



Halls Gap Dam Break Evacuation Plan

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PRELIMINARY DRAFT ONLY

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1 Introduction

1.1 Background

Evacuation in the face of an imminent failure of the Lake Bellfield dam needs to be rapid and efficient, as it could take only 1.6-1.7 hours for Grampians Road to be flooded throughout the length of Hall Gap, and evacuation by road would then become impossible.

In peak periods there is likely to be 8,000-10,000 tourists and over 4,000 vehicles in Halls Gap, so a traffic jam is likely if no dam break evacuation plan exists i.e. attempts to evacuate may become ineffective.

The advice from both the CFA and SES in the face of an emergency is to 'Leave early'. This is even more critical in the face of an imminent dam break. A community-specific evacuation plan is required to support this advice.

1.2 Purpose

This document provides a framework for a dam break evacuation plan, for use as the basis for planning of an actual evacuation.

1.3 Scope

The scope of this plan is limited to Halls Gap as broadly outlined geographically in Figure 2.

1.4 Audience

This document is intended for use by staff of relevant emergency response agencies.

1.5 Caveats

This document

- has not been reviewed by emergency management agencies, as Victoria Police has declined to engage on the issue,
- is a preliminary draft which is intended to evolve and improve as feedback is provided, and
- assumes that there are no other concurrent emergency events that will affect any evacuation e.g. bushfire, flood, landslide, etc.

1.6 Feedback

Any queries on matters not dealt with in this plan, or suggested refinements or corrections to matters included in this plan, should be referred to the Secretary of the Resilience Group via email:

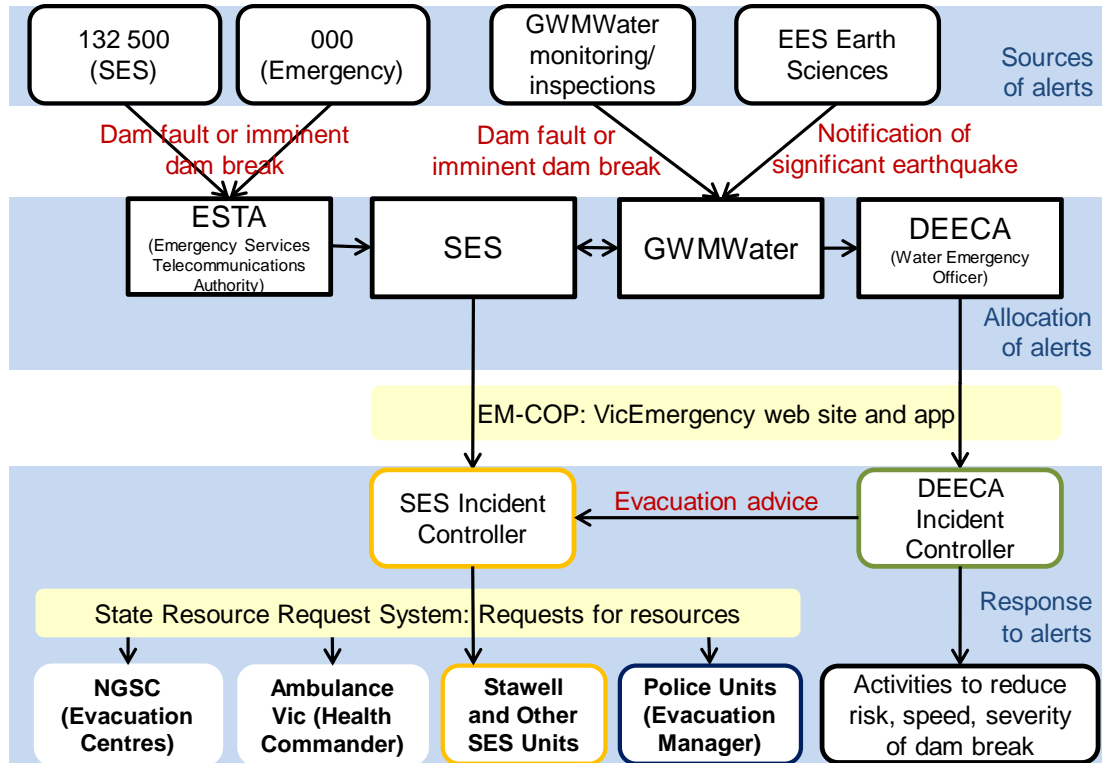
secretary@resiliencegroup.org.au

2 Context for Evacuation

2.1 Emergency Reporting and Control

While the arrangements for a dam break are still unclear, an approximation of the emergency reporting and control for such an event in Halls Gap is provided in Figure 1. DEECA is the control agency.

