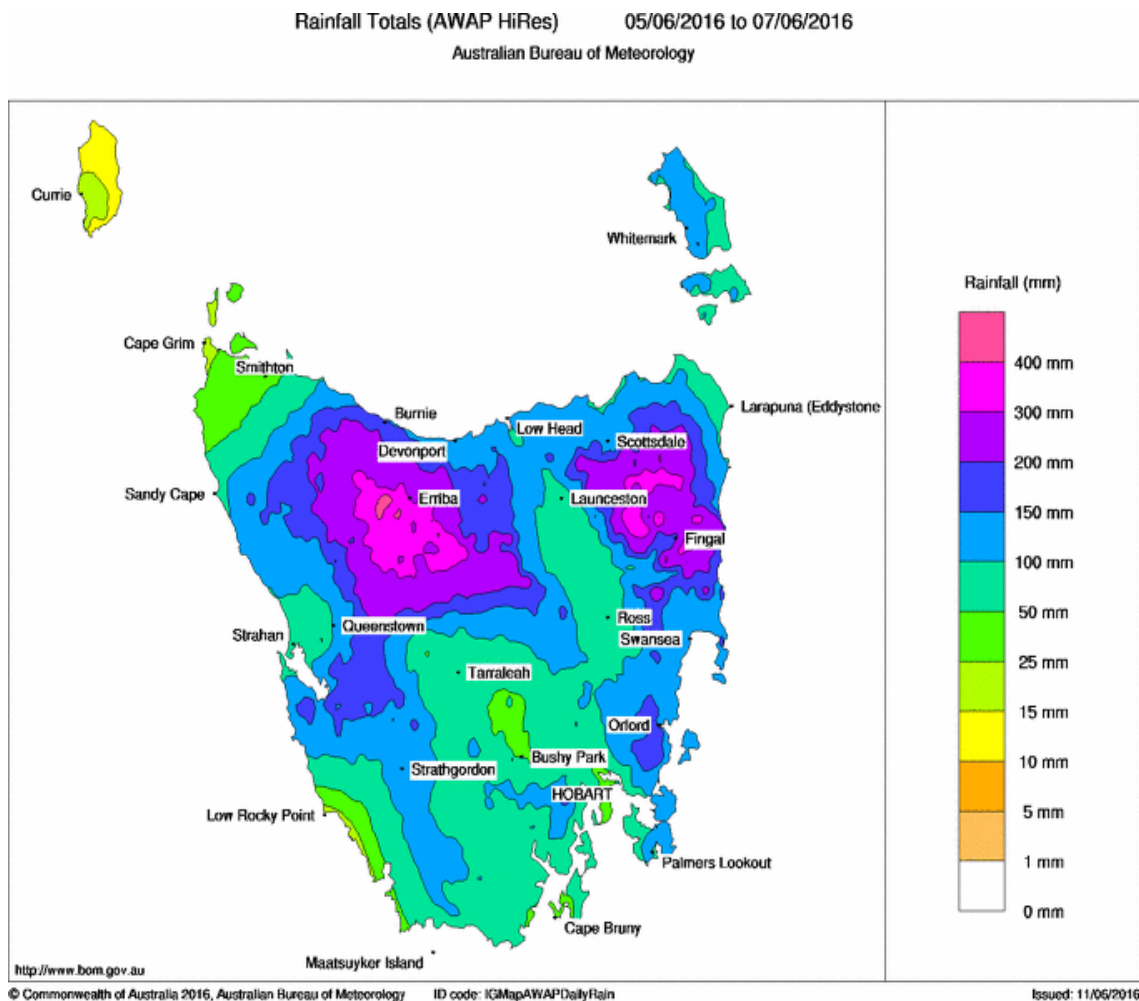


Figure 2 shows that the highest rainfall for this period was reported across the north of the State, particularly the North-East Highlands and Western Tiers. The highest two-day (48-hour) rainfall total recorded for this event was 403 mm at Fisher River (ending at 7 pm on 6 June).

Evident from these facts is that during this event it didn't just rain: the rain experienced was extreme in the Tasmanian context, and so the fact that it led to flooding was not just unsurprising, it was to be expected. These totals, that would be significant in any environment, were particularly so for Tasmania.

Figures 3 and 4 contrast the rainfall pattern for Lake Mackenzie for both the 2011 and 2016 flood events. They are included here to highlight rainfall intensity and how the two events differed.

Figure 3: Lake Mackenzie rainfall pattern, June 2016

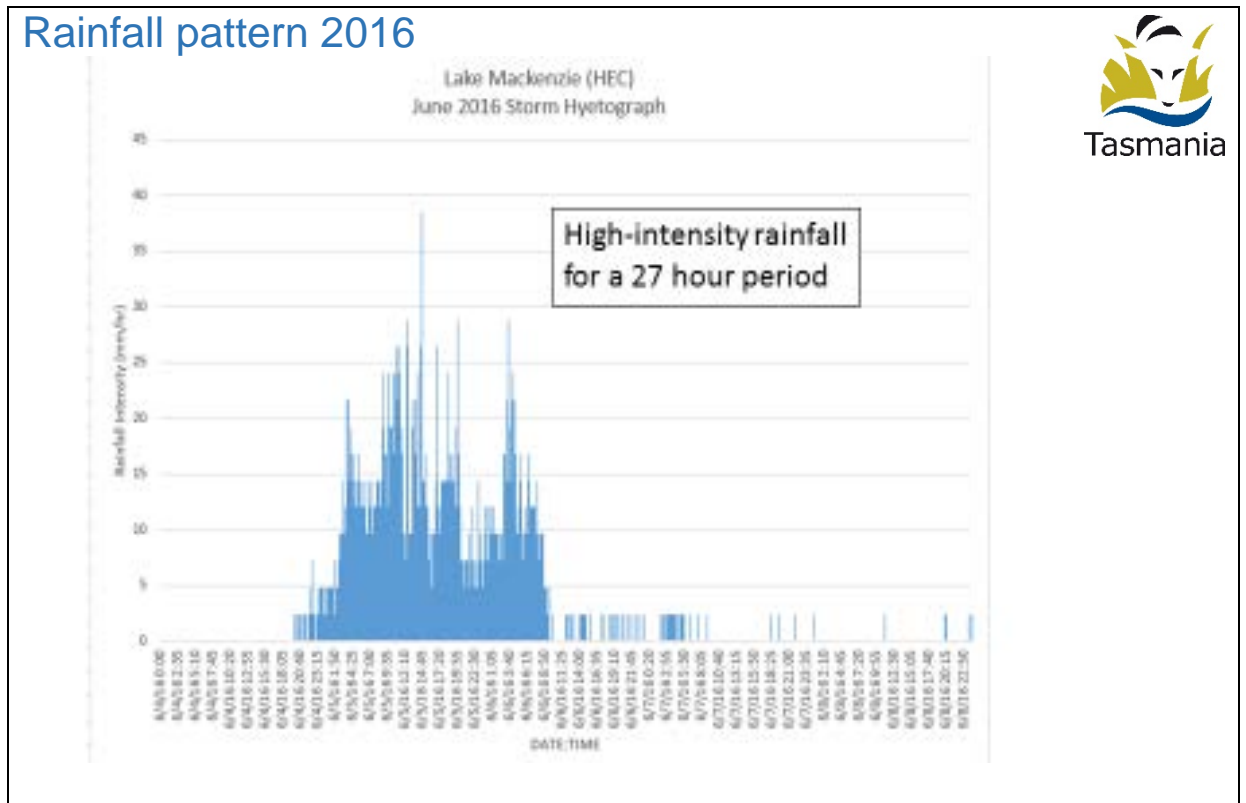
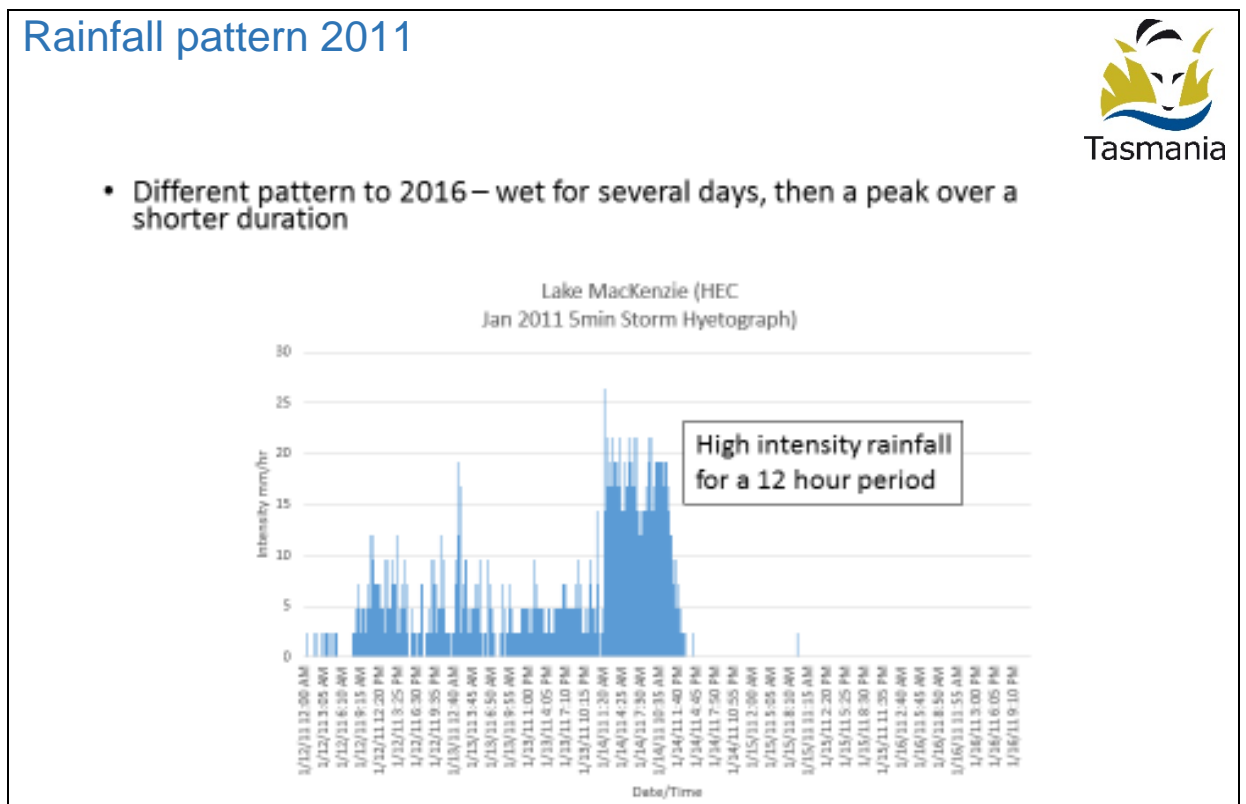


Figure 4: Lake Mackenzie rainfall pattern, January 2011³⁶



³⁶ Mineral Resources Tasmania, Caveside PowerPoint presentation 2016

The Lake Mackenzie rainfall gauge is owned by HT and is located in the Central Highlands in the Western Tiers, adjoining the Mersey, Meander and Derwent catchments. Its central location provides a good indicator for rainfall impacts on those catchments.

Notable from the two figures was the higher intensity of rainfall over a longer duration in the 2016 event, which was a major cause of flooding in the associated catchments.

The total volume of rainfall for both events falls beyond the 1% Annual Exceedance Probability (AEP) category (ie a storm with a 1:100 chance of occurring in any year). It is not impossible for two such events to occur in close succession.

When assessing the rarity of flooding (flow and level), it is the burst duration during the storm that maximises flow, which in turn establishes the rarity of the resulting flood. Apparent from this data were that burst durations, for both the 2011 and 2016 storms, were in the range 4 to 6 hours (the critical burst duration maximising flow: Rigby et al. 2005³⁷) and, on these occasions, both events incorporated bursts of 1:20 to 1:50 AEP.

While both the 2011 and 2016 rainfall events resulted in major flooding, evident from Figure 3 is that the 2016 event was of higher intensity and longer duration, causing higher floods, inundation of farmland and houses, and significant deposition of debris.

3.2 Effect of cloud seeding

Many of the submissions made to the Review expressed the opinion or concern that cloud seeding operations carried out by HT on 5 June before the June floods contributed to rainfall intensity, and so to the flooding.

Cloud seeding is a process whereby an agent is introduced into a cloud from an aircraft to induce rain for the benefit of water managers. HT uses cloud seeding as a technique to improve rainfall targeted at specific catchments aimed at increasing its water storage impoundments.

3.2.1 Rationale for cloud seeding

HT's submission noted that lower than ideal water storage levels in June 2016 was a factor in the decision to undertake a cloud seeding flight on 5 June. The operation was undertaken to increase rainfall into HT's storages in the Upper Derwent catchment (including Lake Echo, which was still below its preferred level at that time).

Had the seeding flight been successful, it was possible there would also have been an effect in the Great Lake catchment, Arthurs Lake and Woods Lake. In its submission, HT noted that there were no flood warnings in place in the Upper Derwent or Great Lake catchments at the time of the flight. This Review confirmed this fact – see Section 4.1.1.

Cloud seeding began at 10.57 am, in seeding conditions that were described on the Flight Log as 'marginal', and continued for 1 hour and 34 minutes to 12.31 pm.

³⁷ Mineral Resources Tasmania, Caveside PowerPoint presentation 2016

3.2.2 Information provided by Hydro Tasmania

HT made information about its cloud seeding operations and related flight details on 5 June publicly available on its website, and addressed this matter as part of its submission to the Review. In its submission, HT included a copy of an independent report into cloud seeding that it commissioned.

The independent report was aimed at informing HT about the impacts on rainfall of its cloud seeding flight on 5 June. HT's independent report concluded that the cloud seeding flight

...had no measurable impact on precipitation...

This conclusion was in line with HT's own analysis of this cloud seeding exercise.

3.2.3 Expert opinion

Given the considerable community interest in the causes of the floods and of any possible effects of cloud seeding on this occasion, we engaged an independent expert (an atmospheric scientist with extensive experience in applied research relevant to cloud seeding) to review both the HT submission and its independent report. A scope of work comprising four items was drafted and responses to all four follow below.

Responses to each item in the scope of work

1. Review of HT's, and its independent, reports into cloud seeding

Our expert concluded that:

The multiple lines of evidence used by HT's independent reviewer all point directly to the justifiable conclusion that conditions on the 5th June were not suitable for rainfall enhancement by cloud seeding.

Our expert also concurred with the independent reviewer's conclusion:

... that seeding would have had no impact on precipitation has a solid scientific basis...

We concur with the conclusions reached by our expert. In addition, our views are:

- In the event HT decides to re-commence its cloud seeding program, improvements are needed to its quality control and assurance processes.
- HT should review its cloud seeding decision criteria in view of our assessment that cloud seeding was unnecessary on this occasion.
- On the basis of our understanding that HT is currently undertaking an internal review of its cloud seeding activities, the results of any such review should be independently reviewed.

2. Advantages and disadvantages of cloud seeding

In view of the public interest in the question of cloud seeding, our expert was asked to address the advantages and disadvantages of cloud seeding.

Based on our expert's analysis and our own research, we noted the following:

- The intended benefit of cloud seeding in Australia is straightforward – increased water availability for water managers in a country that is hot, dry and subject to periodic drought. It is based on the proposition that, under favourable conditions, the value of additional water produced exceeds the cost of the weather modification operations undertaken to produce it.

- Disadvantages are threefold:
 - It cannot break drought – “Because cloud seeding essentially provides incremental rainfall from naturally-precipitating systems, it is not an effective strategy in Australia during time of drought when there is an absence of rain and even cloud”;
 - In Australia there are “comparatively limited circumstances” (but Tasmania is one of these limited circumstances) where cloud seeding is likely to be justified;
 - It is always challenging to determine in a statistically rigorous way the effect of seeding, which can make it difficult to demonstrate the intended benefit and to maintain community support.

In addition, we were advised that, overall, the 1995 ARMCANZ³⁸ ‘Guidelines for using cloud seeding as a tool for water management in Australia: an outline of the Australian experience and principles for water managers’, still provide the best articulation of how the balance between advantages and disadvantages of cloud seeding should be weighed up under Australian conditions. We accessed this report and noted the following from it:

- Research has shown that, given the appropriate conditions, cloud seeding can modify clouds and induce rain.
- Favourable circumstances have occurred, most notably in the Tasmanian hydro-power industry, where appropriate cloud conditions, effective catchment response and positive cost benefit outcomes have justified seeding.
- Inclusion of recommended proposed guidelines for using cloud seeding as a tool for water management in Australia. These guidelines proposed:
 - separating the roles of water managers, design scientists, cloud seeding operators and an independent review scientist; and
 - adopting principles to be applied when conducting cloud seeding experiments.

It is our understanding that HT already takes into account the ARMCANZ guidelines.

We make the following recommendation:

Recommendation 8

That in the event that Hydro Tasmania decides to start cloud seeding again, water managers, represented by DPIPWE³⁹, work with Hydro Tasmania to ensure appropriate, best practice application of the guidelines issued by the Agricultural and Resource Management Council of Australia and New Zealand.

³⁸ Agriculture and Resource Management Council of Australia and New Zealand

³⁹ We noted DPIPWE has no legislative authority to do this but in view of their dam and water management responsibilities, they seemed to us to be the most logical agency to carry out this role.

We also reviewed a 2009 research report titled *On the Analysis of a Cloud Seeding Dataset over Tasmania* (Morrison et al. 2009)⁴⁰ from which, in a section headed 'Discussion', we noted:

- An analysis of the surface rainfall data over Tasmania for the period of 1960-2005 readily finds that, on average, more rainfall did occur during months in which seeding took place in target control regions.
- A standard double ratio calculation finds that the rainfall over the target was somewhere between 5% and 13% greater than over nearby 'control' regions with a satisfactory level of statistical significance being reached (using a bootstrap analysis) in many of the tests.
- As the cloud-seeding projects over Tasmania were never designed as a single long-term field experiment, there are numerous caveats to this approach. (These caveats are listed in the research report but not repeated here.)

Bearing in mind these caveats, this analysis provides some support for the hypothesis that cloud seeding may be physically plausible over Tasmania.

3. Whether the amount of rainfall was impacted by cloud seeding or whether cloud seeding added to the amount of rainfall that fell during this event

Our expert concluded that:

... by using multiple lines of independent evidence HT's independent report provided a solid scientific justification for his conclusion that seeding would have had no impact on precipitation on the 5th of June ...

4. Whether there is a scientific basis for cloud seeding

Our expert concluded that:

... at least for Tasmania, there is a both a sound scientific basis at the microphysical level and a published level of scientific support at the impact evaluation level.

3.3 Statewide water storage management

Water storage in Tasmania is generally a mixture of private dams, irrigation impoundments and HT dams and impoundments. There were a number of significant HT dams in the catchments affected by the June floods. There are no significant irrigation or private dams identified that are relevant to this discussion.

3.3.1 Hydro Tasmania

We noted that a number of private submissions questioned why HT did not lower dam levels before a forecast flood and retain significant floodwaters as a mitigation measure. The proposition being put forward was that HT's system of dam networks should be used as a flood mitigation measure.

⁴⁰ Morrison A.E., Siems S.T., Manton M.J. and Nazarov, A. 2009. *On the Analysis of a Cloud Seeding Dataset over Tasmania*. https://www.hydro.com.au/system/files/cloud-seeding/2014/JAMS2009_On_the_analysis_of_a_cloud_Seeding_Dataset_over_Tasmania.pdf

HT responded to these concerns in its submission in which it noted that:

- It gives a high priority to community safety.
- Its dam infrastructure was designed and built for the purpose of electricity generation and not flood mitigation, but that some minor flooding may be mitigated where dam storages allow.
- Dam safety is clearly a high priority with processes in place, including Dam Safety Plans and physical dam monitoring, to manage HT's infrastructure risks.
- It is a misconception that all HT dams have gates that open to allow lake level reduction of the major water impoundments, and HT are generally only able to reduce lake levels through the process of power generation.