Figure 1: Approximate Emergency Reporting and Control



The key outcome from these processes is the appointment of an Incident Controller, who will coordinate the response to the dam break, obtain resources to implement the plan, and manage the emergency through to its conclusion.

As part of the plan, the Incident Controller is required to consult with Victoria Police to develop, implement and monitor a traffic management plan, including the establishment of road closures and traffic management points (TMPs) on the ground. This plan needs to also include provision for evacuation.

Victoria Police will implement the traffic management plan.

The DEECA Incident Controller will decide whether evacuation of part or all of Halls Gap is recommended or not, after consultation with GWMWater and Victoria Police.

Given the uncertain reporting and control structure shown above, and the fact that most emergency parties are physically remote from Halls Gap, it is highly likely the any decision to evacuate will take time and possibly too much time (see 2.5 below.) It is critical that the reporting and control structure and process be reviewed and agreed between the relevant parties so that no delays occur. (GWMWater does not appear to be a part of the Northern Grampians MEMPC.)

In the absence of any viable alternative, evacuation by vehicle is assumed to be the primary evacuation method. Walking to higher ground may be an option if vehicles are not available.

2.2 Geographic Context

The geographic context for evacuation of Halls Gap is given in Figure 2.

Figure 2: Evacuation Route Context



Source: Google Earth

2.3 Evacuation Routes

The four evacuation routes which are available (see Figure 2) are:

- Grampians Rd heading east towards Stawell, with the option to head south on the Ararat-Halls Gap Rd,
- Grampians Rd heading south towards Dunkeld,
- Mt Victory Rd heading west towards Zumsteins, and
- Mt Zero Rd, heading north towards Roses Gap.

All roads are maintained by VicRoads except for Mt Zero Rd which is maintained by Parks Victoria (PV.)

All evacuation routes carry the risk of native fauna e.g. kangaroos.

2.3.1 Grampians Rd Heading East Towards Stawell

The Grampians Rd heading towards Stawell is an intermediate speed rural road. It is sealed, and horizontal curve radii are in excess of 160m (i.e. curves are gentle enough that there is no need to slow down from 100 km/h.) It travels through relatively flat open country. Long distance visibility is generally good. Drivers can readily maintain speeds of 100 km/h. Lane widths are reasonable at 3m or more. The road has no emergency or passing lanes, but most shoulders have reasonable widths.

Overall, it is a reasonable option for evacuation from a dam break prior to impact.

2.3.2 Ararat-Halls Gap Rd Heading South Towards Ararat

The Ararat-Halls Gap Rd heading towards Ararat is also an intermediate speed rural road. It is sealed, and horizontal curve radii are in excess of 160m. It travels through rolling hills in largely open country. Long distance visibility is variable. Drivers can readily maintain a speed of 100 km/h on most sections of the road, although some advisory speed signs are as low as 80 km/h. Lane widths are reasonable at 3m or more. The road has no emergency or passing lanes until just outside Ararat, but most shoulders have reasonable widths.

Overall, it is a reasonable option for evacuation from a dam break prior to impact.

2.3.3 Grampians Rd Heading South Towards Dunkeld

The Grampians Rd heading towards Dunkeld is also an intermediate speed rural road. It is sealed, and horizontal curve radii are in excess of 160m. It travels through rolling hills and densely forested country. Long distance visibility is lower than on the roads above. While drivers will typically drive at 100 km/h wherever possible, there are sections of the road which are constrained by geometry and visibility to about 90 km/h. Lane widths are reasonable at 3m or more. The road has no emergency or passing lanes, but most shoulders have reasonable widths.

Overall, it is a reasonable option for evacuation from a dam break prior to impact.

2.3.4 Mt Victory Rd Heading West Towards Zumsteins

The Mt Victory Rd is a low speed rural road. It is sealed, but has many curves with radii less than 150m, largely due to the constraints of the difficult terrain. Advisory speeds on some curves are as low as 40 km/h. It travels through steep hills and densely forested country. Long distance visibility is relatively low. Driving requires a high degree of driver alertness, as drivers need to slow down for curves where necessary and then accelerate when the opportunity arises on the straights. Fallen stones on the road may also need to be avoided. Vehicle speeds are therefore very variable.

The road is readily blocked by traffic accidents:

- There are often steep drop-offs on one side of the road and steep embankments on the other side, making it difficult to bypass an accident.
- The road has no emergency or passing lanes, lane widths are as low as 2.3m in places, and the shoulders are very narrow in many places.

- The road is not really suitable for caravans (see warning sign below.)

Overall, this road should not be used for a dam break evacuation, other than as a last resort.

Figure 3: Warnings – Mt Victory Rd



2.3.5 Mt Zero Rd Heading North Towards Roses Gap

The Mt Zero Rd is a low speed rural road. It is not sealed and driving conditions often change. In dry weather visibility is heavily reduced by dust thrown up by vehicles. In the absence of dust, long distance visibility is relatively good. With one exception, horizontal curve radii exceed 160m, but the gravel surface requires relatively low speeds on curves in any case. The general advisory speed is 70 km/h due to the risk of windscreen damage. Lanes are not marked, but the road width is reasonable at 6m or more. The road has no emergency or passing lanes, but most shoulders have reasonable widths.

Overall, it is not a good option for a dam break evacuation other than as a last resort.

Figure 4: Warnings – Mt Zero Rd



2.3.6 Impact of Dam Break on Evacuation Routes

GWMWater's inundation map shows the level of flooding that would arise from a Lake Bellfield dam break (see Figure 5.)

The analysis shows that it would take 1.6–1.7 hours for the water to reach the highest level shown, at which time

- Grampians Road will be covered by flood water throughout most of the town, and
- the initial stages of Mt Victory Road and Mount Zero would be flooded, making them inaccessible.

At this point in time, dam break evacuation will be difficult or impossible.