HT submitted that the large volumes of water resulting from the intense rainfall leading up to the floods were so significant that management of dam levels would not have impacted significantly on the ensuing floods below these dams. To test this, we sought expert advice in relation to a number of water management matters and engaged WMAwater, consultants with expertise in hydrology, to examine this further.

The conclusions drawn by this consultant supported our view that HT's network of dams and infrastructure was not designed for flood mitigation and would not have been capable of having any meaningful effect on the sheer amount of water that fell during this rain event. While dams can be used for flood mitigation, the construction costs for flood mitigation dams is likely to be significant.

We therefore concluded that HT's submission was well-founded and there is no evidential basis for criticising HT for not using its dam network to mitigate the June 2016 floods.

We also concluded that construction of specifically designed water storage impoundments as a flood mitigation measure is extremely costly and we cannot identify any basis for recommending it as a viable option.

Further hydrological advice

The scope of work for WMAwater also included assessing whether HT's dam network would be useful as a flood mitigation tool. They advised that:

- It would be very difficult and costly to adapt HT's dams for flood mitigation.
- To extend HT's charter to include flood mitigation would likely be ineffective in managing floods, and the associated restrictions on operations would be likely to significantly compromise their ability to maximise economic return from hydropower generation and ensure continuity of supply for Tasmania.
- There would be limited scope to construct new flood mitigation dams downstream of existing HT dams.

3.3.2 Role played by DPIPWE in regulating dams and water storage

DPIPWE is:

- the state regulator for dams and water impoundment construction including levees;
- responsible for dam safety and matters that could arise from excessive flooding and impacts on dams and impoundments.

During the floods, DPIPWE undertook desktop assessments and other measures to ensure dams were safely managed. We noted from its submission that its Water Management Branch established a 'streamlined' process for dam repair for private landowners. This allowed farmers and other landowners to conduct dam works and repairs in a more timely fashion, with due consideration to safety reports and structural integrity assessments where necessary.

However, DPIPWE also advised us that there appeared to be many private landowners who construct dams and levees who may not be fully aware of their legal obligations, including the need for hydrological assessments before constructing dams or levees. DPIPWE should address this.

3.4 Impact of debris on flood severity

Several submissions to us raised concern that the extent and impact of the flooding had been made worse by debris in water courses forming temporary dams against structures such as bridges and either impounding water behind them or causing a surge in water levels when the 'dam' failed. One particular example mentioned in several submissions was the Kimberley Railway Bridge on the Mersey River. For this reason we requested WMAwater to consider the impact of the Kimberley Railway Bridge failure on the intensity of flooding downstream.

WMAwater reached two main conclusions about this. The first was that it is unlikely that debris loads were a major contributor to the bridge failure. The primary failure appears to have been caused by earth being scoured away from the embankment between the bridge spans as a direct result of the depth and speed of the flooded river.

The second conclusion was that the volume of water released as a result of the failure of the bridge would have been fairly small relative to the total amount of water coming down the river. WMAwater advised that, in similar situations where technical modelling has been undertaken, although flow velocity and timing of flood level rises may be affected at the instant of failure, the change to peak food levels and velocity is not likely to be significant.

Based on this expert advice, we conclude that the failure of the Kimberley Railway Bridge did not make the flooding along the Mersey River downstream of the bridge significantly worse.

3.5 Debris management

The floods resulted in various types and quantities of debris being mobilised downstream. While we concluded that there is no evidence that this actually made the floods worse, it is clear that the significant amount of debris left behind by the floods presented major issues.

Landowners and infrastructure managers raised a number of observations and concerns including:

- debris that was deposited on land;
- problems with the clean-up of fallen livestock;
- questions about responsibility for clean-up or removal of debris; and
- the significant damage to infrastructure that was either caused, or exacerbated, by the mobilisation and build-up of debris.

The debris mobilisation varied depending on the type of catchment and water velocity. The slower moving floods in the North and South Esk rivers were found to mobilise trees and loose

debris, which was less destructive than in other catchments that were subject to quicker, high intensity floods.

We noted that in areas like Caveside, Merseylea, Weegen and Ouse, fast-moving and high water levels deposited significant debris.

3.5.1 Action taken and what we found

We noted that:

- Properties at Caveside were subject to significant quantities of gravel and silt being deposited, which was the subject of an analysis by Mineral Resources Tasmania who found this to be naturally occurring deposition of silt, rock and cobble from an upstream landslide that deposited significant debris onto lower lying farmland.
- Following various site visits, including at Merseylea, we noted significant damage and deposits of logs, trees, rock, cobble, gravel and alluvium and observed the significant work being undertaken by landowners to remove substantial quantities of such debris.
- A site visit to Gunns Plains showed evidence of similar clean-up operations following deposits of trees and shrubs that had been scoured from the riverbank and damage to infrastructure by both debris and hydraulics.
- A site visit to the Forth River identified that it still had a significant quantity of tree and log debris on either side of the river mouth near Turners Beach.

Based on these site visits, it appeared that much of the timber debris seemed to be naturally occurring and part of natural flood processes. However, in view of the uncertainty, we included this in our scope of work for WMAwater to examine. They concluded:

- Woody debris is an inherent feature of flooding in forested catchments. While it is appropriate to consider reasonable measures to mitigate the supply and mobilisation of damaging debris where possible, it is unreasonable to expect that major river flood flows in forested catchments will be completely free of timber debris.
- Design of waterway structures such as culverts and bridges, as well as planning of development, must consider the risks posed by debris flows.
- In the June 2016 floods, it is likely that the quantity of woody debris was exacerbated more than would have otherwise occurred in another event with similar rainfall, due to:
 - the liquidation of Gunns Limited resulting in the abandonment of private timber plantations throughout the catchments;
 - drought conditions in the years prior to the flooding, potentially increasing the number of dead and distressed trees susceptible to mobilisation; and
 - the widespread major bushfires in the upper Mersey Valley catchment in January 2016, increasing runoff and stream power in the upper Mersey River, leading to increased riparian erosion and vegetation destruction/mobilisation.

As far as we were able to establish, responsibility for management of waterways lies with the owner of the waterway. There are very few formal controls on activities such as removal of vegetation or timber debris from river channels. In practice, Crown Land Services has been providing assistance and advice to landowners in relation to recovery and clean-up after the June 2016 floods. This role may need to be formalised with clear objectives and priorities, and

a review undertaken of whether funding arrangements to Crown Land Services are sufficient to fulfil this role.

For major assets it is considered appropriate that the asset owner should be responsible for debris removal.

3.5.2 Plantation timber

As part of the recovery process, DPIPWE engaged a consultancy firm to assess the June flood, focusing on impacts on waterways, damage and options for treatment (the DPIPWE Report, refer Section 6.1).

The DPIPWE Report identified that the Mersey, Leven, Inglis and Meander catchments were severely impacted; there were 27 recorded log jam sites and 84 river erosion and deposition sites.

The report noted that failed Managed Investment Scheme plantations resulted in the availability of a significant amount of large wood on the floodplain floor, which can quickly accumulate as debris in a flood and cause major blockages. It also noted natural accumulation of large wood occurs from riparian and floodplain vegetation⁴¹, and went on to note that during the June 2016 flood significant quantities of debris moved through the systems⁴².

We noted some private submissions also suggested that plantation timber had contributed to debris. WMAwater examined these matters – see 3.5.1.

However, our conclusions (see 3.5.1) when compared to those made by WMAwater and the DPIPWE Report are not always the same. DPIPWE needs to research this further and consult with the Forest Practices Authority and Environment Protection Authority (EPA) in doing so.

Recommendation 9

That DPIPWE examines the WMAwater report along with its own, analyses the differences, consults with the Forest Practices Authority and Environment Protection Authority, and proposes an appropriate course of action to Government.

Requirements of the *Forest Practices Act 1985*

We met senior management of the Forest Practices Authority and discussed the requirements in the *Forest Practices Act 1985* as they relate to production forests, including the relevance of the *Forest Practice Code 2015 (Code)* to both plantation forests and to riverbank management more generally.

The Code identifies that all watercourses require protection during forestry operations. The Forest Practices Authority manages such operations through a planning approval process and scrutiny by an accredited Forest Practices Officer under the provisions of the Code.

The Code specifies at Table 8 'Minimum Streamside Reserve Widths or Machinery Exclusion Zones'⁴³. These provide minimum distances between forestry operations and rivers, lakes and

⁴¹ DPIPWE Report, page 10

⁴² DPIPWE Report, page 25

⁴³ Forest Practices Code 2015, Table 8

water storages, in order that minimum horizontal distances of native vegetation reserves along watercourses are maintained.

The Code specifies, for rivers, lakes, artificial storages and tidal areas that are marked on 1:100,000 topographical map series with catchments larger than 100 ha, that the minimum horizontal width from the watercourse bank to the outer edge of the reserve is 40 metres. Reserve distances reduce with the size of stream and smaller catchment areas.

Adherence to the Code serves to reduce impacts of plantation timber and logging coupe waste entering rivers as debris. We concluded that other land users operating near rivers or streams should adhere to similar requirements.

Recommendation 10

That DPIPWE examines the *Forest Practice Code 2015* for relevance of its concepts to farming and other business activities near rivers, streams and naturally occurring dams and makes recommendations to Government accordingly.

3.5.3 Willow trees

The DPIPWE Report⁴⁴ noted that flood-impacted sites could be managed by a combination of debris management, willow management, and river and floodplain management.

Willow trees are an introduced species (*Salix* spp. and hybrids) that were planted extensively throughout Australia in the 19th century by landowners to help control river erosion. Unfortunately, if not carefully controlled, willows can increase in number and intensify with root and branch systems that can lead to river blockage.

3.5.4 Livestock carcasses

During the floods, a number of catchments identified that livestock (sheep and cattle) were washed away and drowned in floodwaters. This generally posed debris and clean-up issues for landowners further downstream.

The EPA, a section of DPIPWE, was able to provide some assistance with the removal and burning of carcasses in a number of catchments. However, it was noted in a number of private submissions, and from comments made at a community forum, that specialised skills were needed for retrieving carcasses from rivers and destroying them by burning in wet conditions, and that the effectiveness demonstrated by teams tasked with this work was variable.

We suggest that the EPA should prepare and maintain a fallen stock disposal plan to use either in future flood events (which would need to include considerations such as retrieving fallen stock that had lodged in trees, as a result of the action of floodwaters) or in events such as bushfires or disease outbreaks that result in extensive stock losses.

3.5.5 Responsibility for managing debris

Many landowners and councils raised concerns as to who had responsibility for cleaning up debris after floods. This issue has a number of complexities, but it was evident that this is best dealt with as a shared responsibility between landowners, councils and governments.

⁴⁴ DPIPWE Report, page 25

One of the complexities identified during meetings with a number of councils was that there appeared to be a variation on how land titles and riparian responsibility have been derived over the years since settlement. Some land titles have been issued to landowners with title up to the middle of a river; others have a specified distance from a riverbank; and some rivers are further managed under a 'Water Management Plan' eg *Mersey Water Management Plan*. This issue became particularly evident when assessing responsibility for debris and riparian management.

In Tasmania, resources, including water supply from rivers, are subject to conditions imposed under the *Water Management Act 1999*. Section 6 of the Act outlines the objectives, which include:

- promote sustainable use and development of water resources;
- provide for hydro-electric power generation, and water use for human consumption and commercial activities;
- maintain ecological processes and genetic diversity;
- fair allocation of water resources for community needs;
- increase community understanding of aquatic ecosystems and management; and
- encourage community involvement in resource management.

The Act also describes the obligations of the Minister and Secretary to further the objectives under Schedule 1 – Objectives of the Resources Management and Planning System in Tasmania. These include:

- encourage public involvement in resource management and planning; and
- promote the sharing of responsibility for resource management and planning between the different spheres of government, the community and industry.

We did not seek legal advice as to whether the legislative provisions outlined above, or noted elsewhere in the Act, address who is responsible for management of debris clean-up and restoration of riparian zones. Despite this, we concluded this responsibility remains unclear.

This is illustrated by the following real-life questions we identified during the Review:

- I am a private landowner. Who is responsible for debris (including livestock carcasses) clean-up on my land?
- Are there any restrictions on what I can do to clean up?
- Can I get any financial help to clean up?
- Where there is damage to public infrastructure, who is responsible for repair?
- Where there is damage to private infrastructure, or infrastructure owned by a Government Business, who is responsible for repair?
- Who is responsible for riparian management before and after a flood event?
- There is a Crown reserve between my land and the river. Can I make the Crown clean up debris and manage the banks on that reserve?
- I am a council and there is flood debris all over my foreshore. What are the restrictions on my clearing it up?

Recommendation 11

That DPIPWE clarifies responsibility for river restoration and riparian management and, having done so, communicates this to councils, landowners and other owners of relevant infrastructure.

3.6 Conclusions

During the period 2 to 6 June, it didn't just rain: the rain experienced was extreme in the Tasmanian context and so the fact that this led to flooding was not just unsurprising, it was to be expected. These rainfall totals would be significant in any environment, particularly Tasmania. This situation was exacerbated by soil moisture levels in most catchments across the State being close to saturation.

HT's cloud seeding activities on 5 June had no impact on precipitation, with this conclusion having a solid scientific basis, and conditions on this date were not suitable for rainfall enhancement by cloud seeding. In the event Hydro Tasmania decides to restart its cloud seeding program, improvements are needed to its quality control and assurance processes, there is a need for it to review its cloud seeding decision criteria, and the results of its internal review of its cloud seeding activities should be independently reviewed.

HT's dam network was not designed as a flood mitigation measure, is not suitable in its current configuration for effective flood mitigation, and there would be limited scope to construct new flood mitigation dams due to the significant cost.

Action is needed by DPIPWE to ensure private landowners who construct dams and levees are fully aware of their legal obligations, including the need for hydrological assessments.

The failure of the Kimberley Railway Bridge did not make the flooding along the Mersey River downstream of the bridge significantly worse.

Debris, in the form of fallen livestock, trees, logs, gravel and silt caused significant damage to riverbanks, bridges and farmland during the June floods. What caused trees and logs to be caught up in floodwaters is unclear and requires further review, as does responsibility for clean-up and riparian restoration and management.

3.7 Summary of recommendations in this Section

| Recommendation | | See |
|----------------|---|-------|
| 8. | That in the event that Hydro Tasmania decides to start cloud seeding again, water managers, represented by DPIPWE, work with Hydro Tasmania to ensure appropriate, best practice application of the guidelines issued by the Agricultural and Resource Management Council of Australia and New Zealand. | 3.2.3 |
| 9. | That DPIPWE examines the WMAwater report along with its own, analyses the differences, consults with the Forest Practices Authority and Environment Protection Authority, and proposes an appropriate course of action to Government. | 3.5.2 |

| Recommendation | | See |
|----------------|---|-------|
| 10. | That DPIPWE examines the <i>Forest Practice Code 2015</i> for relevance of its concepts to farming and other business activities near rivers, streams and naturally occurring dams and makes recommendations to Government accordingly. | 3.5.2 |
| 11. | That DPIPWE clarifies responsibility for river restoration and riparian management and, having done so, communicates this to councils, landowners and other owners of relevant infrastructure. | 3.5.5 |

Section 4 Forecasting, alerts and information

The use and efficacy of forecasting, community alerts, warnings and public information by authorities in responding to flood events.

4.1 The use and efficacy of forecasting⁴⁵

The Bureau of Metrology (BoM) is the Australian Government agency that provides Australian communities with weather maps, land and marine weather forecasts, weather warnings including flood warnings, observations and meteorological information.

BoM has a Regional Forecasting Office in Hobart that manages services for Tasmania and Antarctica. It has a *Service Level Specification* (SLS) with the State which details the forecasting and warning products to be provided as well as how BoM interacts to provide services to other partner agencies and the public.

In relation to flood, BoM provides flood watches and warnings directly to stakeholders with emergency management responsibilities. Direct dissemination includes media releases, email, facsimile, SMS, and the internet on websites and social media.

The June 2016 floods are considered an extreme event because rainfall and river level records were broken in a number of locations around Tasmania, and some levels had not been seen since 1929. This exceptional rainfall resulted from a low pressure system that moved toward Tasmania from the North-East and delivered exceptional rainfall to the Western Tiers.

Catchments around the upper Mersey, Leven, and smaller river systems on the North-West Coast were subject to flash flooding caused by the relatively steep terrain and shorter river lengths. These systems rise very quickly, in a matter of hours, as opposed to rivers like the South Esk and Meander which fall at much lower rates per kilometre over longer distances, allowing for river rises to be predicted days in advance. These variations provided challenges for BoM in its role of modelling, predicting and forecasting this weather event.

Any discussion of forecasting, and warnings based on forecasting, needs to take into account the fact that weather forecasting by its nature involves estimates of what will occur. There is no scientific model that can give exact figures for amounts of rainfall, or their precise impacts on catchments. Unless there is specific evidence that forecasters made mistakes in their method or missed some crucial piece of data, it is unrealistic to criticise them for not being 'exactly right'. We uncovered no such evidence.

Emergency planners need to factor in the need for some sort of real-time, on-the-ground monitoring of conditions, particularly in localities with short catchments where flood onsets may be rapid. Evidence of where this seems to have worked was Central Coast Council, which had learnt from the 2011 floods affecting the Forth River. On hearing BoM's warnings about a significant rainfall event in the days leading up to 4 June, it sent Council staff to look at how the Forth River was behaving, and began mitigating activity before the floods eventuated.

4.1.1 BoM warnings issued

BoM was aware of the upper level trough over Queensland in the first week of June that ultimately resulted in floods in Tasmania. The system caused rainfall and damaging winds in NSW on 4 - 5 June and continued south, developing into a significant mainland East Coast Low pressure system. Further details about the weather event and subsequent flooding are outlined in Section 3.

⁴⁵ This information is from the BoM submission to this Review.

BoM forecasters first alerted the Tasmanian SES on Thursday 2 June, having identified the potential for heavy rain in Northern Tasmania to occur on Sunday 5 June. How SES responded is dealt with in 4.2.2.

BoM issued an initial **Flood Watch** at 11.58 am on Friday 3 June for all Northern and Eastern river basins. This was extended to all Tasmanian river basins at 4.15 pm on 5 June. The Mersey catchment was included in this Flood Watch advice. A total of eight Flood Watches were issued between 3 and 7 June.

BoM issued the first **Severe Weather Warning** at 1.53 pm on Saturday 4 June, forecasting heavy rain for the northern half of Tasmania, north of a line from Swansea to Strahan during Sunday.

Between 3 and 7 June, BoM issued a total of 13 Severe Weather Warnings.