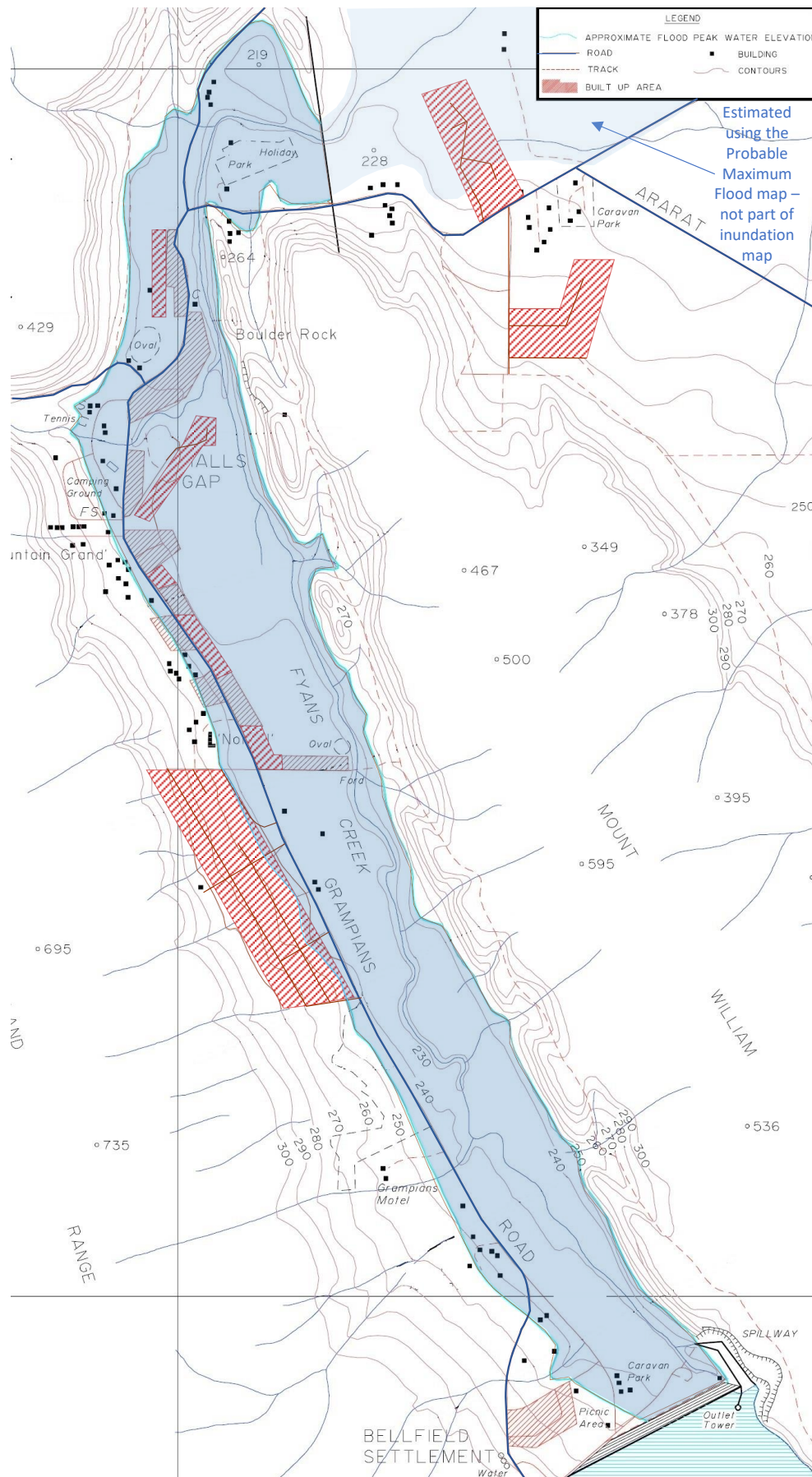
2.3.7 Summary of Evacuation Routes

In the absence of any other factors affecting the evacuation, a summary of the evacuation options is provided in Table 1 below.

Table 1: Evacuation Route Summary

Is this road acceptable as a potential evacuation route?		
Road	Prior to Impact	During a Dam Break
Grampians Rd East	Yes	For a limited time only (1.5 hours)
Grampians Rd South	Yes	For a limited time only (1.5 hours)
Mt Victory Rd	Only as last resort	For a limited time (1.5 hours) and only as last resort
Mt Zero Rd	Only as last resort	For a limited time (1.5 hours) and only as last resort

Figure 5: Inundation Map



Adapted from the inundation map developed by Sinclair Knight Merz for GWMWater

2.3.8 Conclusions

In general, the primary evacuation routes for Halls Gap are

- Grampians Rd heading east towards Stawell, with the option to head south on the Ararat-Halls Gap Rd, or
- Grampians Rd heading south towards Dunkeld, or
- both of the above at the same time.

However none of these options are likely to be viable about 1.5 hours after a dam break.

2.3.9 Recommendation

A primary focus in a dam break should be on determining when it is no longer viable to evacuate people out of the town, at which time evacuating people to higher ground within the valley will be required.

2.4 Time to Impact

The time to impact for a dam break is uncertain. GWMWater has advised that the most likely cause of a dam break would be a significant earthquake. This could lead to cracking (and piping), or settlement.

Piping is likely to take some time before any dam failure follows. However the other defects may lead to rapid failure e.g:

- Multiple cracks could lead to a section of the dam wall being forced out of place by water pressure.
- Settlement of the dam's earthen core due to the shaking created by the earthquake may lead to over-topping.

In either of the latter two cases, the level of water in the dam will have a significant effect on the outcome.

As described in 2.3.6, the water would reach its peak in the valley in 1.6-1.7 hours, but evacuation from lower-lying areas in the valley would need to be almost immediate i.e. time to impact would be very short for some people.

Based on the estimates in section 2.5 below, it is possible that in peak periods there will be inadequate time to evacuate the town before the valley is completely flooded and evacuation is impossible.

2.5 Time to Evacuate

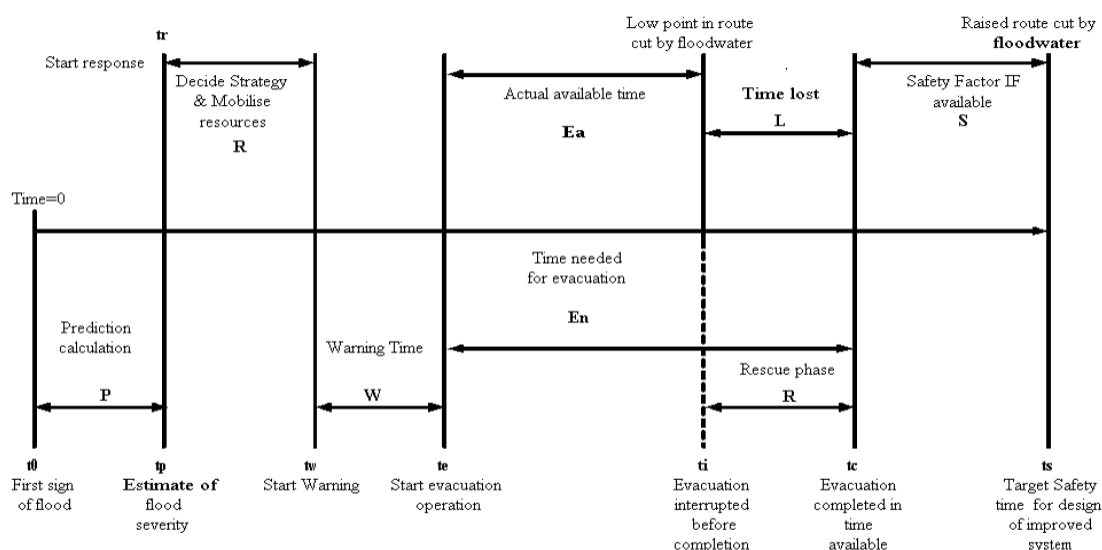
As shown in Figure 6, the total time to evacuate is determined by many factors, particularly

1. the time taken to inspect the dam and assess the status of the dam break,
2. the time taken to decide an evacuation strategy and mobilise resources,
3. the warning time between any **Prepare to Evacuate** message and the **Evacuate Now** message, and
4. the core time needed for evacuation i.e. the actual time taken to evacuate vehicles from the town.

If the time associated with factors 1-3 is greater than 0.5 hours, Table 2 shows there will be inadequate time to evacuate the town, even under good conditions and using Grampians Rd in both directions.

If any **Prepare to Evacuate** message was appropriately responded to, people should be able to respond to the **Evacuate Now** message promptly. If there is no **Prepare to Evacuate** message (see 4.4) responses may be much slower.

If prior to its completion evacuation is interrupted by the flooding of Grampians Rd, a rescue phase may need to be initiated. This would be based on requests for assistance to VICSES.

Figure 6: Factors Affecting Total Time to Evacuate¹**Schematic Time Line of Emergency Response for Flood Evacuation**

Notes: S will be a negative value (safety Factor < 0) when t_i occurs earlier than t_c . S will be zero when all available time needed (E_n) is used. Only when t_i occurs after t_c does a Safety Factor begin to accrue. The magnitude of S has to be determined by reference to the capacity to cope with uncertainty and interruptions. The time elements are not drawn to scale in this diagram but should be for proper analysis.

The core time needed for evacuation is dependent on the design flow rate on a rural road of 1,200 vehicles/hour/lane, which should be achievable under good conditions. If downgraded by a factor of two to account for adverse driving conditions such as heavy rain, darkness, and driver unfamiliarity, a flow rate of 600 vehicles/ hour/lane should be achievable¹. Assuming minimal self-evacuation before the evacuation order, in peak periods (about 4,000 vehicles) it would take the times shown in Table 2.

Table 2: Time for Vehicle Evacuation During Peak Periods

Evacuation Route	Dam Break (70% of town)	
	Good conditions	Poor Conditions
Grampians Rd East only	2.3 hrs	4.7 hrs
Grampians Rd South only	2.3 hrs	4.7 hrs
Grampians Rd both directions	1.2 hrs	2.3 hrs

The most viable option will be to evacuate via Grampians Road in both directions, but this option will be heavily dependent on which parts of Grampians Road are flooded first. The road will need to be monitored closely, and its status rapidly updated to the Incident Controller when sections are flooded.