During the floods, BoM hydrologists ran computer models of water flows in catchments, and monitored rainfall and river gauge observations to help predict flooding. This modelling and monitoring resulted in warnings provided, as noted from the BoM submission⁴⁶ to this Review, and summarised as follows:

| River | Flood warnings issued |
|----------------------------------|--|
| Forth River Basin | <ul style="list-style-type: none"> Initially issued Minor flood warning – 4.19 pm EST on 4 June Upgraded to Moderate – 5.15 pm EST on 5 June Upgraded to Major – 8.37 am EST on 6 June A total number of 13 flood warnings were issued between 4 and 7 June. |
| Mersey River Basin ⁴⁷ | <ul style="list-style-type: none"> Initially issued Moderate flood warning – 3.17 pm EST on 4 June Upgraded to Major – 4.16 pm EST on 5 June Downgraded to Moderate – 7.07 am EST on 7 June Downgraded to Minor – 8.13 pm EST on 7 June A total number of 23 flood warnings were issued between 4 and 8 June. |
| Meander River Basin | <ul style="list-style-type: none"> Initial Minor flood warning issued – 3.52 pm EST on 4 June Upgraded to Major flood warning – 9.58 pm EST on 5 June Downgraded to Minor flood warning – 3.00 pm EST on 10 June Finalised – 3.41 pm EST on 11 June Total number of flood warnings issued – 41. |
| Macquarie River Basin | <ul style="list-style-type: none"> Initial Minor flood warning issued – 4.19 pm EST on 4 June Upgraded to Moderate flood warning – 8.05 am EST on 6 June Upgraded to Major flood warning – 2.37 pm EST on 6 June |

⁴⁶ BoM issued and provided to the Review Team, available on request.

⁴⁷ This warning was for the basin, not specifically for Latrobe Township, including the Latrobe Bridge, which remained as minor because there was no other level defined. This is explored further in 4.1.8.

| | |
|----------------------------------|---|
| | <ul style="list-style-type: none"> • Downgraded to Moderate flood warning – 8.26 pm EST on 8 June • Downgraded to Minor flood warning – 10.06 am EST on 10 June • Finalised – 10.02 am EST on 12 June • Total number of flood warnings issued – 34 (and one correction). |
| North Esk River Basin | <ul style="list-style-type: none"> • Initial Minor flood warning issued – 3.27 pm EST on 4 June • Upgraded to Moderate flood warning – 12.43 pm EST on 5 June • Upgraded to Major flood warning – 6.25 am EST on 6 June • Downgraded to Moderate flood warning – 3.03 am on EST 7 June • Downgraded to Minor flood warning – 9.00 pm EST on 7 June • Finalised – 9.53 am EST on 11 June • Total number of flood warnings issued – 27 (and one correction). |
| South Esk River Basin | <ul style="list-style-type: none"> • Initial Moderate flood warning issued – 3.49 pm EST on 4 June • Upgraded to Major flood warning – 7.21 am EST on 6 June • Downgraded to Moderate flood warning – 6.02 am EST on 9 June • Downgraded to Minor flood warning – 6.10 pm EST on 9 June • Finalised – 9.38 am EST on 12 June • Total number of flood warnings issued – 40 (and three corrections). |
| Derwent River Basin | <ul style="list-style-type: none"> • Initial Minor flood warning issued – 10.36 pm EST on 5 June • Upgraded to Major flood warning – 12.10 pm EST on 6 June • Downgraded to Moderate flood warning – 6.46 am EST on 7 June • Downgraded to Minor flood warning – 11.29 pm EST on 7 June • Finalised – 9.54 am EST on 9 June • Total number of flood warnings issued – 16. |
| Jordan River Basin ⁴⁸ | <ul style="list-style-type: none"> • Initial Minor flood warning issued – 5.25 am EST on 7 June • Finalised – 9.55 am EST on 10 June • Total number of flood warnings issued – 8 (and one correction). |

BoM also provides an automated rainfall and river level alert service which is articulated in the SLS. Once a river level or rainfall threshold is met, an alert is issued. This service is managed by BoM on behalf of the SES. During the June floods, 132 river alerts and 30 rainfall alerts were issued.

BoM also issued four media alerts and three severe weather updates, and conducted at least 70 media interviews with television, radio and print media.

⁴⁸ Huon Valley and Coal River catchment are not included as there was no warning required for this event.

The SLS guides BoM with message construction, configuration and dissemination in line with nationally accepted standards.

Throughout the period 2 June to 8 June, BoM maintained telephone contact with the SES to provide advice and knowledge on the modelling, predictions and forecast weather.

4.1.2 Arrangements between BoM and SES

We noted the comments in the SES submission that indicated the close relationship between BoM and SES, and the interaction whereby BoM's forecasters discuss directly with SES Managers the modelling, forecasts and predictions. As discussed in Section 1.1.5, it is the role of the SES to interpret the consequences of BoM warnings and provide community safety advice.

However, as we currently understand it, SES usually takes no action when BoM issues flood watch advices. The purpose of a flood watch is to heighten awareness and we consider that SES should use them as an opportunity both to confirm internal readiness should the situation escalate and to provide preliminary messaging to communities recommending vigilance particularly in flood-prone areas.

4.1.3 Actual rainfall (compared to forecast)

Predicted rainfall in the North-West was higher than expected/forecast, resulting in a number of significant floods causing unexpected inundation in the early hours of Monday morning, particular in the Mersey River near Latrobe⁴⁹.

This heavy rainfall also affected the North and South Esk rivers and therefore Longford and Launceston. However, the communities of Longford and Launceston had significantly more time than the Latrobe communities to prepare.

4.1.4 Public submissions regarding BoM warnings

Timeliness of warnings

While we noted a number of submissions were critical of the timeliness of BoM warnings, we assessed this and our analysis showed that heavy rain was predicted by BoM for the northern half of Tasmania as early as 4 June 2017. We also noted:

- In fact there was an early 'heads-up' and all parties (councils, SES and the community) might have responded sooner. We noted in 4.1.1 that BoM forecasters first alerted the SES on Thursday 2 June having identified the potential for heavy rain in Northern Tasmania on Sunday 5 June and:
 - BoM issued an initial **Flood Watch** at 11.58 am on Friday 3 June for all Northern and Eastern river basins. This was extended to all Tasmanian river basins at 4.15 pm on 5 June. The Mersey catchment was included in this Flood Watch advice;
 - BoM issued the first **Severe Weather Warning** at 1.53 pm on Saturday 4 June forecasting heavy rain for the northern half of Tasmania, north of a line from Swansea to Strahan during Sunday; and
 - BoM issued a total of 13 severe weather warnings between 3 and 7 June.

⁴⁹ The glossary to this report defines 'flash floods'. We did not seek to establish whether or not flooding in the Mersey catchment satisfied this definition. Whether the flooding that occurred were flash floods or not is not relevant – the damage caused was severe.

- Evident therefore is that the timeline of warnings shows them escalating over the period from Thursday 2 June to Sunday 5 June.
- Crucially, it is not BoM's job to ensure communities are warned of impacts. BoM post their warnings where they post them, and it is someone else's job to analyse these and push impact warnings out to communities.
- So, while there may always be a case for communities to feel that they should have been provided with warnings sooner, our view is that BoM's warnings were reasonable, and that, therefore, there is scope for:
 - communities to be more self-aware; and
 - us to explore councils' and SES' roles in warning communities and assessing whether that was done successfully. We examine this in 4.2 below.

In any event, this highlighted that better community awareness of how to interpret flood watch and flood warnings would improve their understanding of, and preparation for, possible flood extent.

Recommendation 7 in Section 2 addresses improved community awareness through SES education and community workshops. This forum could also assist with improving interpretation and understanding of warnings.

Recommendation 12

That heightened awareness and action is needed by communities when BoM issues flood watches and related warnings. Councils and SES need to facilitate this.

Communication of warnings

In submissions to this Review, some farmers indicated that during the flood event they experienced difficulty receiving information while in their paddocks due to mobile phone reception difficulties and because access to mobile devices in adverse weather can be problematic.

We also noted an expectation that SES or councils would doorknock properties susceptible to poor electronic communications. While we recognise that door-knocking is a highly effective way of communicating a warning to residents, it is also very labour intensive and is not a realistic strategy in thinly populated rural areas. For that reason, we do not think that people should rely on door-knocking as their only way of obtaining information or warnings about floods.

Recognising this difficulty, despite it being unrealistic to expect emergency management agencies to provide a door-to-door service advising whole communities of a developing emergency event, this was a strategy that was employed to warn many people at highest risk of inundation and danger from floodwater. This occurred primarily in the Launceston, Longford, Central Coast and Huonville areas.

This strategy was adopted in the Latrobe municipality but was less successful because of the rapid rise in the level of the Mersey River, flooding of roads and bridges, and great number of properties inundated.

Despite the above, members of the Latrobe community argued that information available regarding flood levels in the Mersey River and associated catchments was not timely nor accurate (see above and 4.3).

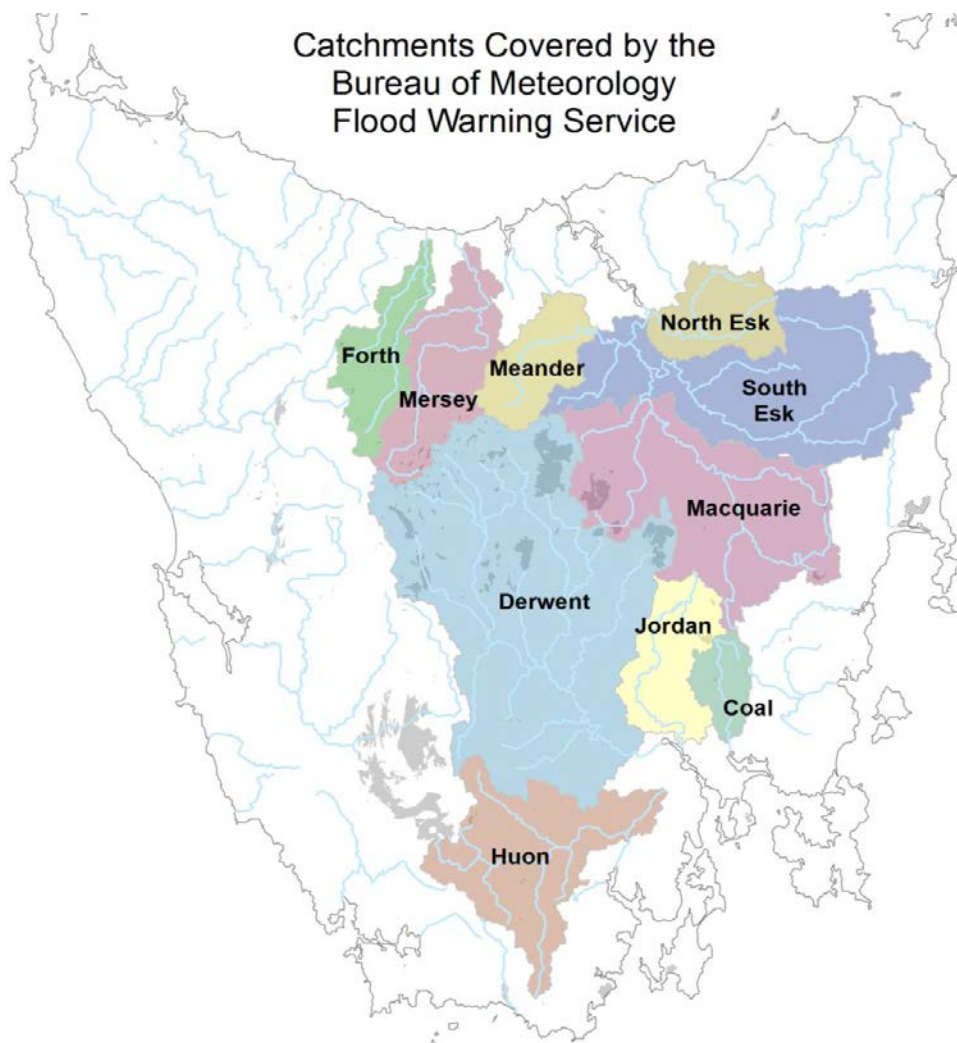
4.1.5 Flood catchments

BoM provides flood warnings by catchment, which includes predicted flood classifications and river heights for specific rivers in each catchment. The catchments covered by BoM's Flood Warning Service is documented in the SLS. This document is available on BoM's website⁵⁰.

Flood watches may cover areas outside of these catchments.

The 10 catchments identified in the SLS covered by BoM's flood warning service are depicted in Figure 5.

Figure 5: Water catchments covered by BoM's flood warning service



⁵⁰ <http://www.bom.gov.au/tas/flood/SLS-2014-15-TAS-signed.pdf>

The Ouse River

The Derwent River covers a number of municipal areas including Central Highlands, Derwent Valley, Clarence and Hobart. The SES Southern Region manages flood responses for these municipalities.

The Ouse River forms part of the Derwent Catchment and has its origins in the Central Plateau through Lake Augusta, below which it is joined by the Pine River near Miena and the Shannon River near Osterley. Water from these sources can result in floods at Ouse that are different than the wider Derwent River Basin, which are fed from further west at Lake St Clair.

In the case of the Ouse River, a minor flood warning was included in the Initial Minor Flood Warning⁵¹ issued by BoM for the Derwent River Basin at 10.36 pm on Sunday 5 June. This warning also specified sections of the Ouse River, including near the Ouse township, that were expected to exceed minor levels overnight on Sunday and Monday morning. The Ouse River flooded, causing the closure of the Lyell Highway at around 10 am on Monday, and a farmer was swept away while checking sheep at 8 am. At 12.10 pm on Monday 6 June, BoM issued a Major Flood Warning for the River Derwent, which included specific detail of a major flood developing along the Ouse River during Monday.

Therefore, the residents of Ouse were provided with reasonable notice of flooding above minor levels as early as Sunday morning, although these floods were similar to flash floods and occurred overnight, making it difficult to prepare. However, the flood warning for Ouse may have been clearer to the public had BoM described the Ouse River as its own catchment.

We also noted a recommendation in the SES After Action Review that flood mapping of the Ouse River be undertaken. This recommendation is supported and the FWCC should, in the interests of the Central Highlands community, consider the merits of delineating the Ouse River as a separate catchment from the Derwent River Basin.

Recommendation 13

That the Flood Warning Consultative Committee considers the merits of delineating the Ouse River as a separate catchment from the Derwent River Basin.

4.1.6 Rainfall and river gauges

An effective flood intelligence system is integral to BoM providing accurate and timely warnings to emergency management agencies and communities. A foundation for such intelligence is reliable and suitably located rainfall and river gauges.

In accordance with the SLS, BoM has listed all river and rainfall gauges from which it collects data to support flood modelling and predictions across 10 major river catchments. These gauges are owned by a combination of BoM, DPIPWE, councils and HT. They are predominantly automated, although there are a number of manually read gauges.

As may be expected, many HT gauges were designed for the purpose of supporting its power generation operations and not flood intelligence. Despite this, HT proactively provides data from its gauges to BoM to help inform flood predictions and warnings. However, HT gauges measure

⁵¹ BoM Initial Minor Flood Warning for Derwent River Basin, 5 June 2016

river heights from the river floor rather than the Australian Height Datum⁵², which adds an element of complexity to BoM's predictive modelling.

We noted some catchments affected by the June 2016 floods did not have gauges, such as the Leven, Emu and Inglis rivers on the North-West Coast.

We concluded that:

- Additional gauges would improve flood intelligence in Tasmania, which should be considered in conjunction with BoM and would be best coordinated through the FWCC.
- Where additional gauges are sought, clear responsibilities for funding, ownership and maintenance should be developed and agreed.

To test our thinking on the suitability and number of rainfall and river gauges, we requested our hydrological consultant to examine the number, accuracy, location and usefulness in providing any gaps in warnings. Their report included observations that:

- The quality of the hydrometric sites is considered fit for purpose.
- In some cases a location, or other site constraints, may mean that the site is not optimal for collecting data during a flood.
- Under current arrangements, data can be 1 - 2 hours old by the time it reaches BoM.
- BoM obtaining access to TasWater and Tasmanian Irrigation rainfall, river flow and water storages data in a timely manner may improve flood warnings and forecasts.
- Reliance on the mobile network for communication for gauging sites could be an issue during a flood event, as the network may be overloaded or unavailable.
- For the smaller basins on the North-West, North and East Coasts, there is very poor availability of, and access to, data which can hinder flood forecasting.

Recommendation 14

Subject to funding, that the Flood Warning Consultative Committee investigates the hydrological matters and advice received during this Review and detailed in this Report in Sections 4.1.9 and 4.1.11.

A central flood policy unit (see Recommendation 6) would be well placed to coordinate policy and management of matters raised here.

In making Recommendation 14, we acknowledge that FWCC is a committee without funding or other resources to project manage the recommendation made. However, it has sufficient influence to initiate solutions to river and rainfall gauge difficulties identified by this Review.

⁵² The Australian Height Datum is a common national survey height datum as a reference level for defining reduced levels; 0.0m AHD corresponds approximately to sea level.

4.1.7 Damage to flood and river gauges

During the floods, 16 river gauges were damaged by floodwater and debris which reduced BoM's capacity to maintain optimal modelling monitoring, predictions and warnings. The damage affected BoM, HT and DPIPWE gauges, some for short periods while others were completely destroyed. Most gauges have now been restored and the flood warning system is operational.

It was noted in the BoM submission that, given the extreme flooding in a number of rivers, the shape, course and flow rates will have changed as a result of the floods. This impact will reduce the quality of data due to changes in river height and flow rates, which will require hydrologists to recalibrate gauges and the hydrologic models.

4.1.8 Flood gauges and classifications

The SLS specifies three levels of flood classification (minor, moderate and major) and it articulates the trigger levels for flood classification for most gauges on each river.

- **Minor flooding** – Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.
- **Moderate flooding** – In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.
- **Major flooding** – In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

The FWCC, which is chaired by BoM, comprises a range of emergency management partners including SES, councils, HT and DPIPWE. It is an advisory body to BoM and provides a consultative mechanism for the Flood Warning System. As part of this process, the FWCC reviews and sets the trigger levels for respective flood classifications.

It is important to note that BoM predicts river heights. However, it can only describe consequential predicted flooding as 'minor, moderate or major' if it has been advised what those trigger points are. In some locations, the riverine landscape may be such that a flood will only ever have, or be predicted to have, minor impacts.

We noted that a number of gauges listed in the SLS had only minor flood classification levels set at the time of the June floods. This included the Mersey River at the Latrobe Bridge⁵³, which meant that BoM was only able to provide advice that identified the flood as 'expected to reach minor flood level' on Sunday 5 June even though the flood classification upstream at Liena to Kimberley was at major.

BoM and SES have since taken steps to define moderate and major classifications at the Latrobe Bridge. However, there would be merit in the FWCC reviewing classifications at all gauges across the flood warning system and ensuring that they are relevant.

⁵³ This circumstance was acknowledged by the Latrobe Council in its submission to the Review.

Recommendation 15

That the Flood Warning Consultative Committee reviews flood classification levels in the Service Level Specifications with BoM specifically relating to flood level triggers on gauges.

4.1.9 Hydrological advice on gauges

The scope of work for the consultancy firm we engaged, WMAwater, included review of river and rainfall gauges assessing, in particular, their number, accuracy and location. Their conclusions included:

- The main hydrometric data-collection agencies in Tasmania are BoM, HT and DPIPWE. Data-sharing agreements are in place between them for the purposes of flood forecasting and warning services.
- The quality of the current hydrometric sites is considered fit for purpose, noting that the purpose of HT and DPIPWE sites is not for providing flood information.
- The types of measuring instruments used at all sites is suitable for use in the flood warning network.
- In some cases, the location of HT or DPIPWE sites, or other site constraints may mean that the site is not optimal for collecting data during a flood event.
- To be optimal for flood forecasting and warning, HT and DPIPWE sites could be upgraded where necessary, as long as this does not compromise their use for their primary purpose.
- Upgrades or changes that may be required include those associated with increases in polling rates and taking additional flood gauges to better define the high flow end of river level to flow rating curves. Each site would need investigation and a funding source would need to be identified for this work.
- Where sites run by agencies other than BoM are identified as critical to the flood warning network, it may be appropriate to consider provision of funding to ensure that they are maintained in a timely manner for flood forecasting and warning purposes.
- More rapid access to data provided to BoM by other agencies might improve forecasting ability.
- Timeliness of data transfer currently conforms with agreed Operating Guidelines in data-sharing agreements, which means that data can be one to two hours old by the time it reaches BoM.
- BoM obtaining access to TasWater and Tasmanian Irrigation rainfall, river flow and water storages data in a timely manner might improve the provision of existing flood warnings and forecasts and possibly enable BoM to provide flood warnings and forecasts to additional basins with significant flood risks.
- The reliance on the mobile network for communications with gauging sites could be an issue in a flood event, as the network may be overloaded or unavailable.
- For the smaller basins in the North-West, North and East coasts, there is very poor availability of, and access to, data, which can hinder the provision of flood forecasts and warnings.