For off-peak periods, it is likely that there will be less than 600 vehicles present in the town, and if everyone responds promptly the times would be much shorter and evacuation out of the town should be viable for everyone (see Table 3.)

Table 3: Time for Vehicle Evacuation During Off-Peak Periods

Evacuation Route	Dam Break (70% of town)	
	Good conditions	Poor Conditions
Grampians Rd East only	20 mins	45 mins
Grampians Rd South only	20 mins	45 mins
Grampians Rd both directions	10 mins	20 mins

¹ Oppen S., (2004) "The Application of Timelines to Evacuation Planning", NSW SES, https://www.ses.nsw.gov.au/media/2557/the_application_of_timelines_to_evacuation_planning.pdf

2.6 Evacuation to Higher Ground

Where people do not have a vehicle to aid in evacuation, quickly walking to higher ground will be the best option.

Once Grampians Road begins to be flooded, evacuation to higher ground may be the best option for vehicles also.

Locations of higher ground should be pre-identified to ensure evacuation warnings direct people and vehicles appropriately. They could include

- the Bellfield dam lookout car park,
- the higher reaches of the Bellfield Settlement,
- High Road, and possibly Scott Road,
- the higher reaches of the Breeze Caravan Park – Halls Gap, near School Road,
- the higher reaches of Reid's Lane,
- the roads leading up the west valley wall, including the higher reaches of Rosea Street and Mackeys Peak Road, and
- for those walking to higher ground, the walking tracks leading up the valley walls.

3 Impact of a Dam Break

Based on Figure 5, the following consequences of a dam break can be expected:

- The dam itself would be severely damaged, and depending on the level of the water remaining, water services to Halls Gap and Pomonal (and other downstream users) may be cut off.
- The water treatment plant will be flooded and treated water will no longer be produced.
- Many of the accommodation assets (dwellings, resorts, caravan parks, hotels, motels, guest houses, backpacker hostels, etc.,) located on the valley floor will be flooded and may be damaged or destroyed, including some of the larger capacity sites such as the Lakeside Tourist Park, the Country Plaza, the lower reaches of the Breeze Caravan Park – Halls Gap, Big 4 Holiday Park, etc.
- Many of the community assets (Primary School, Halls Gap Hub, Brambuk Visitor/Cultural Centre, Neighbourhood house, Botanic Garden, Community Garden, picnic shelters, swimming pool) located on the valley floor will be flooded and may be damaged.
- The Neighbourhood Safer Place – Bushfire Place of Last Resort (NSP-BPLR) will be flooded.
- Many of the non-accommodation businesses in the town (restaurants, food and grocery outlets, bars, medical centre, pharmacy, souvenir shops, petrol station, etc.,) will be flooded and may be damaged or destroyed.
- The Parks Victoria works depots will be flooded, which may limit access to vehicles and equipment.
- Some of the overhead power lines in the valley are likely to be brought down, and power throughout some sections of the town may be lost.
- The essential services precinct (Police Station, Fire Station and Ambulance Station) will be flooded, and services may be affected.
- Both locations used for helicopters will be flooded i.e. the helipad in the paddock behind Brambuk, and the Sports Oval.
- Budja Budja Medical Clinic will be flooded.
- Most or all sewage pump stations will be flooded and human pathogens can be expected in the flood waters.
- While it is well downstream, the sewage/ wastewater treatment plant may be flooded releasing human pathogens into Back Creek.
- The base of the telecommunication towers, and the Telstra Exchange next to Delleys Bridge will be flooded and telecommunications services may be unavailable.
- Depending on how well secured they are, gas tanks (which are very buoyant) may break free, and float away in the flood waters. Gas may be released from open bottle valves or broken gas lines, creating a hazardous substance risk, or a gas flare risk.

Other likely consequences of the dam break would include

- damaged and unsafe structures, unsafe electrical and gas facilities, and unsafe fuel storage,
- the presence of hazardous conditions e.g. ground, air or water contaminated by asbestos or other hazardous materials, sewage, dead animals, etc.,
- roads and properties blocked by fallen trees and flood debris, and
- damaged equipment and vehicles in works depots and the essential services precinct.

Overall the impact on the town will be extreme and will not only affect property owners directly, but may limit the ability of property owners to return to the town promptly due to health and safety risks.