- ALERT (telemetered gauges) flood-warning systems could be developed in a number of locations, which could be further assessed for suitability and determination of appropriate funding arrangements.
- A formal audit of the Tasmanian flood warning network, such as that undertaken in Victoria, would provide detailed information on any improvements that could be made to the network, and the costs and benefits.
- A secure website containing all available data, for access by those responding to floods, should be considered by the State.

Recommendation 16

That BoM and the Flood Warning Consultative Committee, in consultation with gauge owners, review flood gauges and develop a program to update data used to support hydrologic modelling. This should include reviewing gauge maintenance before and after floods.

4.1.10 Weather radar

Rainfall is detected by weather radars that assist forecasters track and estimate quantity of rainfall over an area. Understanding rainfall intensity is important to forecasting flood levels, as it gives forecasters some idea of how much rain will fall in river catchments and so how much water will need to make its way down a river. In Tasmania there are two weather radars, one at Takone in the North-West and the other at Hobart Airport.

The accuracy of radar detection diminishes over distance. Visibility of approaching rainfall from the June 2016 low pressure system from the north-east was limited on existing radars, but would have been more easily detected if a third radar was positioned in North-East Tasmania. However, we note that weather systems are also tracked by BoM using satellite technology.

In discussions with meteorologists it was apparent that, while they would have found an additional radar useful, it is uncertain what difference it would have made to forecasting this event. We were advised that the estimated cost of an additional radar is \$10 - \$15 million and would require careful cost-benefit analysis before proceeding with a weather radar on the North-East.

4.1.11 Hydrological advice on radar

The scope of work for WMAwater included review of weather radars and/or other contemporary technology assessing whether these technologies would improve flood warning. They concluded:

- North-East Tasmania has limited radar coverage.
- There are currently no plans or funding in place to cover either the capital or operating costs for an expansion of the weather radar network.
- With the current technology and processes in BoM, a radar in the North-East might have assisted in defining the spatial distribution of rainfall in its area of coverage during the June 2016 flood event. The most direct benefit would have been over short lead times.

- Radar data will become progressively more useful for forecasting, as scientific and technological advancements allow for further integration of radar information into forecasting processes.
- Direct assimilation of radar data into the next version of high-resolution weather models is planned by BoM for 2018. Areas with radar coverage will benefit from these improvements, which will aid in forecasting.
- The cost of a new weather radar is typically \$9 - \$10⁵⁴ million to install and operate over a 15-year lifetime.

We concluded from sections 4.1.10 and 4.1.11 that an additional radar in the North-East of Tasmania might assist the accuracy and timeliness of warnings, but that it is a significant investment requiring consideration by both the Tasmanian and Australian Governments.

4.2 Warnings given by authorities

4.2.1 Role of Police

Tasmania Police play an active role in advising the public on a range of community safety issues through the DPFEM website and media outlets. During floods, operational police take a lead role in response to public safety concerns, traffic management and search and rescue.

During a significant emergency, such as the 2016 floods, the District Police Commander undertakes the role of Regional Controller under the *Emergency Management Act 2006*. This person's functions include instituting and coordinating emergency management, and supporting those functions in their region as chair of the Regional Emergency Management Committee.

Tasmania Police supports the SES as the Management Authority for flood and, as such, SES has at its disposal resources in the Police Radio Dispatch Services and Media and Communications unit to assist with alerts, warnings and public messaging.

Actions taken by Tasmania Police before and during the floods

On 3 June, Tasmania Police held a media conference warning the public about the dangers of driving through floodwaters.

Between 6 and 9 June, Police Media and Communications Services embedded staff in the SES State Operations Centre to assist with composing messages. They issued 26 media releases, updates and talking points for about 80 media interviews.

Police Media and Communications shared alerts, warnings and messages on social media using Facebook, Twitter and Sound Cloud. An example, provided in the DPFEM submission regarding the reach that these actions achieved, was that one post alone – about evacuations in Invermay – reached 171,000 people.

The Police website also provided a platform for warnings and advice.⁵⁵ The website provides links to warnings and information on other websites such as BoM, SES and TFS.

⁵⁴ These amounts differ from those in Section 4.1.10. The amounts referred to in the latter Section were based on general discussion with them being validated as did the work completed by the hydrologist.

⁵⁵ <http://www.police.tas.gov.au/community-alerts>

4.2.2 Role of SES

The SES manages flood response as the Management Authority under the provisions of the TEMP and the *State Special Emergency Plan – Flood*⁵⁶. It provides:

- flood safety advice on actions and consequences that are designed to provide community safety messages to complement BoM warnings;
- a range of information on its website⁵⁷ about the *Tasmanian Emergency Management Plan*, safety in relation to floods, storm, bushfire etc and a link to the national *FloodSafe* program. These web pages aim to raise awareness and provide useful flood information for communities.

Actions taken by SES before and during the floods

During the floods, SES issued media releases on Friday 3 June, Sunday 5 June and Monday 6 June. These warnings included advice about expected heavy rain, strong winds and damaging surf. The rainfall advice was for possible falls in excess of 100 mm in the North-East and Western Tiers. Specifically, the warning on 3 June was that a weather system over Eastern Australia was expected to bring rainfall of up to 100 mm during Sunday in the North and East. Higher totals were possible about elevated areas in the North-East Highlands and Western Tiers.

The SES media releases were issued after the BoM warnings and were widely reported by the emergency broadcaster, ABC, on radio, TV and in print media. In addition, the ABC announced a number of safety messages between 3 and 8 June.

ABC news reports, which were based on advice from BoM and SES beginning on 3 June⁵⁸, indicated that heavy rainfall and severe weather were expected across the State. Specifically, heavy rain and strong winds in Northern and Eastern Tasmania were expected on Sunday and Monday.

We noted from the SES submission that during the floods the telephone-based warning system, Emergency Alert (EA), managed by the TFS, was used for a number of areas around Tasmania, with polygons (mapped areas where phone subscribers receive an automated message) being identified and recorded. EAs are only used when there is an expectation of significant community impact.

Police used EA to advise people in Latrobe and Railton of a flood preparation warning at 8.19 am on 6 June. A second EA message was sent from the SES to Invermay for an evacuation warning on 7 June 2016. However, the EA message to Latrobe came some eight hours after houses were inundated. The lateness of this message was a concern raised in a number of submissions from farmers in the Mersey Valley, and from the Latrobe Council. Members of the Latrobe community also raised this concern at a forum we ran in February 2017.

The earlier use of an EA on this occasion is considered in Section 1.3.2.

⁵⁶ At the time of the June floods, this plan reflected existing arrangements but had not been approved.

⁵⁷ <http://www.ses.tas.gov.au/h/em/awareness>

⁵⁸ SES media release provided to media outlets on 3 June 2016.

Use of social media by the SES

In addition to the modes of communication used, and the extent to which these were utilised, by SES and Police, we noted:

- SES used TasAlert and social media to communicate a range of warnings, safety advice and evacuation advice messages. See 4.2.3 below.
- During the period 1 - 9 June, the SES website received over 4.6 million hits, with a monthly total over 5.6 million hits, which represented a 300% increase on the previous highest month.
- During the floods, the SES also reported gaining 4,133 new followers on Facebook with post engagements for the period 1 - 9 June of 281,365.

These figures indicate the effectiveness of SES social media reach in facilitating awareness during the floods. However, this does not necessarily translate into actual awareness and action.

4.2.3 Whole-of-government Public Information Unit and TasALERT

On 6 June 2016, the whole-of-government Public Information Unit (PIU) was activated after a request by SES in response to the floods. DPAC is responsible for managing the PIU and supporting the coordination of whole-of-government public information. The PIU was staffed by personnel from DPAC, DPIPWE, DHHS and DoJ.

The scale of the floods presented a challenging communications environment. The PIU worked very closely with the SES and other key stakeholders to communicate whole-of-government information to the public. The PIU used the TasALERT channels, which include a public website and social media accounts.

TasALERT was the primary channel for communicating information and alerts to the public, bringing together information from emergency services and Government agencies in one space. The TasALERT website and social media accounts were very active.

Warnings concerning severe weather and flooding events were being issued via TasALERT social media from Saturday 4 June. Examples include:

- Facebook – 89 posts from 4 - 16 June with an average reach of 33,464 (the highest reach was on 4 June with 99,213); and
- Twitter – 76 Tweets from 4 - 16 June with an average reach of 7,700 (the highest reach was on 7 June with 37,537).

The PIU circulated a daily document with updated and verified key public information topics to a wide range of stakeholders. Information included school closures, impacts on tourism operators, evacuation centres, help for animals, advice on volunteering and donating, disaster assistance and public health messages in relation to flood waters. This information was released daily at 10.30 am.

After the flood event, the PIU identified that there wasn't a high level of awareness of the TasALERT channels in the North-West Region. An action plan has been developed to address this.

4.2.4 The community's understanding of warnings

There are many forms of alerts, warnings and messages available for the public. The increasing use of social media is well known and, while reach continues to grow, it is but one of a number of forms of communication.

Given the variation in areas affected by the floods, there is no 'one size fits all' approach to communications.

The June floods were felt far and wide, from high-altitude fast catchments causing rapid onset flooding to the longer meandering rivers through farmland, flooding suburbia.

Emergency services and BoM aim to promulgate forecasts and warning messages far and wide, but to achieve 100% coverage of all communities is difficult.

Communities, families and individuals need to share in the responsibility to identify a reliable communications plan with contingency for communications failure. For those in areas without mobile phone or internet reception, reliance on landline telephones alone is problematic. Farmers, outdoor workers and wilderness recreational users also need to consider alternative communications to those methods more applicable in towns and cities.

Satellite phones, mobile phones, internet connectivity, TV, radio, UHF/VHF radio all provide methods for receiving information. It is well known how emergency services and BoM deliver messages, and it is up to all of us to ensure we have a reliable way of monitoring and receiving those messages.

It is incumbent on emergency services agencies to be as timely as possible with good predictions and forecasting to assist with timely warnings and alerts to be sent and received. It is equally important that we all as individuals, families and communities have a safe, workable and reliable communication plan that is robust enough to work in the environment in which each of us lives.

Therefore, whether or not emergency management authorities did or did not do enough on this occasion, warnings – bearing in mind the inherent limitations in any warning systems – will only ever be effective if there is a context of community planning and engagement, responsibility for which sits with government to a greater or lesser degree. This is discussed in Section 1, from which we concluded that Government could do more to engage with communities, using an all-hazards approach, resulting in Recommendation 6 and Recommendation 7.

The development of a State Flood Warning System by the SES, that was to be launched in mid-2017, is expected to include improvements in communication of advice/warnings and community understanding. We understand this will be achieved through use of standardised visual symbols and descriptions of emergency levels designed to prompt a response action by communities.

This State-based system has also been developed with consideration to the work being undertaken by the Flood Warning sub-committee under the AFAC National Warnings Group, who are working towards a nationally consistent messaging framework for flood warnings.

Recommendation 17

That Government supports the anticipated SES State Flood Warning proposals aimed at improving public warnings and communication, and that the proposed warning system is consistent with the National Frameworks.

4.3 Mersey River flooding

This catchment was subjected to rapid onset flooding that resulted in significant damage for landowners. A criticism from landowners and the Latrobe Council was that warnings issued were only specified as minor in relation to the area covered by Kimberley to Latrobe Township including Latrobe Bridge.

In view of the significant damage caused by the Mersey River and the number of submissions received, we decided to explore this further and in doing so we examined all available information regarding warnings issued, which is discussed as follows.

4.3.1 Warnings issued

Flood watch

An initial **Flood Watch** was issued at 11.58 am on Friday 3 June for all Northern and Eastern river basins. This was extended to all Tasmanian river basins at 4.15 pm on 5 June. The Mersey catchment was included in this advice.

Severe weather warning

The first **Severe Weather Warning** was issued by BoM at 1.53 pm on Saturday 4 June, forecasting heavy rain for the northern half of Tasmania, north of a line from Swansea to Strahan during Sunday. This included the Mersey catchment.

Flood warnings

Flood Warnings were also issued for each catchment, specifying the flood classification of minor, moderate or major flood levels for key river height stations. The Mersey River has specific warnings for the Mersey River above Liena, Mersey River at Liena, Mersey River from Liena to Kimberley, Mersey River at Kimberley, Mersey River from Kimberley to Latrobe Township and the Mersey River at Latrobe Bridge. An initial Moderate Flood Warning was issued at 3.17 pm on Saturday 4 June for the Liena to Kimberley section, which was upgraded to a Major Flood Warning at 4.16 pm on Sunday 5 June. However, the warning at the Latrobe Bridge was only ever at the Minor level – see 4.3.2 below.

4.3.2 River gauges

As outlined in 4.1.6, a number of gauges listed in the SLS had only minor flood classification levels set at the time of the June floods. This included the Mersey River at Liena and at the Latrobe Bridge, whereas the Mersey River at Kimberley is classified for minor, moderate and major levels.

This meant that, as it related to the Mersey River at Liena and at Latrobe Bridge, BoM could only issue flood warnings up to a minor level, which it did. As it related to the Mersey River at Kimberley, BoM issued moderate and major flood warnings. This issue was addressed in the 2011 flood study (see Section 0), which predicted impacts for the Latrobe township based on flood levels at the Kimberley Bridge.

4.3.3 Role played by the SES relating to the Mersey River

Late in the afternoon of Sunday 5 June, the SES North-West Regional Manager attended the Northern ROC, which had been established on Saturday to deal with both Northern and North-Western requests for assistance (RFAs).

SES began receiving RFAs at 4.30 pm on Sunday 5 June across the North-West Coast relating to storm and flood damage, and responded to 85 RFAs.

The SES North-West Duty Officer attended Latrobe at about 5 pm on Sunday from where the coordination of SES volunteers took place. During the evening and overnight, SES responded to RFAs; door-knocked at-risk residents around Latrobe; assisted police with evacuations, rescue of people at-risk and road closures; and monitored the Mersey River levels.

The SES North-West Regional Manager contacted the Latrobe Council Emergency Management Coordinator on the evening of 5 June to provide advice about the flooding and to coordinate the Council's response, which included monitoring rivers and gauges, managing road closures and monitoring damage to infrastructure.

The SES received a further 100 RFAs on Monday 6 June, which mainly related to flood inundation and sandbagging requests. At 10.00 am on this day, the SES Regional Manager set up a ROC at Burnie and provided advice to the Regional Controller who had set up the Regional Emergency Management Committee (REMC) in Burnie to coordinate the multiagency emergency response.

Despite these actions, because the deteriorating conditions along the Mersey became known on Sunday afternoon, and in view of the Flood Watch advice provided by BoM as early as 3 June, the Severe Weather Warning provided on 4 June and, in light of major flood warnings elsewhere in the Mersey basin on the afternoon of 5 June, we formed the view that more could have been done to monitor the river in real time and to get messaging out to affected residents.

It also seems to have been overlooked that the 2011 Mersey River Flood Study predicted direct impacts on the Latrobe Township in the event of major flood warnings at the Kimberley Bridge, noting that the flood was expected to take some hours to travel down the river from there. If that had been more clearly understood, it seems that more might have been done following the major flood warning for Kimberley Bridge on the afternoon of 5 June. This was also explored in Section 1.3.2.

So, in line with our conclusion in Section 4.1.4, that is “while there may always be a case for communities to feel that they should have been provided with warnings sooner, our view is that BoM's warnings were reasonable, and that, therefore, there is scope for communities to be more self-aware”, on this occasion, SES and the Latrobe Council could have acted sooner.

Recommendation 18

That emergency management authorities react with heightened awareness and action when BoM issues flood watches and related warnings.

4.4 Conclusions

BoM's forecasting and warning products were within the bounds of what could be reasonably expected. There may be additional work to do to engage with the community to explain that a forecast can never be relied on as a 100% accurate prediction.

It is not BoM's role to warn communities of impacts: it only identifies forecast river levels and whether predetermined minor, moderate or major triggers have been reached.

It is the responsibility of local authorities to plan for flood impacts in their areas, including defining triggers for action. It is the responsibility of SES to disseminate community warnings about impacts.

There is a need for heightened awareness by communities and emergency management authorities on actions needed when flood watch and other warnings are issued by the BoM.

The need for flood mapping of the Ouse River is supported, as is the need for this river to be delineated as a catchment in its own right.

An effective flood intelligence system is integral to BoM providing accurate and timely warnings to emergency management agencies and communities. A foundation for such intelligence is reliable and suitably located rainfall and river gauges. Additional gauges would improve flood intelligence in Tasmania, which should be considered in conjunction with BoM and would be best coordinated through the FWCC. Where additional gauges are sought, clear responsibilities for funding, ownership and maintenance should be developed and agreed.

In line with developments interstate, much work has been done locally to develop a revised State Flood Warning System aimed at improving public warnings. This work is supported, needs to be concluded and actioned.

BoM was only able to provide advice that identified the flood at the Latrobe Bridge as "expected to reach minor flood level" on Sunday 5 June even though the flood classification upstream at Liena to Kimberley was at major. BoM and SES have since taken steps to define moderate and major classifications at the Latrobe Bridge.

There would be merit in reviewing classifications of all gauges across the flood warning system to ensure they are relevant and development of a program to update data used to support hydrological modelling including gauge maintenance both before and after flood events.

4.5 Summary of recommendations in this Section

| Recommendation | | See |
|----------------|---|-------|
| 12. | That heightened awareness and action is needed by communities when BoM issues flood watches and related warnings. Councils and SES need to facilitate this. | 4.1.4 |
| 13. | That the Flood Warning Consultative Committee considers the merits of delineating the Ouse River as a separate catchment from the Derwent River Basin. | 4.1.5 |

| | Recommendation | See |
|-----|---|-------|
| 14. | Subject to funding, that the Flood Warning Consultative Committee investigates the hydrological matters and advice received during this Review and detailed in this Report in Sections 4.1.9 and 4.1.11. | 4.1.6 |
| 15. | That the Flood Warning Consultative Committee reviews flood classification levels in the Service Level Specifications with BoM specifically relating to flood level triggers on gauges. | 4.1.8 |
| 16. | That BoM and the Flood Warning Consultative Committee, in consultation with gauge owners, review flood gauges and develop a program to update data used to support hydrologic modelling. This should include reviewing gauge maintenance before and after floods. | 4.1.9 |
| 17. | That Government supports the anticipated SES State Flood Warning proposals aimed at improving public warnings and communication, and that the proposed warning system is consistent with the National Frameworks. | 4.2.4 |
| 18. | That emergency management authorities react with heightened awareness and action when BoM issues flood watches and related warnings. | 4.3.3 |

Section 5 From response to recovery

The effectiveness of transition from response to recovery in the week following the June floods; including capacity and priorities for infrastructure repair, and immediate assistance payments.