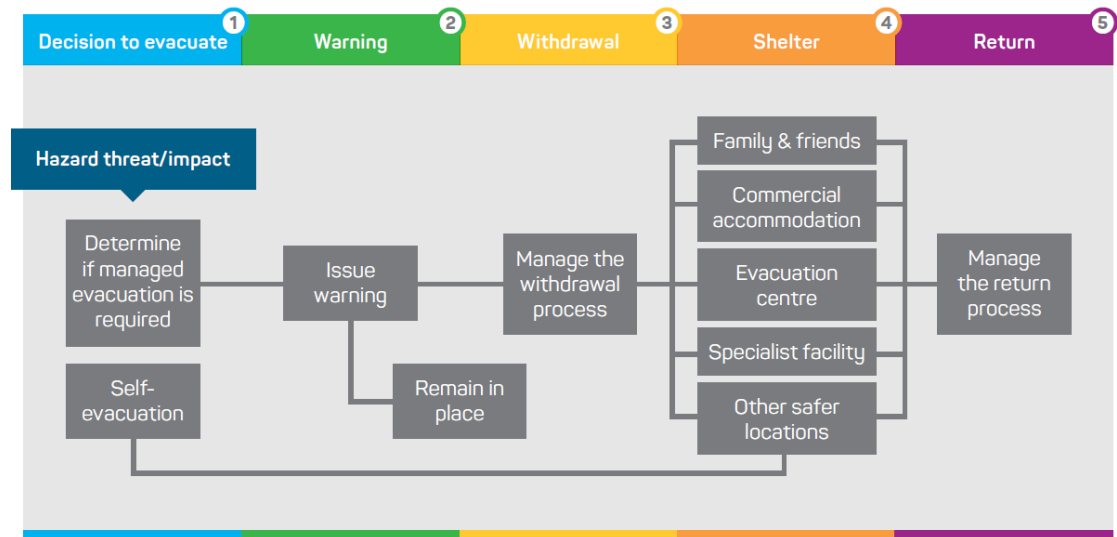
4 Evacuation Considerations for a Dam Break

While the JSOPs are adequate to handle evacuations, they are unlikely to be adequate to handle the specific case of a dam break i.e. they should be supplemented by the information in this plan. (Some of the information below duplicates information from section 3.)

4.1 Overview

The five-stage evacuation process is summarised in Figure 7.

Figure 7: Evacuation Process



Source: Australian Disaster Resilience Handbook 4: Evacuation Planning

4.2 Self-Evacuation

Some people may decide to self- evacuate e.g. as a result of an emergency alert from the VicEmergency app or website. It is critical that any alerts highlight the risks associated with evacuating via Grampians Road, and the alternative of evacuating to higher ground.

4.3 Decision to Evacuate

Depending on the stage of the dam break and the flooding of Grampians Road, the risks of evacuating out of the town may be greater than the risks of evacuating to higher ground within the valley i.e. the type of evacuation warning issued by the Incident Controller needs to suited to the way the situation develops, and should include recommended evacuation routes.

In urgent circumstances requiring immediate evacuation the Incident Controller will disseminate the recommendation to evacuate, irrespective of whether or not they have contacted Victoria Police or reviewed any other consideration.

In some urgent life-threatening circumstances, and in an effort to preserve life, the decision to recommend evacuation may be made by any agency representative e.g. a GWMWater officer. In this circumstance, the Incident Controller is required to be notified of the decision as soon as possible.

A secondary evacuation may be required as, once flood waters have receded, it may be desirable for people who moved to higher ground to be evacuated out of town, due to

- health and safety risks (unsafe structures, unsafe electrical and gas facilities, unsafe fuel storage and other hazardous facilities, or the presence of any hazardous conditions e.g. ground, air or water contaminated by asbestos, sewage, dead animals, etc.),
- the lack of water, electricity and sewage services, and
- the lack of services from food and grocery outlets, and the lack of medical services.

4.4 Issue Warning

Past disasters have shown that lives can be lost if decisions are left until the last minute. For this reason, **Prepare to Evacuate** warnings may not be appropriate – it may be better to issue an **Evacuate Now** message immediately, in consultation with GWMWater and Victoria Police.