5.1 Recovery governance

Effective recovery involves whole-of-government, along with its recovery partners, in planned and coordinated activities for social, economic, infrastructure and environmental recovery, applying the national principles for disaster recovery.⁵⁹

The Tasmania Recovery State Special Plan details information about recovery services that are provided through partnerships between local, State and Australian Governments and non-government organisations (NGOs), and generally include the following activities:

- management of recovery at the municipal level with the affected community/ies;
- ongoing assessments of consequences affecting the community; and
- maintenance of transparent and flexible relief assistance packages.

Under the EM Act, Regional Emergency Management Committees (REMC) are established to deal with an emergency, the functions of which include instituting and coordinating emergency management in the relevant region in line with respective regional emergency management plans. Councils are responsible for maintaining recovery arrangements in their municipality.

The REMC has a significant role in emergencies, including collaboration with councils to manage the four elements of recovery. The REMC may form a Regional Recovery Committee to coordinate recovery elements that may be required.

The municipal Social Recovery Coordinator, generally, chairs the Regional Recovery Committee because its key priority is to provide community social recovery support.

Councils undertake the primary role in providing recovery services in the immediate aftermath of an emergency and can be supported by a number of State Government agencies and NGOs, depending on their capacity and the presence of support services in the area. Council assistance is usually provided in any of three main ways:

- providing required assistance;
- coordinating and prioritising provision of assistance required from external parties; and
- requesting that the relevant Regional Recovery Coordinator coordinates provision of the required services/support.

From the above, we conclude that Government had given significant thought to the way in which recovery should operate following a major event. Tasmania experienced major bushfires in 2013 and lessons identified from the recovery processes after that appear to have been applied to support effective recovery arrangements after this event.

5.2 Recovery action taken by Regional Emergency Management Committees

5.2.1 Initial recovery action

During the June floods, both North and North-West REMCs and Regional Emergency Coordination Centres (RECCs) were activated on Monday 6 June under the control of the respective Regional Controller. In the South, requirement for recovery actions was less demanding and these were managed by the Regional Controller.

⁵⁹ TEMP Issue 8

Recovery activities began during the response phase of the June floods, both at the governance level and practical application by a number of government agencies. This fact is evidenced by:

- activation of the REMCs and RECCs on 6 June;
- councils opening seven evacuation centres, two in the North-West, four in the North and one in the South; and
- as the need for these evacuation centres reduced over the coming days, recovery centres were established at the Latrobe Memorial Hall and Service Tasmania in Launceston to assist in the recovery process.

Rapid impact assessment teams started assessing flood damage as soon as floodwaters receded to safe levels from 6 June. There were over 130 residential properties affected by the floods: 72 in the North-West, 52 in the North and six in the South.

5.2.2 Subsequent action

As the magnitude of the flood events became more evident, the need for statewide coordination of recovery became apparent. As a result, the State Emergency Management Committee (SEMC) appointed a State Flood Recovery Coordinator on 8 June to lead a Tasmanian Flood Recovery Taskforce (the Taskforce).

We heard some negative comment to the effect that it had taken too long to appoint a State Flood Recovery Coordinator. In fact, we understand that the only delay was in announcing the appointment, which had to wait for Cabinet approval. This was not in place until 13 June. This may explain the perception that some people had of delay; we suggest later in this Section a way in which this may be mitigated in the future.

The State Flood Recovery Coordinator formed a State Recovery Committee, with government representatives responsible for recovery activities. This Committee was jointly chaired by a DPAC Deputy Secretary and a senior Police Commander.

Regional Recovery Committees in both North-Western and Northern Regions continued recovery activities in line with the strategic direction of respective Regional Controllers, which transitioned to the Taskforce.

After this transition, Affected Area Recovery Committees were established to coordinate recovery. They included local council representatives with the chair of each being a nominated local mayor.

The North-West and Northern Affected Area Recovery Committees were formally established on 16 and 17 June respectively, and were also known as Regional Flood Recovery Committees.

The Taskforce coordinated statewide recovery activities from June 2016 until early 2017. As it transitioned out of the recovery process, government agencies and councils continued the role of long-term recovery, including community support and environmental rehabilitation.

We found that the governance arrangements for recovery were activated in a reasonably timely way in tandem with response. That said, the current TEMP does not provide for a single management authority for recovery. DPAC was responsible for providing overall management

and leadership while DPFEM was responsible for all approvals for expenditure, state service staffing was coordinated through OSEM and external staff procurement was run through DHHS.

We understand that these arrangements in some cases caused a lack of clarity around approvals processes. We think that this could be streamlined by the establishment of DPAC as standing Recovery Management Authority for emergencies in Tasmania to provide a single point of contact for issues such as:

- staffing and accommodation of recovery taskforces;
- activation of recovery staff and activities in tandem with response;
- retention of oversight of recovery activities following transition out of recovery by a Taskforce or Regional Flood Recovery Committee;
- maintenance of a state of readiness of recovery trained staff; and
- maintenance and review of the State Special Emergency Management Plan: Recovery.

Recommendation 19

That DPAC becomes the Management Authority for recovery in Tasmania.

5.3 Recovery assistance by non-government organisations

The *National Strategy for Disaster Resilience* guides recovery and notes the shared responsibility for it. NGOs play a vital role in the process and indeed many community-based organisations contributed to recovery following the June floods, including:

- Volunteering Tasmania, including coordination of EV CREW
- Conservation Volunteers Australia
- natural resource management organisations
- Rural Alive and Well
- Blaze Aid
- Rural Business Tasmania
- Anglicare
- Salvation Army
- Red Cross
- St Vincent de Paul Society
- Tasmanian Council of Churches

We noted the Taskforce acknowledged the enormous amount of good work undertaken by NGOs. This work included coordinating financial relief and assistance payments, providing basic food and household items, emotional support, advice and guidance for affected people. However, in submissions to this Review, some NGOs stated that they were not consulted early enough, or not at all, during the response phases.

We raised this with senior emergency managers who, while acknowledging the value that NGOs contribute to relief and recovery activities, expressed some concern that in the past this had led

to claims for reimbursement being made after the event that had not been negotiated in advance.

It seems to us that it is important that emergency managers should have a good appreciation for planning purposes both of what NGOs can offer and what the associated costs are. We suggest greater awareness by response management authorities of the roles and functions NGOs can perform would benefit early engagement and more effective service delivery during emergency events.

Recommendation 20

That Government engages with non-government organisations that may provide services during emergency events to clarify the terms and conditions for support through a written arrangement (MOU or similar).

5.4 Capacity and priorities for infrastructure repair

5.4.1 Priorities

Once rapid impact assessment teams (SES and TFS trained staff) could safely enter flooded areas, they conducted about 800 assessments of damage. The purpose was to provide a rapid initial assessment of damage and not to prioritise repair. The assessments were submitted to DPAC whose role is to collate a statewide picture of damage and impact.

Government agencies, local councils, Government Business Enterprises (GBEs) and State-owned Companies (SOCs) also assessed damage to infrastructure and their recovery needs. Infrastructure owners, individually, identified priorities for repair as follows⁶⁰:

- Department of State Growth and councils working to repair damaged roads, bridges, culverts and footpaths;
- TasRail repairing bridges, track and rail lines;
- TasNetworks restoring power to over 2,000 homes and businesses;
- Port of Devonport reopening after four days when marine debris was removed;
- DPIPWE coordinating the removal of logjams, debris and a coordinated disposal service for livestock carcass removal;
- farmers removing logjams and debris, and assisting each other by providing fodder; and
- councils providing extra waste collection to assist clean-up.

We noted that in the Taskforce submission⁶¹, damaged roads and bridges caused significant issues for access to properties. The submission noted that road management extended beyond State Growth and councils to include Forestry Tasmania, Parks and Wildlife Service and HT.

This submission included an example of the Lemonthyme Road in the Kentish Municipality, which was damaged in the June flood, cutting access to the community of Lorinna. Ownership

⁶⁰ *Tasmanian Flood Recovery – From Floods into Recovery*, Tasmanian Flood Recovery Taskforce 2017

⁶¹ Tasmanian Flood Recovery Taskforce submission, available at [//www.dpac.tas.gov.au/government_flood_review](http://www.dpac.tas.gov.au/government_flood_review)

of, and hence the responsibility for repair of, this road was unclear, which led to State Growth being tasked with prioritising essential roadworks to allow property owners access to homes.

It was noted in Forestry Tasmania (FT)'s submission that Mersey Forest Road and Lake River Road, which are managed by FT but not used for current forestry production, are also used for tourism and recreational hunters. Subsequently, Government contributed financially to the repair of these roads in the community interest, while FT contributed with staff and contractors. Works began in November 2016 and are expected to be completed by mid-May 2017.⁶²

This was reflected in some comments we observed from members of the community who had needed to rely on FT roads to access their properties after public roads were cut. The suggestion was made that FT should repair their roads to make this access easier but were reluctant to do so.

Evident from this discussion is that no single agency oversees prioritisation of infrastructure repair having regard to the broader public interest and awareness of resource capability.

The broader public interest is particularly important in this context. There are two aspects to this:

- the public interest in allocating limited funds to the highest priority activities; and
- the potentially conflicting interests of the public who may be using Government Business or other public assets, and the Government Businesses themselves whose purposes may not include providing those assets to the public (for example, forest roads).

Recommendation 21

That, in the event of a major emergency such as the June floods, a government department (DPAC or State Growth) be appointed to coordinate infrastructure repair, to the extent that funding allows, for the whole state. Individual entities will still have the right and responsibility to repair and maintain their own assets, but some central oversight and coordination is, in our view, likely to be beneficial.

5.4.2 Capacity

In responding to this element of our Terms of Reference, we considered how selected government entities and councils responded to infrastructure and related repair in their submissions⁶³ to us, from which we noted⁶⁴:

- **State Growth** suggested that it may be beneficial to provide early advice on funding and responsibility for recovery by GBEs and SOCs to ensure appropriate priorities can be considered. State Growth holds some temporary bridging stock but suggested the need for an audit of bridging stock statewide and consideration of a pool of temporary bridging for use in emergencies.

⁶² http://www.transport.tas.gov.au/road/projects/flood_recovery_works

⁶³ www.dpac.tas.gov.au/government_flood_review

⁶⁴ Inclusion of extracts from submissions should not be read as suggesting we concur. They are included here simply to reflect information provided in a submission in relation to infrastructure capacity.

- **DPIPWE** noted in its submission the capacity for assistance during and after the flood response was as follows:
 - staff were actively involved in response and recovery management, including with the Taskforce;
 - GIS provided land-surveying and flood-mapping services;
 - Biosecurity Tasmania was involved in animal welfare issues;
 - EPA managed livestock carcass disposal;
 - web page with information, advice and services guide for the public;
 - threatened species impact assessments;
 - natural and cultural heritage remediation and advice;
 - administration of NDRAA Grants;
 - Parks and Wildlife Service managed road and bridge repairs;
 - streamlined dam assessment and repair processes;
 - repaired or replaced 23 damaged or destroyed water gauge stations; and
 - agreed with BoM to provide water gauge data to support forecasting and warning services.
- **TasRail** crews and contractors were engaged to progressively open the rail routes after damage at 65 locations including five bridges. They engaged hydrological consultants to ensure appropriate design of infrastructure repair, including design improvements to the Kimberley Rail Bridge. Access to TasRail's Capital Project team and consultants was a significant factor in repair after the flood damage, which they estimate will be \$10 million.
- **TasWater** operated an Emergency Operations Centre 24/7 in Launceston and two other facilities in Hobart and Forth to manage response to the flood event. They followed internal incident management procedures using 23 staff and were represented on the REMCs. TasWater continues to consider resilience as one of its corporate strategies and is building an Emergency Management Centre at Devonport. The Centre incorporates systems to electronically track repair works, scheduling and despatch of resources.
- **Hydro Tasmania** noted that in the week after the floods they focused on assessments of damage, making impacted sites safe and ensuring access. This work was led by production and maintenance staff based in Northern Tasmania, in close liaison with other agencies. Key points included:
 - appointment of a flood recovery coordinator and project manager;
 - assessment of damages and cost of repairs;
 - prioritisation process considering criticality, production and safety;
 - completion of high priority repairs within four months; and
 - ongoing liaison with the Taskforce and government agencies.
- **Forestry Tasmania** suffered a two-week loss of production in some forest operations due to wet soils. Damage to infrastructure included 120 km of forest road, 6 bridges and 30 culverts, which were also mentioned in their submission. The estimated cost of repairs was \$1.57 million (excluding Mersey Forest Road). FT undertook repair works using staff and contractors; however, full completion is planned over a number of years.

- **Councils:**

- **Kentish Council** stated that the June 2016 floods were devastating for the municipality with 20 houses, 27 businesses and farm properties suffering severe inundation. The Council provided sandbagging and trucks delivering sand, road signage was erected and staff were recalled from days off or leave to assist. Council assessed damage, cleared roads, helped residents, provided temporary 4WD road access to Lorinna and kept Kentish residents informed.
- **Latrobe Council** stated that there were deficiencies in relation to capacity for infrastructure repair, including:
 - limited capacity in Tasmania for bridge reconstruction, particularly by State Growth, such as delays in repairing Hoggs Bridge;
 - lack of support from State Growth;
 - lack of road signs provided by State Growth;
 - no details from the SES rapid impact assessments; and
 - lack of timely access to SES information through the COP.
- **Central Highlands Council** redirected council works crew to undertake urgent flood repairs to roads and infrastructure, noting this caused delays to other scheduled works programs.
- **Central Coast Council** identified in their submission that they:
 - have limited staff numbers;
 - recorded damage to infrastructure;
 - liaised with the Regional Flood Recovery Committee;
 - undertook road and bridge repairs to isolated communities; and
 - monitored communities, including infrastructure, and advised relevant authorities regarding assessments and repair.
- **City of Launceston Council** noted the need for:
 - a review of the *Emergency Management Act 2006* and *Tasmanian Fire Service Act 1979* to better reflect the current emergency management arrangements;
 - the installation of a weather radar in the North-East for better and more accurate weather forecasting for Launceston; and
 - support for an emergency management planning coordinator, which was a recommendation arising from the DoJ Review into emergency management.

From this we concluded that there was some collaboration between entities and widespread efforts to assess damage and provide resources to repair damaged or replace destroyed infrastructure. Overall, there was a good focus on recovery and, where some elements of recovery appeared to have taken a long time to swing into action, this can likely be explained by limitations on the funds available, which will always be a challenge after a major event.

However, there is a need for making sure that Government Businesses are engaged in a holistic, statewide picture of recovery needs. Recommendation 21 applies.

5.4.3 Hydrological advice

Our engagement of WMAwater included assessing the adequacy of bridge design from a flooding perspective. They reported that:

- Bridge design for waterways should include:
 - assessment of flood levels and velocities for a range of flood events, including extreme events such as the probable maximum flood, and the most frequent flood probability that will impinge on the bridge superstructure;
 - specification of maximum allowable flow from the bridge as part of the concept design stage, based on consideration of surrounding development. The design of the bridge should incorporate assessment of the expected afflux, including a reasonable consideration of the impacts of debris blockage, for example using guidance from *Australian Rainfall and Runoff* (Ball et al. 2016)⁶⁵;
 - consideration of load scenarios resulting from debris accumulation on the bridge piers/superstructure, and debris impacts, and the potential exacerbation of water level afflux resulting from debris accumulation;
 - sensitivity assessment of design assumptions, including flow rates, debris loads, and potential climate change effects; and
 - consideration of additional factors of safety for load cases or additional freeboard above the design flood level, where there is significant sensitivity to the design assumptions, or uncertainty about the assumptions.
- It is likely that the above areas are already considered to some degree as part of current bridge design practices in Tasmania (although perhaps not historically for some of the failed bridges).

This work resulted in the hydrologist recommending, which we support, as follows:

Recommendation 22

That the organisations responsible for construction, maintenance and ownership of bridges review their design guidelines and, if necessary, update them to specifically include consideration of debris and flood impacts on bridge design. A review of existing bridges by the responsible organisations could also be undertaken to highlight any potential issues.

⁶⁵ Ball, J. et al. 2016 *Australian Rainfall and Runoff: A Guide to Flood Estimation*

5.5 Immediate assistance payments

The Taskforce managed a number of financial assistance payments and packages for the community on behalf of the Government. It worked with a number of government agencies to administer the Tasmanian Relief and Recovery Arrangements (TRRA) and the jointly funded Commonwealth–State Natural Disaster Relief and Recovery Arrangements (NDRRA).

Emergency Assistance Grants⁶⁶ were provided to over 2,000 people who had been displaced by the floods, in order to provide basic living requirements such as food, water, clothing and accommodation. These grants, which totalled over \$375,000, were paid to families (up to \$750 for each family) and individuals (up to \$200 per adult and \$100 per child) under the NDRRA category A arrangements, and distributed through the Department of Health and Human Services (DHHS).

Recovery and Restoration Grants⁶⁷, also paid under NDRRA category A, were provided to 149 individuals and families for temporary living expenses, replacing household goods and housing repairs. A total exceeding \$363,000 was paid out and was administered by DHHS.

Natural disaster assistance was also provided to sport and recreation clubs that suffered damages from floods. Grants of up to \$2,000 were provided to 38 organisations amounting to over \$73,000 under the NDRRA Category B arrangements; these grants were administered by DPAC.

A range of other grants, loan schemes and assistance has been provided by Government to assist farmers, businesses and clean-up work beyond the short-term immediate assistance.

During the flood recovery process, Service Tasmania was engaged as a point of public contact through an '1800' telephone service. This provided additional call centre operators to direct funding and assistance payment enquiries to DHHS and the Taskforce. This system had not been used previously and, once set up and tested, was found to be beneficial in providing advice to the public and directing enquiries.

Assistance payments to hobby farmers

Hobby farmers were entitled to immediate assistance payments but were not eligible for the farmers and business grants. It was clear from submissions to us that this led to a perception of unfairness, particularly among those hobby farmers who were reliant on income from their land to contribute to their household budget.

Decisions about who is eligible for assistance payments inevitably involve questions of how best to allocate limited funds and what the underlying rationale for making these payments is. We do no more here than draw Government's attention to the issue and suggest that consideration should be given well in advance of any future event as to how eligibility for assistance payments to hobby farmers and any other members of the community should be determined.

⁶⁶ *Tasmanian Flood Recovery – from Floods to Recovery*, Tasmanian Flood Recovery Taskforce 2017

⁶⁷ *Tasmanian Flood Recovery – from Floods to Recovery*, Tasmanian Flood Recovery Taskforce 2017

5.5.1 National funding arrangements

Funding for flood mitigation and strategy can be sought through the Australian Government under a National Partnership Agreement administered through the Natural Disaster Resilience Program (NDRP). The Australian Government partners with the states and territories to jointly fund emergency management initiatives. This program is designed to jointly fund the costs of specific projects, addressing risks in each jurisdiction. In Tasmania the program is administered through the SES.

For example, the Railton Flood Mitigation Survey 2012-13 was funded under the NDRP.

The Australian Government also funds post-disaster relief arrangements through Natural Disaster Relief and Recovery Arrangements (NDRRA) and the Australian Government Disaster Recovery Payments.

5.6 Conclusions

Lessons identified from the recovery processes after the 2013 bushfire appear to have been applied to support effective recovery arrangements.

Prompt action was taken to appoint a State Flood Recovery Coordinator with the only delay being in announcing the appointment, which had to wait for Cabinet approval.

The TEMP does not provide for a single management authority for recovery, with DPAC, DPFEM, DHHS and OSEM all having different but important roles. This could be streamlined by the establishment of DPAC as standing Recovery Management Authority for emergencies in Tasmania to provide a single point of contact.