Where authorisation by the Incident Controller is not practicable and an extreme and imminent threat to life may exist, an evacuation message can be issued by any agency person.

Warnings will be issued through the Emergency Alert system which sends voice messages to landlines and text messages to mobile phones within an evacuation area. However, the base of the telecommunication towers, and the Telstra Exchange next to Delleys Bridge will become flooded and telecommunications services may become unavailable and Emergency Alert warnings may no longer be effective.

As delivery of Emergency Alert messages is not guaranteed, emergency vehicles with public address systems should broadcast verbal warnings particularly in those areas located in low lying areas of the valley, if it is safe to do so. Face-to face interactions such as door knocking may also be needed, if it is safe to do so, but it is unlikely to be a timely method of communication as it could take up to 4 hours to door knock the entire town.

The standard EM-COP warnings should also be placed on the VicEmergency web site, and through mass media outlets (ABC radio, and TV/newsprint channels.)

4.5 Remain in Place

For those in the locations of higher ground, remaining in place may be an option.

For those located in the low-lying areas of the valley, remaining in place will not be a viable option. **Anyone in these areas who seeks community assistance to remain in place should be told there is no suitable venue, and that they should evacuate with everyone else. If they cannot evacuate for any reason, they should be advised to call VICSES and request assistance.**

4.6 Managing the Withdrawal Process

Victoria Police will need to monitor the stage of flooding (particularly along Grampians Road) and manage the evacuation process closely, including providing updated information on the status of flooding to the Incident Controller, who will ensure evacuees are kept sufficiently informed to make well considered decisions, particularly on whether to evacuate or move to higher ground.

The essential services precinct (Police Station, Fire Station and Ambulance Station) will be flooded when water reaches its peak, and services may be affected.

Similarly, both locations used for helicopters will be flooded i.e. the helipad in the paddock behind Brambuk, and the Sports Oval. Aerial evacuation may be difficult and very limited.

4.7 Shelter

There are no formal Evacuation Centres in Halls Gap, and if there were, they would most likely be flooded. The Neighbourhood Safer Place – Bushfire Place of Last Resort (NSP-BPLR) will be flooded and is not an option for shelter for any resident or tourist.

Much of the commercial accommodation will be flooded and unavailable for shelter, including some of the larger capacity sites such as the Lakeside Tourist Park, Big 4 Holiday Park, the lower reaches of the Breeze Caravan Park, the Country Plaza, etc.

Some of the higher ground locations listed in section 2.6 have limited capacity and may fill quickly. The primary shelter in these locations will be the vehicles people evacuate in. Shelter for those who walk to higher ground will be uncertain.

Budja Budja Medical Clinic will be flooded, and will not be able to provide emergency medical services.

4.8 Return

Those who evacuated to higher ground and who observe the flood waters receding may self-return without the involvement of any emergency services personnel or warnings.

This may require close monitoring by the Incident Controller and Victoria Police, as there may be a need to restrict access for the same reasons as listed in section 4.3 i.e.

- areas that still pose a threat to health and safety due to unsafe structures, unsafe electrical and gas facilities, unsafe fuel storage and other hazardous facilities, or the presence of any hazardous conditions e.g. ground, air or water contaminated by asbestos or other hazardous substances, sewage, dead animals, etc., or
- locations where deaths have occurred, or are suspected to have occurred, or
- locations where crime scene preservation is required.

Mitigation of health and safety risks will be a prerequisite for any approvals to return, and in any case should be a focus for recovery activities (see below.)

Any lack of treated water may require advice to residents to boil their water.

4.9 Recovery

Recovery is technically out of the scope of an evacuation plan, but nevertheless some key issues follow:

The Parks Victoria works depots will have been flooded, which may limit the use of equipment which could aid in the recovery from the flood e.g. clearing roads blocked by trees and flood debris.

Recovery priority should be given to mitigation of risks i.e.

- securing unsafe structures,
- repairing or isolating unsafe electrical facilities, gas facilities, fuel storages, and other hazardous facilities,
- mitigating any other hazardous conditions e.g. ground, air or water contamination,

and restoration of essential services i.e.

- treated water supply,
- electrical services,
- sewage services,
- telecommunication services, and
- food and grocery supplies.