Better appreciation by emergency management authorities of what NGOs can offer, their roles, functions and associated costs, would benefit early engagement and more effective service delivery during emergency events.

No single agency currently oversees, having regard to the broader public interest, prioritisation of infrastructure repair and awareness of resource capability. Despite this, there was evidence of some collaboration between entities, and of widespread efforts to assess damage and provide resources to repair damaged or replace destroyed infrastructure.

Overall, there was a good focus on recovery and, where some elements of recovery appeared to have taken a long time to swing into action, this can likely be explained by limitations on the funds available, which will always be a challenge after a major event.

Emergency assistance payments were processed in a timely and efficient manner, providing relief and assistance to those most in immediate need. However, decisions about who is eligible for assistance payments inevitably involve questions of how best to allocate limited funds and what the underlying rationale for making these payments is. Consideration should be given well in advance of any future event as to how eligibility for assistance payments to hobby farmers and any other members of the community should be determined.

The TRRA and the jointly funded Commonwealth–State NDRRA provided a process for emergency assistance payments to individuals and households affected by the floods.

5.7 Summary of recommendations in this Section

| | Recommendation | See |
|-----|---|-------|
| 19. | That DPAC becomes the Management Authority for recovery in Tasmania. | 5.1 |
| 20. | That Government engages with non-government organisations that may provide services during emergency events to clarify the terms and conditions for support through a written arrangement (MOU or similar). | 5.3 |
| 21. | That, in the event of a major emergency such as the June floods, a government department (DPAC or State Growth) be appointed to coordinate infrastructure repair, to the extent that funding allows, for the whole state. Individual entities will still have the right and responsibility to repair and maintain their own assets, but some central oversight and coordination is, in our view, likely to be beneficial. | 5.4.1 |
| 22. | That the organisations responsible for construction, maintenance and ownership of bridges review their design guidelines and, if necessary, update them to specifically include consideration of debris and flood impacts on bridge design. A review of existing bridges by the responsible organisations could also be undertaken to highlight any potential issues. | 5.4.3 |

Section 6 Environmental effects

Consideration of the detrimental environmental effects of the flooding upon the landscape, and what effective mitigation measures may be necessary to avoid similar events.

6.1 The landscape

We noted evidence of significant detrimental environmental impacts of the June floods. A number of submissions included photographs that illustrated the extent of the erosion of riverbanks by scouring, deposition of logs, rock and soils, and downstream debris accumulations.

During the course of our work, we noted the engagement by DPIPW of Alluvium Consulting Australia Pty Ltd to assist in flood recovery assessments. Alluvium Consulting is a nationally recognised company in this field and we had confidence in its report as being authoritative. The report is now referred to as the DPIPW Report.

The DPIPW Report⁶⁸ considered the effects of the June flooding across 21 Tasmanian catchments, 16 of which were regarded by the report's authors to be significant floods because of a greater than 20-year ARI. Of those floods, the Ouse, North Esk, Inglis and Leven rivers exceeded previously recorded river levels, with an ARI greater than 185 years for each.

The report identified that the effect of high flow rates varies from river to river dependent on a number of factors, which include:

- flow rate and volume
- river gradient
- sediment type
- riparian vegetation
- debris quantity and type

High flow rates that occur suddenly cause riverbank erosion through energy, which is lost as the water flows downstream; the rate of this loss is known as stream power. Stream power is used in the natural process when water runs over a riverbed and through turbulence. It is the excess power produced by a flood that causes the detrimental environmental impacts such as sediment transmission, erosion to riverbeds and riverbanks, and channel changes.

In considering the detrimental environmental effects of flooding on the landscape, we considered:

- riparian management, including responsibility for it;
- damage caused by landslips;
- management of forest plantations, including relevance of the FPA Code;
- role played by the Office of Climate Change and actions taken by Government based on that Office's advice; and
- other academic research.

⁶⁸ DPIPW Report, December 2016.

6.1.1 Riparian management and responsibilities

Riparian management includes ensuring appropriate vegetation is maintained alongside riverbanks. Doing so effectively results in lessening the impacts of floods.

We identified a number of complexities regarding this matter, exacerbated by uncertainty as to ownership of land and associated titles including rivers on that land. This matter has arisen through inconsistency in the issue of titles between municipalities and over time since settlement, which has resulted in variations in property boundaries being at, near to, or including rivers. This is discussed in Section 3.5.5 with Recommendation 11 designed to clarify riparian responsibility.

In any event, landowners, land managers and Government need to take responsibility for the appropriate management of rivers. This might, for example, include leaving buffer vegetation zones alongside rivers and revegetating native species where land clearing has been detrimental to riparian health.

6.1.2 Damage caused by cobble deposition

Mineral Resources Tasmania (MRT), a division of the Department of State Growth, is responsible for managing landslip issues. As a result, for the June floods MRT conducted a study of the effects of a landslip at Caveside in the North-West.

The Caveside review found that:

- substantial soil, cobble and rock had been deposited onto farmland as a result of flash flooding;

and concluded that:

- the material had primarily originated from a previous landslide and debris entering into a creek during heavy rain in 2011;
- during the flooding in June 2016, much of the landslip material was mobilised and deposited downstream onto farmland; and
- while the outcome caused significant deposition of debris and channel disturbances, the causes were determined as primarily natural.

In the absence of any contrary evidence we accept these conclusions and, accordingly, in any future flood event of a similar magnitude, acknowledge that riparian damage and debris deposition might again occur (depending on whether the catchment flooded contained similar natural rock debris). It follows that the deposition effects cannot be effectively mitigated against and the focus would then be on whether it is cost effective to rehabilitate land that has been subject to deposition and whether the public purse should be expected to (or already does, under NDRRA) underwrite the cost.

6.2 Future mitigation measures

This section discusses possible approaches to mitigate the harmful effects of floods including:

- riparian management
- riparian vegetation
- forest practices
- State planning policy

6.2.1 Riparian management

We noted significant damage to farmland and infrastructure along rivers where land use has resulted in clearing of native vegetation. The DPIPWE Report noted the role of integrated riparian and floodplain management in building environmental resilience to floods. It provided an assessment of the June flood event, impacts, damage and options for mitigation, which include:

- managing debris, especially removing large wood that can remobilise and cause further damage;
- removing and replacing willow trees;
- managing erosion by stabilising riverbanks;
- revegetating native flora;
- managing floodplains to reduce channelling; and
- engaging the community to undertake cooperative programs with landowners, councils and Government.

Recommendation 11 applies.

6.2.2 Riparian vegetation

Riparian vegetation provides an effective way to diffuse stream power in and alongside rivers, and tree root systems consolidate riverbanks. We noted that channel erosion in the Mersey and Leven rivers occurred in farmland that had been cleared of native riparian vegetation.

Riparian management and options for flood mitigation for the environment are considered in the DPIPWE Report and other documents on the DPIPWE, DoJ and Natural Resources Management South websites.

A common theme in these publications is the principle of river stabilisation through planting of native flora species and caution regarding the use of introduced species, such as willow trees — see Section 3.5.3.

The DPIPWE Report (page 35) describes a case study of the Inglis River catchment where the Lower Inglis and Lower Flowerdale rivers were examined. The Inglis catchment was the subject of intensive farming, and a tree-clearing program 10 - 15 years ago removed willows from the two rivers. The Lower Inglis had small areas of native revegetation compared with the Lower Flowerdale, where the landowner had undertaken an intensive native revegetation program. During the June floods, the Lower Flowerdale experienced significantly less bank erosion and channel migration.

This suggests to us that effective riparian management may not be possible without appropriate riparian vegetation on riverbanks.

Forest practices

During the June floods, substantial quantities of large timber, logs and trees mobilised, which resulted in 27 significant log jams in 18 rivers across the State.

We noted in a number of submissions that plantation timber was considered a significant factor in large wood debris.

As a result, we asked WMAwater – the independent hydrological consultant we engaged – to examine the issue of debris, with their report⁶⁹ considering the impacts of both natural large wood and plantation timber. The report noted that:

- A large portion of a failed plantation above Kimberley on the Mersey River had been swept clean during the period of the floods.
- There were examples of natural large wood also being mobilised during the floods, and the report drew no definitive conclusion in respect to the proportion of each.

In its submission, Forestry Tasmania identified that there was no significant loss of production timber managed under their operations during the floods, which are guided by the *Forestry Practices Code 2015*. The Code (which is discussed in Section 3.5.2) describes minimum streamside reserve widths or machinery exclusion zones. These reserves are designed to retain natural riparian vegetation alongside rivers and streams to reduce mobilisation of timber debris.

Evident from the discussion about riparian management, riparian vegetation and forest practices is the need for an agency to take responsibility for ensuring these practices occur appropriately in Tasmania.

Recommendation 11 applies.

6.2.3 State planning policies

DPAC is currently undertaking statewide flood planning work to support DoJ's introduction of the Tasmanian Planning Scheme (TPS). It is anticipated that the scheme will incorporate a Riverine Inundation Hazard Code which will include areas identified by respective councils subject to flooding.

It is also expected that the Tasmanian Planning Scheme will provide guidance for managing flood risk by defining areas of flood risk for existing and future built developments, zoning of land and building requirements. Such land-use planning will help determine the tolerable risk for development in flood-prone areas for the benefit of the community and government.

Recommendation 23

That, to provide greater clarity for building development, design and approval within tolerable risk levels, the Tasmanian Planning Scheme, including a relevant Riverine Flood Hazard Code, is finalised and approved as soon as practicable.

⁶⁹ Hydrological Advice Report, WMAwater 2017

6.3 Conclusions

The June floods were significant, with many rivers exceeding record levels, causing widespread environmental damage to rivers and catchments that included erosion of riverbanks by scouring, mobilisation and deposition of vegetation, logs, rock and soils, and downstream debris accumulations.

Possible approaches to mitigating the harmful effects of flooding can include riparian management, riparian vegetation and broader application of forest practices.

However, we identified a number of complexities regarding this including uncertainty as to ownership of land and associated titles including rivers on that land. This complexity has arisen through inconsistency in the issue of titles between municipalities and over time since settlement, which has resulted in variations in property boundaries being at, near to, or including rivers. These complexities and uncertainties need resolution.

In any event, landowners, land managers and Government need to take responsibility for the appropriate management of rivers. This might, for example, include leaving buffer vegetation zones alongside rivers and revegetating native species where land clearing has been detrimental to riparian health. Relevant to this is timely completion of the proposed revised Tasmanian Planning Scheme including a relevant Riverine Flood Hazard Code.

6.4 Summary of recommendations in this Section

| | Recommendation | See |
|-----|--|-------|
| 23. | That, to provide greater clarity for building development, design and approval within tolerable risk levels, the Tasmanian Planning Scheme, including a relevant Riverine Flood Hazard Code, is finalised and approved as soon as practicable. | 6.2.3 |

Section 7 Other matters

Any other matters relevant to the Terms of Reference.

7.1 Introduction

During this Review, we identified a number of factors worthy of inclusion in this 'other matters' section, all of which we regarded as relevant to the Terms of Reference. These factors arose from submissions made to, and discussions held throughout, the Review including (with each dealt with in a separate section below):

- **Climate change:** We explore here research done by the Climate Change Office, whether and how to adapt to climate change and extracts from the TSNDRA.
- **Flood and all-hazards mitigation:** How much should governments, at all levels, invest in flood (or all-hazards) mitigation?
- **Fiscal risk:** Are floods and other natural hazards recognised as a fiscal risk, and should they be?
- **Key person dependencies:** Government is reliant on a small, dedicated number of people with emergency management expertise resulting in key-person dependency risk.
- **Gaps in the TEMP:** Whether there are gaps in the TEMP and how they should be addressed.
- **Roles played by Government Businesses:** The roles played by Government Businesses and community understanding thereof.
- **Inquiry into natural disaster funding arrangements:** Productivity Commission Inquiry Report No. 74, 17 December 2014 titled 'Natural Disaster Funding Arrangements Australia'⁷⁰.
- **Sharing council learning:** The extent to which Councils can learn from each other.
- **Coordination issues:** Are too many government agencies involved and who coordinates their activities?
- **Resilience of the State's infrastructure:** Floods can and do destroy infrastructure and we explore this here.

7.2 Climate change

Climate change is defined as a change in worldwide climate patterns that has been observed over many years, and has and is being caused by increasing greenhouse gases that result from burning fossil fuels⁷¹.

7.2.1 Climate Change Office

In Tasmania, climate change research and policy is developed by the Climate Change Office, a section within DPAC, for advice to Government and the community. Information on a range of climate change issues can be found on its website⁷².

⁷⁰ <http://www.pc.gov.au/inquiries/completed/disaster-funding/report>

⁷¹ http://www.dpac.tas.gov.au/_data/assets/pdf_file/0004/304492/Fact_Sheet_-_TCCO_-_2016_-_Climate_Change_Key_facts_and_figures_-_September_2016.pdf

⁷² <http://www.dpac.tas.gov.au/divisions/climatechange>

The Climate Change Office has produced a fact sheet that identifies the specific flood-related impacts that are expected to be influenced by Tasmania's climate in the coming century. These impacts were identified through the Climate Futures for Tasmania Project⁷³, and are summarised as follows:

- a rise in temperatures by 1.6°C - 2.9°C by 2100;
- similar rainfall totals, but significant changes in seasonal cycles:
 - increases of 20 - 30% in summer and autumn rainfall for the East Coast; and
 - increases of 15% in winter and a decrease of 18% in summer rainfall on the West Coast;
- a decrease in run-off due to rain and snow melt in the Central Highlands and an increase in the Derwent Valley and Midlands;
- an increase in heatwaves;
- extreme rainfall which may lead to flash flooding;
- rising sea levels;
- river flooding in some catchments; and
- drought in some parts.

The research is underpinned by regional climate modelling and hydrological models for Tasmania. The project used six global climate models combined with runoff and river-flow projections up to 2100.

The project considered modelling of 78 rivers in Tasmania and identified that 50 rivers are projected to have increased flows by 2100. While some river flows in the Central Highlands are projected to decrease, others, including the Macquarie, Coal, and Clyde rivers, are anticipated to increase.

The report concluded that there is overwhelming scientific evidence that supports impacts as a result of global warming and that the consequences include changes to: rainfall, wind, evaporation, cloudiness and other variables. The effects will see changes to averages in climate conditions, and also in the frequency and intensity of extreme events including heatwaves, rain and floods in Tasmania.

7.2.2 National Climate Change Adaptation Research Facility

The outcomes of the Tasmanian research is supported by national research including projects undertaken by the National Climate Change Adaptation Research Facility (NCCARF), which produced a document identifying strategies for community adaptation to floods⁷⁴. In this report, it identified that climate change effects included an increase in extreme rainfall events which would contribute to greater frequency of riverine and flash floods in Australia.

The NCCARF report examined the effects of the Queensland floods in 2011, which affected Brisbane, Emerald and Donald communities. It suggested adaptive strategies that may be

⁷³ <http://acecrc.org.au/climate-futures-for-tasmania>

⁷⁴ <https://www.nccarf.edu.au/publications/community-adaptation-strategies-floods>

considered by governments and communities to build on the resilience of flood-prone communities in Tasmania. These strategies include:

- targeting all demographics with specific, action-oriented communication of information before, during and after a flood;
- legislating to improve housing construction and design in flood-prone areas;
- educating property owners about flood-resilient building design;
- promoting and maintaining volunteerism and community initiatives that assist communities, including vulnerable people, before, during and after floods;
- using personal stories to educate people about the nature of flood events;
- increasing flood mitigation infrastructure;
- re-evaluating government flood-relief assistance programs; and
- informing communities about the limited resources of the SES.

7.2.3 Tasmanian State Natural Disaster Risk Assessment

Also relevant is the reference in the TSNDRA (see Section 1.1.2) to recognition of risks associated with agreed scientific evidence supporting climate change. In this regard, the TSNDRA identifies that, in relation to future flood risk in Tasmania, there are likely to be fewer rainy days but more frequent intense rainfall events, which is likely to increase the risk of flooding, particularly flash flooding.

This research provides useful pointers to actions needed to strengthen community resilience and for Government to promote and consider climate change impacts in all decision making. We encourage DPAC to explore this further and develop strategies to address this. In doing so, DPAC should have regard to proposed changes to the Tasmanian Planning Scheme currently under consideration by Government.

7.3 Flood and all-hazards mitigation

In trying to answer how much governments should invest in this area, we noted numerous instances where reports and submissions highlighted costs associated with floods and other natural hazardous events. Some submissions also referred to lack of resources to deal with natural hazards. Examples highlighting costs and related matters include:

- 2013 Deloitte report⁷⁵ – In this report, Deloitte Access Economics noted that:
 - In 2012 alone, the total economic cost of natural disasters in Australia is estimated to have exceeded \$6 billion. Further, these costs are expected to double by 2030 and to rise to an average of \$23 billion per year by 2050, even without any consideration of the potential impact of climate change.
 - Each year, an estimated \$560 million is spent on post-disaster relief and recovery by the Australian Government compared with an estimated consistent annual expenditure

⁷⁵ Deloitte Access Economics report titled 'Building our nations resilience to natural disasters commissioned by the Australian Business Roundtable for Disaster resilience and safer Communities <http://australianbusinessroundtable.com.au/assets/documents/White%20Paper%20Sections/DAE%20Roundtable%20Paper%20June%202013.pdf>

of \$50 million on pre-disaster resilience: a ratio of more than \$10 post-disaster for every \$1 spent pre-disaster.

- Productivity Commission Inquiry Report No. 74, 17 December 2014 titled 'Natural Disaster Funding Arrangements Australia'⁷⁶ from which we noted the following relevant to our Review:
 - Australia is exposed to natural disasters on a recurring basis. Effective planning and mitigation of risks is an essential task for governments, businesses and households.
 - Current government natural disaster funding arrangements are not efficient, equitable or sustainable.
 - Governments overinvest in post-disaster reconstruction and underinvest in mitigation that would limit the impact of natural disasters in the first place. As such, natural disaster costs have become a growing, unfunded liability for governments.
 - Australian Government post-disaster support to state and territory governments (states) should be reduced, and support for mitigation increased.
 - States need to shoulder a greater share of natural disaster recovery costs to sharpen incentives to manage, mitigate and insure against these risks.
 - Australian Government mitigation funding to states should increase to \$200 million a year and be matched by the states.
 - These reforms would give state and local governments autonomy in how they pursue disaster recovery and mitigation. The reforms should be supported by performance and process-based accountability mechanisms that embed good risk management.

We have not sought to test observations made in the Deloitte and Productivity Commission reports, but include them here for the following primary reasons:

- They both suggest that the economic impacts of natural disasters is high, much higher than the investment in mitigation.
- It seems likely that natural disasters may occur more frequently.
- Higher investment in mitigation is needed.

While neither report may have direct relevance to Tasmania, in our view the principles and findings are relevant to Tasmania. This is supported by observations made:

- In the DPAC submission to this Review we noted the following issues relevant to our Review:
 - The June 2016 floods had widespread impact on the State, causing devastation to individuals, families, businesses, farmers and local communities across 19 local government areas.
 - The full impact of the floods may take many months or years to be realised. However, based on current estimates:
 - the total damage bill will exceed \$180 million, including \$80 million damage to infrastructure;

⁷⁶ This report can be located at <http://www.pc.gov.au/inquiries/completed/disaster-funding/report>

- the economic cost to agribusiness is estimated to be \$70 million and the estimated cost to small business is \$3.4 million;
 - numerous parks and reserves suffered significant damage, including roads, bridges, walking tracks, campgrounds, viewing platforms and other public amenities with the cost of repair estimated to be \$6.4 million; and
 - significant damage was caused to local government assets, and there is likely to be significant and ongoing impacts on many industries, such as tourism, which cannot yet be fully quantified.
- The Chapter dealing with floods in the 2012 Tasmanian State Natural Disaster Risk Assessment: A Guide to Staying Safe notes that “Flooding is one of Tasmania’s most frequent, disastrous and costly natural hazards. In 2011, Tasmania’s damage bill for flooding was \$24 million.”
 - Geoscience Australia (GA) recently undertook a project, commissioned by LCC, to examine the costs and benefits of the upgraded Launceston levee after the June 2016 floods⁷⁷. GA identified, based on the 2016 floods (a 50-year ARI event) in Launceston, that estimated avoided losses of business and residential properties was about \$216 million, and it concluded that the upgrade project was a sound economic investment.

We include this reference not to suggest levees are always the most appropriate mitigation solution, but simply to illustrate whether this investment was worthwhile in this instance. However, it highlights that appropriately researched, funded and constructed levees can provide flood mitigation for relevant flood-prone areas, providing protection for existing properties and development opportunities.

Other benefits include potentially lower insurance premiums for properties protected. Another, perhaps more difficult to quantify, benefit is greater awareness by communities of flood risk in their township and associated preparedness to respond appropriately when flood risks threaten. (see Section 1.4).

Again, we have not tested the amounts quoted, but they are significant in the context of our State and lead us to ask the following question – is Tasmania, by which we include governments, businesses and communities, sufficiently investing in mitigation?

While we have no answer to this question, and we recognise governments at all levels must prioritise scarce resources, we suggest more work is needed to answer it. In doing so, however difficult this may be, regard must be had to the unpredictable frequency of natural hazardous events like floods. In this respect, a balance is needed between investing in mitigation now, including training for all impacted parties, when the next flood (or other natural hazardous event) may or may not occur for some time or may occur unpredictably.

7.4 Fiscal risk

In trying to answer whether floods and other natural hazards are (and should be) recognised as a fiscal risk, we researched developments at a state and national level.

⁷⁷ Launceston Flood Risk Mitigation Assessment Project, BNHCRC, February 2017

7.4.1 State level

We referenced the Tasmanian Government Fiscal Sustainability Report 2016⁷⁸ (Fiscal Report) which addresses the long-term sustainability of the Tasmanian Government's finances. The Executive Summary identifies factors that may have a significant influence on the State's future financial position and examines the extent to which the State's finances may alter under different economic and fiscal conditions.

The Fiscal Report is sound, dealing effectively with current policy implications under suitable scenarios. It does not, however, nor was it intended to, address climate change or natural disaster risk.

The word 'fiscal' can refer to "public treasury or revenues: fiscal policies of or relating to financial matters in general"⁷⁹. And, the word 'sustainable' has numerous definitions including:

- the ability to be maintained at a certain rate or level⁸⁰ – "the sustainability of economic growth"; and/or
- avoidance of the depletion of natural resources in order to maintain an ecological balance – "the pursuit of global environmental sustainability".

The point we make here is that long-term sustainability is not only about financial or economic sustainability, and that any assessment of future sustainability should have regard to what are our natural resources, how we use them and our natural disaster risk.

7.4.2 Other jurisdictions

We referenced the New Zealand Treasury's 2016 Statement on the Long-Term Fiscal Position (the NZ Report), titled 'He Tirohanga Mokopuna'⁸¹, from which we noted in the Foreword:

- The Public Finance Act 1989 requires that the Treasury prepares a statement on New Zealand's long-term fiscal position (the Statement) at least every four years. The Statement must cover at least the next 40 years and include a description of all significant assumptions underlying any projections.
- This, our fourth long-term fiscal statement, builds on the challenges and opportunities for New Zealand identified through these processes.

In a media statement by the New Zealand Secretary of the Treasury accompanying the release of the NZ Report, we noted:

- He also stresses that it is timely to consider how to strengthen New Zealand's long-term fiscal position.
- "Significant shocks that could hit the New Zealand economy are not rare events. We have experienced natural shocks with the Canterbury earthquakes, international shocks with the global financial crisis and its ongoing repercussions, and more recently, political shocks in important trading partner countries. As a small trading nation New Zealand has to be adaptable and resilient to major disruptions both local and global⁸²."

⁷⁸ Prepared by the Department of Treasury and Finance and required by the *Charter of Budget Responsibility Act 2007*.

⁷⁹ <http://www.dictionary.com/browse/fiscal>

⁸⁰ <https://www.google.com.au/search?q=sustainability&oq=sustainability&aqs=chrome..69i57j0l5.3742j0j9&sourceid=chrome&ie=UTF-8>

⁸¹ <http://www.treasury.govt.nz/government/longterm/fiscalposition/2016>

⁸² <http://www.treasury.govt.nz/publications/media-speeches/media/22nov16>

Of relevance to our Report are:

- the reference to rare natural events; and
- the NZ Report includes a discussion on the need to sustainably manage New Zealand's natural resources.

7.4.3 Future sovereign funds

Inclusion of this section is not to suggest that Government needs to establish a sovereign fund aimed at funding mitigations or responses to natural disasters. On the contrary.

We referenced an April 2012 report issued by the Institute of Chartered Accountants in England and Wales⁸³ titled 'Sustainable Public Finances: Global Views' and specifically the article on page 16 by Ken Warren, Chief Accounting Advisor, New Zealand Treasury, from which we noted:

- When disaster strikes, be it a financial or a natural disaster, there is a common approach by governments. Some governments have a better approach to managing such disasters. Other governments should follow suit. A financially competent approach concentrates on: the best response and recovery process; the cost of those processes; and how those costs will be paid for.
- This is how the Australian Government accounted for the 2010-11 southern summer floods and how the New Zealand Government accounted for the recent Canterbury earthquakes. The other approach, the trial-and-error approach to setting up funds, has had its day.
- Commonly, however, the first thing politicians announce when a disaster strikes is that they have established a large fund to tackle the problem. The main aim of this fund is to reassure the public. But the value of the fund is largely irrelevant.
- The amounts announced never match up to the final cost. These announcements are also confusing given the variety of ways the fund can be set up and how they interact with the government's budget process.
- A competent financial management approach to a disaster provides a rehearsed immediate response plan based on scenario planning and previous experience. Politicians are therefore able to say what is happening over the immediate period, what it will cost, and how these costs will respond to the needs of those affected. Beyond this, governments should announce a medium-term process for a recovery plan.
- This process should include a financial management response team of risk assessors, actuaries, accountants and policy advisers. This team should determine the best response, and the cost of that response. Politicians can then announce when they will be making decisions on that team's recommendations (ideally within a six-week period).
- If politicians accept the team's recommendations, they can announce the initial cost forecast, and outline how this will be met. These two items should then be incorporated into the budget process for legislative scrutiny. They will be updated through forecasting and accounting processes as the claim's development matures.

Our purpose behind raising these matters is to suggest that governments at all levels should have greater regard for fiscal risks associated with managing our natural resources, natural disasters and associated climate change risks. We offer no silver bullet in this regard but suggest work on this is needed in the immediate term.

⁸³ <https://www.yumpu.com/en/document/view/41864389/sustainable-public-finances-global-views-icaew>

7.5 Key-person dependencies

We did not set out to assess the capability of the individuals working in emergency management related matters in the State's public service. However, we noted from our interviews the presence of highly committed individuals operating in the best interests of the public, but that some were:

- fulfilling multiple tasks, although this is not unusual in an emergency management setting;
- operating in 'acting' capacities; and
- allocated to particular tasks, carrying out reviews being an example, but then reallocated before the task was completed.

From this, and based on our interviews and the quality of documentation examined, we formed a view of a capable but potentially small and under-resourced group leading to our conclusion that, as this relates to emergency management, our State may be exposed to key-person dependency risk. Our Recommendation 6 may go some way to addressing this.

Some might argue that existing knowledge management systems – the TEMP and 2016 TSNDRA are examples – compensate for this. We agree, but in an environment where responding to natural disasters is not a day-to-day activity, there is a risk that practical application of these knowledge-based systems may wane. See Section 1.6.

7.6 Gaps in the TEMP

The Tasmanian Government's planning and risk assessment documentation is comprehensive and in line with national frameworks. However, we make the following suggestions for consideration by Government as it finalises the proposed new Tasmanian Emergency Management Arrangements (TEMA):

1. The TEMA provide greater clarity of, following agreement with, the roles to be played by Government Businesses other than in the recovery phase. For example, clause 1.22 of the TEMP notes '... will ensure interoperability between agencies in terms of systems, terminology, training, skills, roles and functions', with the word 'agencies' referring to entities in the general government sector. We fail to see how full interoperability can be achieved without including, for example, systems and skills of Government Businesses having direct roles to play in emergency management, such as Hydro Tasmania and TasNetworks.
2. The TEMA articulate a role for relevant Government Business on the Security and Emergency Management Advisory Group. Without this, the SEMC, on which Government Businesses are not represented, is informed of emergency management policy implications for these entities, second hand.
3. This concern is exacerbated by the fact that the TEMP's Table '4 SEMC Advisory Agencies and Management Authorities for Hazards' currently makes no mention of any Government Businesses. Nor is there any reference to the roles that could or should be applied to NGOs – our Recommendation 20 applies.
4. The TEMA articulate, following discussion with them, a role for TasRail in emergency management. In this regard we noted no reference in the tables on pages 33 to 36 of the TEMP to railway infrastructure damage caused by floods.
5. Similarly, tables dealing with other functional responsibilities on pages 40 to 48 of the TEMP make no reference to management of railways or ports.

6. The TEMA articulate not only how communities need to behave when natural emergencies occur, but how communities are made aware of, and agree with, these behavioural expectations. Our Recommendation 6 applies.

7.7 Roles played by Government Businesses

Evident from correspondence we read was perhaps a lack of understanding by communities about the roles and functions of Government Businesses and the extent to which they can be directed by Government.

There are two types of Government Businesses:

- Government Business Enterprises. GBEs are established under their own legislation and the *Government Business Enterprises Act 1995* under which:
 - each GBE's principal objective is to⁸⁴ perform its functions and exercise its powers so as to be a successful business by (our additions emphasised by underlining):
 - operating in accordance with sound commercial practice and as efficiently as possible; and
 - achieving a sustainable commercial rate of return that maximises value for the State in accordance with its corporate plan and having regard to the economic and social objectives of the State; and
 - performing on behalf of the State its community service obligations (assuming there are any) in an efficient and effective manner; and
 - performing any other objectives specified in the Portfolio Act.
 - GBEs may or may not be required to provide community service obligations. Where they are required, these are normally separately funded by Government. We do not believe that FT's road construction activities are community service obligations – if this is correct, this could lead to the outcome that FT will not repair flood damaged roads other than in connection with its business activities. This is also explored in Section 5 where we suggested the need for statewide coordination of infrastructure repair.
 - It is unusual for Ministers to direct GBEs to fulfil certain functions or activities. Ministerial Charters (Section 36), Corporate Plans (Section 39) and Statements of Corporate Intent (Section 41) are avenues under which Ministers can express expectations of GBEs.
- State-owned Companies (SOCs) which are established under the Commonwealth's *Corporations Act 2000*. This Act requires company directors to operate in the best interest of the entity, which may not always be in the best interests of the shareholders. However, SOC's are also subject to Ministerial Charters and must prepare corporate plans and statements of corporate intent for approval by shareholder Ministers. Where they are required to provide community service obligations, these are separately funded and any directions given by Ministers must be recorded in annual reports issued by SOC's.

Further information about how GBEs and SOC's are expected to operate and respective governance arrangements are outlined on the Department of Treasury and Finance's website.⁸⁵

⁸⁴ Refer section 7 of the GBE Act - http://www.thelaw.tas.gov.au/tocview/index.w3p;cond=;doc_id=22%2B%2B1995%2BAT%40EN%2B20170512130000;histon=;pdfauthverid=;prompt=;rec=;rtfauthverid=;term=;webauthverid=

⁸⁵ <http://www.treasury.tas.gov.au/government-businesses>

7.8 Inquiry into natural disaster funding arrangements

The Productivity Commission's Inquiry Report No. 74 has a summary of findings and recommendations from page 37 with direct and indirect relevance to state and territory governments. For example:

- Finding 4.1 – The availability of information on natural hazards and exposure has improved significantly in recent years, especially in relation to floods. However, there is scope for greater coordination and prioritisation of natural hazard research activities across governments and research institutions.
- This finding is followed by a number of recommendations, including that:
 - Governments at all levels should make new and currently held natural hazard data publicly available in accordance with open public sector information principles. When collecting new natural hazard data or undertaking modelling, all levels of government should:
 - make information publicly available unless it would not be in the public interest to do so;
 - use private-sector providers where cost effective, and use licensing arrangements that allow for public dissemination. Where there are costs involved in obtaining intellectual property rights for existing data, governments should weigh up these costs against the public benefits of making the data freely accessible; and
 - apply cost recovery where governments are best placed to collect or analyse specialist data for which the benefits accrue mostly to private sector users.

We read the Commission's Report to identify any relevance to flood emergency management in Tasmania. In our view, some of the findings and recommendations have relevance and it is incumbent on state governments to identify for communities:

- which recommendations are in fact relevant; and
- proposed responses.

Recommendation 24

That the State Emergency Management Committee allocates resources to reviewing all findings and recommendations in the Productivity Commission Report No. 74 relevant to Tasmania and, for those identified as relevant, actions taken and, if none, why not.

7.9 Sharing council learning

During our meetings with emergency management representatives at LCC, we noted comprehensive and advanced flood disaster planning arrangements in place. This was unsurprising in view of floods that have occurred there in the past and the significant investment in the Launceston levee.

While not an area we specifically focused on, our assessment is that LCC is well placed to assist smaller, less well-resourced councils in its region with emergency planning and, to the extent that it does not already, it should proactively do so.

Also noted from this Review were councils that had experienced floods and prepared debrief reports facilitating preparedness for future such events. An example is the debrief prepared by Huon Valley Council (see Section 8) which, through LGAT, could be used to inform other councils.

7.10 Coordination issues

During the course of this Review, we noted up to 13 agencies (there may well be others and we have not included local government entities here) were playing some sort of role in assessing flood damage or related activities. This includes flood modelling by Mineral Resources Tasmania, and landslide and stream erosion assessments by the Forest Practices Authority.

In no case do we consider that these entities should not be carrying out their current activities, but raise this because it was unclear to us whether this work is known to SEMC, and how this work is coordinated to ensure common learning is achieved and duplication is minimised.

7.11 Resilience of the State's infrastructure

The TEMP does not contain a definition of resilience in an emergency management setting. It refers to a 'comprehensive approach to emergency management' which is defined as:

A way of thinking about emergency management by considering prevention and mitigation, preparedness, response and recovery (PPRR) aspects of emergencies and their consequences.

Neither 'prevention and mitigation' nor 'preparedness' deal with resilience being respectively defined as:

Prevention and mitigation – planned and coordinated measures that eliminate or reduce the frequency and/or consequences of emergencies.

Preparedness – planned and coordinated measures so safe and effective response and recovery can occur.

In our view, neither definition fully addresses resilience. So we referenced the draft Tasmanian Emergency Management Arrangements (TEMA) which is expected will replace the TEMP. In its draft Chapter 6, the TEMA references the *National Strategy for Disaster Resilience* (NSDR) adopted by all state and territory governments in 2011, noting that it does not define the term resilience, focusing instead on the characteristics of 'disaster resilient' communities, individuals and organisations. The NSDR goes on to note that emergency management is a shared responsibility between governments, business, communities and individuals⁸⁶. The TEMA then describes awareness raising, roles and responsibilities etc.

However, this still does not address how to ensure communities are resilient in the first instance or whether communities, individuals or businesses understand what is meant by, or their roles in, a shared responsibility.

The TEMP also discusses capacity in two respects:

- 'Capability which is defined as a function of human and physical resources, systems/processes, training and the supply chain (eg trained personnel with equipment ready for deployment).'

⁸⁶ Draft TEMA, page 73

- ‘Capacity which is defined as the extent to which a capability can be applied to a particular task or function.’

Section 3.1 of the TEMP, *Prevention and Mitigation*, addresses most of our concerns regarding resilience, including for example the need for land-use planning reforms, although two matters, as these relate to flooding, are in our view missing:

- how communities (individuals, communities and businesses) are involved and have *ownership* of their roles in making themselves resilient; and
- what work has been done to ensure that the State’s flood-related infrastructure has the capacity to withstand floods or to bounce back from severe floods in reasonable time frames when these occur.

Without having a view as to whether or not the examples we provide now should or should not have received a higher or lower priority, we note examples provided to us where damage to infrastructure is being addressed in some cases by improved infrastructure and sometimes by respective councils and communities working together⁸⁷:

- Hoggs Bridge – works have begun, and this is still scheduled to be completed by Christmas – this date will continue to be reviewed, as there have been some delays.
- Kellys Cage Road Bridge – tender was awarded in early November, improvements to previous bridge structure are to be made – the old bridge was a timber bridge and new one will be concrete, wider, stronger and higher, therefore more resilient in a future flooding event. Access is currently via the Gog range tracks which have had some improvement works. Essentially, it will take a bit longer to replace the bridge, but the new bridge will be much better in the long term.
- Olivers Creek bridge, Lorinna – emergency repairs were conducted by Kentish Council soon after the floods, with a new bridge to be installed sometime in 2017.
- There were a number of bridges over the Mersey River which were damaged in the floods, and infrastructure owners worked together to plan access and replacement of these structures. In particular, temporary bridging was considered at Hoggs Bridge/Merseylea, but the cost and time of providing access, which wasn’t suitable for heavy vehicles, had to be weighed up against providing a longer term cost-effective solution for all road users.
- River Road, Lorinna – was planned to be opened by the end of November, but Council has not confirmed if reopened yet. Improvements were made to the road and culverts. Access is via Wilks Road in the meantime.
- State Growth has also been doing works to Lemonthyme Road, which joins River Road, to restore access to Lorinna.

We also noted, from the submission to this Review, action taken by TasRail to repair the Kimberley Railway Bridge and that in so doing steps were taken to enhance the flood resilience of this bridge⁸⁸.

We urge Government, businesses and communities to invest in resilience both in related infrastructure and in shared understanding of respective responsibilities.

⁸⁷ Information provided by Latrobe Council staff on 5 May 2017

⁸⁸ Refer TasRail submission

7.12 Conclusions

Research by the Climate Change Office and nationally notes a growing climate change risk and a need for adaptive strategies and investment in flood mitigation infrastructure to deal with resilience, in particular in flood-prone areas. DPAC is encouraged to explore this further.

Based on studies read as part of this Review, it may be that Government under-invests in flood mitigation, which may contribute to higher direct and indirect response costs. Should this be a fair conclusion, the question is how much, and on what, mitigation investment is needed especially for irregularly occurring events. We did not set out to answer this question but it needs to be considered, as does the extent to which Government should manage its natural resources and natural disasters from a fiscal perspective.

Government may be exposed to key-person dependency risk in its emergency management arrangements. This must be managed, as must the need to ensure ongoing reminders of the relevance and application of knowledge management systems.

Government's emergency management and natural disaster risk assessment documentation is suitable, but there are aspects that need to be addressed as it updates these. Gaps identified include articulation of roles played by Government Businesses, and informing communities about behaviours expected of them and obtaining their 'buy-in'.

Emergency management authorities might benefit from reviews conducted by third parties like the Productivity Commission. Doing so would enhance accountability to communities.

Better resourced councils, and those with stronger experience in flood management, should share these resources and experiences with their colleagues.

Better coordination of the many useful flood-related activities undertaken by multiple agencies is needed.

The June floods resulted in significant damage to road, rail and bridge infrastructure and we urge Government, businesses and communities to invest in resilience in relevant infrastructure. In this regard, consideration could be given to a review of all critical flood-related infrastructure, including infrastructure managed by local government, to assess that infrastructure's capacity to withstand and recover from flood (and other hazardous) events.

7.13 Summary of recommendations from this Section

| | Recommendation | See |
|-----|---|-----|
| 24. | That the State Emergency Management Committee allocates resources to reviewing all findings and recommendations in the Productivity Commission Report No. 74 relevant to Tasmania and, for those identified as relevant, actions taken and, if none, why not. | 7.8 |

Section 8 Huonville floods

The Huonville flood event on 15 July 2016.

8.1 Context

The Huon River flows from Scotts Peak Dam in the Southwest National Park for about 150 km and is joined by five main tributaries before it runs through the towns of Judbury and Huonville, at which stage it becomes tidal. Huonville has suffered numerous floods causing inundation, including in 2010 and 2011.

Huon Valley Council (HVC) recognises that flooding is a significant risk for the Huonville community and has worked closely with BoM and SES to develop the Huon River Flood Warning System that is supported by recent flood studies, a network of five river height gauges and a number of upper catchment rainfall gauges.

HVC has a range of information available to the public on its website⁸⁹ including:

- flood advice;
- a link to BoM Huon River height data;
- flood action guide;
- preparedness information;
- emergency evacuation advice; and
- access to The Huon Valley Emergency Management Plan.

8.2 The flood event and associated warnings

In July 2016, a warm south-westerly airstream brought heavy rain to western Tasmania with rainfall exceeding 100 mm in the 48 hours up to 9 am on 15 July⁹⁰. This rain fell after snow had previously settled on elevated areas above 300 metres in the catchment and soils were already saturated with moisture.

As a result of these conditions, the Huon River rose quickly, causing moderate flooding at Judbury (10 km upstream of Huonville) and a major flood in Huonville that peaked at 4.3 metres at the Huonville Bridge gauge at 10.52 am on 15 July.

BoM first issued a flood warning for Huonville at 10.05 am on Thursday 14 July followed by a further four warnings issued up to 10.04 pm that day. BoM issued a sixth warning at 4.42 am on Friday 15 July stating that the flood level had exceeded moderate and was expected to reach a major level (4.2 metres) at Huonville Bridge and peak between 4.2 and 4.4 metres on that Friday morning. In total, BoM issued eight flood warnings.

8.3 Preparation

On receipt of the first flood warning, HVC alerted all council staff and contacted the Police and SES to start response planning.

After consultation with Police on 14 July, carparks in low lying business areas in Huonville, known to have previously suffered inundation, were closed to traffic. Council prepared eight

⁸⁹ <http://www.huonvalley.tas.gov.au/services/my-community/community-safety/>

⁹⁰ BoM submission – Major Flooding in Huonville July 2016

cubic meters of sand for filling 2,500 sandbags and SES began door-knocking businesses and residents in flood-prone areas using a pre-scripted message for consistent messaging.⁹¹

Power was isolated to low-lying recreational areas near the Huon River and contact was made with TasNetworks' Operations Team regarding electricity isolation planning for the community. Council staff advised business owners on Main Street, Huonville about flood preparation.

Late in the afternoon of 14 July, responding agencies met. They reviewed preparation measures and planned response actions. The Council General Manager updated staff.

Evident from these actions is our impression that people in the Huonville community are well aware of flood risk so, on the whole, the community response was effective. However, SES advised us that it was hard to reach rental property occupants, including businesses, who might change regularly and be less aware.

If there is a lesson out of this, it is that awareness is really helpful, but it is difficult as well and requires ongoing attention by local governments and SES to keep awareness 'current' among the community.

8.4 Response

SES actively monitored river levels at Huonville from 12 midnight on Thursday 14 June. At 3.12 am on 15 July, the Huon River rose to 3.8 metres at the Huon Bridge gauge and was observed to be raising rapidly. Water had begun to inundate low-lying buildings and affect roads next to the river.

Police closed a number of roads and SES assisted three residents to evacuate. TasNetworks was contacted to begin isolating power to affected houses and businesses.

SES started sandbagging businesses and houses, and providing sandbags to property owners. SES updated the Council General Manager about unfolding events.

Additional people were evacuated by Police and SES who continued to monitor river levels and inundation.

SES activated a Regional Operations Centre (ROC) in Hobart at 9.00 am on 15 July to coordinate the response, which included:

- Police managed traffic and road closures, including the Huonville Bridge.
- SES filled extra sandbags for businesses and residents.
- Department of State Growth monitored the Huonville Bridge for safety.
- TasNetworks isolated power to inundated properties.
- HVC set up a flood relief centre for residents at the Town Hall.
- HVC Family Services staff provided advice and support to property owners.
- Public information was provided using the Police website and media outlets.
- The Environmental Protection Authority was contacted to assist with environmental protection of service station assets.

⁹¹ HVC Report on Huonville Flooding 15 July 2016

- HVC staff, including customer service staff, were updated with information and advice for the public.
- Printed information was delivered to residents advising on power restoration.

8.5 Recovery

The Huon River peaked between 9 and 11 am on Friday 15 July before it slowly receded, allowing for recovery actions to begin. HVC social workers began contacting affected people and providing access to emergency food, clothing and furniture.

The Red Cross offered assistance including flood clean-up advice for residents.

HVC:

- conducted a rapid impact assessment of flood damage;
- provided extra daily rubbish removal services and waived tip fees;
- provided sanitising kits to affected residents; and
- provided property insurance information to residents.

8.6 Post-flood debrief

HVC hosted an operational debrief at the Huonville Council Chambers for responding agencies including:

- SES
- Police
- TasNetworks

This debrief provided an opportunity to evaluate the preparation and response actions for the event and identify lessons learnt. This led to a formal document⁹² identifying what went well, issues, lessons and actions for respective agencies.

8.7 Community feedback

HVC received a variety of community feedback⁹³ from business owners and residents. Much of the feedback was positive and appreciative of assistance provided by emergency services, while we note the issues raised previously about the importance of ensuring that new arrivals to the community have access to information about flood risk and actions required.

This feedback was included in the HVC report on the flood event, which was a succinct and comprehensive account of the event and actions taken by emergency service agencies.

⁹² HVC Report on Huonville Flooding 15 July 2016

⁹³ HVC Report on Huonville Flooding 15 July 2016

8.8 Existing reports and warning systems

HVC and SES benefited from a number of existing emergency management plans as well as a specific flood-warning system. Together these were used in providing information for BoM to assist with issuing timely warnings, advice to SES on response actions and to HVC for flood prevention, response and recovery activities.

These plans and system included:

- Huon River Flood Warning System, developed in partnership between HVC and BoM, completed in 2012 using NDRP funding;
- The Huon River Evacuation Plan, commissioned by Hydro Tasmania and currently being finalised by Entura, which identifies inundation risk including from riverine flood and dam failure;
- Huon Valley Emergency Management Plan, developed by HVC with SES and reviewed in March 2015; and
- The Huonville Floodplain Management Study and Risk Assessment Report, commissioned by SES and undertaken by Entura and the University of Tasmania in collaboration with a range of stakeholders. This study and risk assessment report addresses risks and mitigation strategies for consideration by councils and Government because, for example, it identifies inundation at specified river levels.

8.9 Future actions

Through the debrief and report process, HVC has considered opportunities for improved flood response for their community. These include:

- finalising the Huon River Evacuation Plan including floor heights for at-risk properties;
- more broadly disseminating warnings and timely information to allow residents the maximum time for flood preparation;
- conducting an annual information session for the public to raise awareness;
- seeking funding for mitigation strategies and initiatives to strengthen community resilience; and
- continuing current flood-related emergency management programs.

8.10 Conclusions

The preceding snow melt, saturated soils and heavy rainfall provided conditions for a more rapid river rise in the Huon catchment than is usually experienced. The Huon River rose quickly causing Huonville to flood in the early hours of Friday 15 July 2016.

Emergency management agencies, including the Huonville Council responded effectively to this flood event because:

- the Huon Flood Warning System has rainfall and river height gauges that provide timely data for BoM to model and predict flood extent;
- lessons had been learnt from previous flood events, resulting in heightened awareness, including by members of the community, and prompt action;

- flood planning, inundation and evacuation documentation facilitated prompt and appropriate action; and
- debriefs indicated a willingness to learn from the July 2016 event, and gaps were identified for continuous improvement.

However, an important lesson learnt was the need for ongoing community awareness, in particular for households and businesses who are new to the area.

The manner in which the Huonville flood event was managed provides an example of effective planning, preparation and collaboration that other flood management authorities should learn from.

8.11 Summary of recommendations in this Section

There are no recommendations in this Section.

APPENDICES

- Appendix A. Abbreviations
- Appendix B. Glossary
- Appendix C. List of figures
- Appendix D. List of submissions
- Appendix E. Review budget outcome

Appendix A – Abbreviations

| | |
|--------|--|
| ABC | Australian Broadcasting Corporation |
| AEP | Annual exceedance probability |
| AFAC | Australasian Fire and Emergency Service Authorities Council |
| AHD | Australian Height Datum |
| ARI | Annual recurrence interval |
| BoM | Bureau of Meteorology |
| COAG | Council of Australian Governments |
| COP | Common Operating Platform |
| DHHS | Department of Health and Human Services |
| DoJ | Department of Justice |
| DPAC | Department of Premier and Cabinet |
| DPFEM | Department of Police, Fire and Emergency Management |
| DPIPWE | Department of Primary Industries, Parks, Water and Environment |
| EA | Emergency Alert |
| ELM | An exercise and lessons management unit |
| EM Act | Tasmanian <i>Emergency Management Act 2006</i> |
| FT | Forestry Tasmania |
| FWCC | Flood Warning Consultative Committee |
| GA | Geoscience Australia (Commonwealth) |
| GIS | Geographical Information Systems |
| GBE | Government Business Enterprise |
| HT | Hydro Tasmania |
| ICA | Insurance Council of Australia |
| LCC | Launceston City Council |
| LFA | Launceston Flood Authority |
| LiDAR | Light detection and ranging |
| LIST | Land Information Services Tasmania |

| | |
|-----------------|---|
| MA | Management Authority |
| NDRP | Natural Disaster Resilience Program |
| NDRRA | Natural Disaster Relief and Recovery Arrangements |
| NSDR | National Strategy for Disaster Resilience |
| OSEM | Office of Security and Emergency Management |
| PC | Productivity Commission |
| PPRR | prevention, preparedness, response and recovery |
| RECC | Regional Emergency Coordination Centre |
| REMC | Regional Emergency Management Committee |
| Review Team | Flood review team |
| ROC | Regional Operations Centre |
| SEMC | State Emergency Management Committee |
| SES | State Emergency Service |
| SFOC | State Flood Operations Centre |
| SLS | Service Level Specifications – arrangement between the State Government and BoM |
| SOC | State-Owned Company |
| TEMA | Tasmanian Emergency Management Arrangements |
| TEMP | Tasmanian Emergency Management Plan |
| TFS | Tasmania Fire Service |
| The/This Review | Independent Flood Review of the flood event in June 2016 |
| TRRA | Tasmanian Relief and Recovery Arrangements |
| TSNDRA | Tasmanian State Natural Disaster Risk Assessment |

Appendix B – Glossary

| | |
|---|--|
| AEP | Annual exceedance probability. The chance of a flood of a given size (or larger) occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m ³ /s has an AEP of 5%, it means that there is a 5% chance (ie a 1 in 20 chance) of a peak. |
| ARI | Annual recurrence interval. The long-term average number of years between the occurrence of a flood as big as (or larger than) the selected event. For example, floods with a discharge as great as (or greater than) the 20-year ARI design flood will occur on average once every 20 years. |
| Australian Height Datum | A common national survey height datum as a reference level for defining reduced levels; 0.0 metre AHD corresponds approximately to sea level. |
| Awareness | Knowledge or perception of a situation or fact. (Oxford Living Dictionary) |
| DPIPWE report | A report developed Alluvium Consulting Australia Pty Ltd, which was engaged by DPIPWE to assist in flood recovery assessments. Alluvium Consulting is a nationally recognised company in this field and we had confidence in its report as being authoritative. |
| <i>Emergency Management Act 2006</i> | Sets out powers and functions and provides authority for high-level government leadership and response functions by management authorities. This covers all emergencies and disasters in an all-hazards approach to effective management of emergencies. |
| Flash flood | Flash floods are normally defined as those floods that occur within six hours of rain, and characterised by rapid rises in water levels. Flash floods can occur anywhere and can be embedded in more widespread riverine flooding, resulting from isolated intense bursts of rainfall. They can also develop independently as a result of heavy rainfall or thunderstorms. (State Special Emergency Management Plan – Flood) |
| Flood | A general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters from the unusual and rapid accumulation of runoff of surface waters from any source. (State Special Emergency Management Plan – Flood) |
| Flood (as per the insurance ICA submission) | 'Flood' means the covering of normally dry land by water that has escaped or been released from the normal confines of any of the flowing: (a) a lake (whether it has been altered or modified); (b) a river (whether it has been altered or modified); (c) a creek (whether it has been altered or modified); (d) another watercourse (whether it has been altered or modified); (e) a reservoir; (f) a canal or (g) a dam. (<i>Insurance Contracts Regulations 1985</i>) |
| Flood warning | A written product to provide advice on impending flooding so people can take action to minimise its negative impact. This will involve some people taking action on their own behalf and others doing so as part of agency responsibilities. |

| | |
|---------------------------------|---|
| Flood watch | A written product that alerts when the combination of forecast rainfall and catchment conditions indicates that flooding is likely. |
| Government | Government refers to the Tasmanian Government unless specified otherwise. |
| LiDAR | Stands for Light Detection and Ranging. A LiDAR instrument transmits an intense laser light at an object and detects the laser light reflected back from the object to determine the range from the instrument to the object. A LiDAR flown in an aircraft is an extremely cost-effective method of measuring detailed height data relating to the ground and features on the ground. It is ideal for generating digital terrain models and contours, and mapping infrastructure such as powerlines, and corridors for proposed pipeline, rail and road routes. |
| Minor flooding | Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas, inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas, removal of stock and equipment may be required. |
| Moderate flooding | In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas, removal of stock is required. |
| Major flooding | In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be affected. |
| National Partnership Agreements | NPAs are arrangements between the Australian Government and the states and territories. A number of such agreements exist. Generally they deal with service delivery expectations, clarity about respective roles and responsibilities including reporting, and, where relevant, funding arrangements. |
| Preparedness | Planned and coordinated measures, so safe and effective response and recovery can occur. (Tasmanian Emergency Management Plan) |
| Rain | Precipitation of liquid water drops greater than 0.5 mm in diameter. In contrast to showers, it is steadier and normally falls from stratiform (layer) cloud. |
| Rainfall | The total liquid product of precipitation or condensation from the atmosphere, as received and measured in a rain gauge. |
| Recovery | Means the coordinated process of supporting disaster-affected communities in the reconstruction of the physical infrastructure, rehabilitation of the natural environment, re-establishment of the local economy and restoration of emotional, social and physical wellbeing of individuals and communities. Recovery includes the following |

| | |
|---------------------|---|
| | elements: social, economic, infrastructure and environmental. (State Special Emergency Management Plan – Recovery) |
| Resilience | The ability of communities to withstand impacts and recover more rapidly following an emergency. |
| Riparian vegetation | Plants (trees, shrubs, ground covers and grasses) which grow on the banks and floodplains of rivers and other waterbodies. A 'healthy' riparian zone is characterised by a homogeneous mix of plant species (usually native to the area) of various ages. This zone is important in protecting water quality and sustaining the aquatic life of rivers. |
| Response | Planned and coordinated measures that resolve emergencies. (Tasmanian Emergency Management Plan) |

Appendix C – List of figures

Figure 1: Emergency management arrangements

Figure 2: Three day rainfall totals across Tasmania ending at 0900 on 7 June 2016

Figure 3: Lake Mackenzie rainfall pattern – June 2016

Figure 4: Lake Mackenzie rainfall pattern – January 2011

Figure 5: Water catchments covered by BoM's flood warning service

Appendix D – List of submissions

The submissions may be viewed at http://www.dpac.tas.gov.au/government_flood_review

| | |
|--|-----------------------------------|
| 1. Salvation Army | 28. West Tamar Council |
| 2. Tasmania Police | 29. TasWater – General Manager |
| 3. Bushfire & Natural Hazards CRC | 30. Tasmanian Planning Commission |
| 4. Local Government Association | 31. Martin, Sally |
| 5. Central Coast Council | 35. Rural Business Tasmania |
| 6. State Emergency Service | 33. Sands, Richard |
| 7. Tasmanian Farmers and Graziers Association | 34. Lambert, Paul |
| 8. City of Launceston Council | 35. Austin, Paul and Katie |
| 9. Department of Justice | 36. Bloomfield, Luke |
| 10. Hydro Tasmania | 37. Perkins, Michael |
| 11. Kentish Council | 38. Lambert, Mark |
| 12. Latrobe Council | 39. Irving, Mark and Shirley |
| 13. Central Highlands Council | 40. Hayward, John |
| 14. Geoscience Australia | 41. State Growth |
| 15. Metro Tasmania | 42. Stubbs, David |
| 16. Insurance Council of Australia | 43. Burnie City Council |
| 17. Emergency Management Reforms Project | 44. Bureau of Meteorology |
| 18. Tasmanian Health Service | 45. Forestry Tasmania |
| 19. Landcare Tasmania | 46. Chilcott, Geoff |
| 20. Northern Regional Flood Recovery Committee | 47. DPIPWE |
| 21. Tasmanian Flood Recovery Taskforce | 48. DPAC |
| 22. Burling, Mark and Linda | 49. Australian Red Cross |
| 23. Mt Roland Rivercare Catchment | 50. St Vincent de Paul Society |
| 24. Lambert, Ted and Kathryn | 51. Insurance Australia Group Ltd |
| 25. Davie, Philip | 52. Soutter, Wayne |
| 26. Alsop, Barbara | 53. Mineral Resources Tasmania |
| 27. Harvest Moon, Forth | 54. TasRail |

Appendix E – Government Flood Review budget outcome

Government Flood Review – Budget Outcome estimate as at 1 June 2017

| Budget Line Item | YTD Expenditure |
|---|-----------------|
| COMMUNICATIONS – NETWORKS | 162 |
| COMMUNICATIONS - PHONES | 18 |
| LEAD INVESTIGATOR ⁹⁴ | 37,227 |
| OFFICE SUPPLIES | 412 |
| OTHER INFORMATION TECHNOLOGY | 187 |
| OTHER OPERATING EXPENSES | 161 |
| PRINTING & PUBLICATIONS | 3,610 |
| PROFESSIONAL SERVICES & CONSULTANCIES ⁹⁵ | 162,021 |
| TEAM MEMBERS ⁹⁶ | 114,067 |
| TRAVEL - VEHICLE EXPENSES | 110 |
| TRAVEL AIRFARES | 522 |
| TRAVEL ALLOWANCES | 1,027 |
| | |
| ESTIMATED SPEND TO DATE | 319,525 |
| BUDGET | 400,000 |
| UNSPENT | 80,474 |

⁹⁴ Including estimated costs remaining – Lead Investigator consultancy \$5K

⁹⁵ Including estimated costs remaining – Professional Editing \$10K

⁹⁶ Including estimated costs remaining – Team Members salaries \$5K