Dams Safety NSW

www.damsafety.nsw.gov.au

Dams Safety NSW Emergency Plans

March 2024

Acknowledgement of Country

Dams Safety NSW acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Contents

Version	Approved date	Approved by	Notes
1	September 2020	CEO Dams Safety NSW	Initial issue of the guideline
2	March 2024	CEO Dams Safety NSW	Addition of the standard summary information sheet for the NSW SES and other amendments

1. Introduction and purpose of this document

Dams Safety NSW is an independent regulator established under the *Dams Safety Act 2015 (the Act)*. Dams Safety NSW seeks to ensure that dam owners achieve compliance with the Act and the Dams Safety Regulation 2019 (the regulation).

Dams Safety NSW "declares" those dams which have a potential to threaten downstream life, or cause major property, environmental, or public welfare damage. Owners of declared dams must comply with the requirements of the Act and regulation.

Dams Safety NSW publishes guidelines to clarify legislative requirements and to provide information to assist dam owners.

Dam owners are responsible for ensuring compliance with the legislation and this guideline is not intended to provide an acceptable means of compliance.

When referring to the requirements of the legislation this guideline uses the words 'need to', 'required to', 'requires' or 'must'. Otherwise, it uses the words 'may' or 'should' when clarifying requirements or suggesting actions, methods or techniques.

Dam owners are not required to adopt the suggested methods, techniques or other material contained in this guideline unless the wording includes 'need to' 'must' or 'requires' and a dam owner may adopt other approaches if they fit better with a dam owner's systems.

However, the regulation requires that a declared dam owner is to have regard to any relevant guidance material issued by Dams Safety NSW. Dams Safety NSW expects declared dam owners to have regard to the information sheet guidance contained in this guideline when preparing their emergency plan.

The regulation also requires that a declared dam owner provide a copy of the emergency plan to Dams Safety NSW and the NSW State Emergency Service *in a form approved by Dams Safety NSW*. Dams Safety NSW does not specify a particular form for the emergency plan but does require that a summary information sheet is included at the front of each emergency plan in the form specified in this guideline (Appendix 1).

A declared dam owner must prepare and implement an appropriate emergency plan for their dam.

The emergency plan is intended to address an imminent or actual failure of the dam structure. Dams Safety NSW considers that effective emergency plans are a vital part of a dam owner's dam safety management system to minimise consequences in the unlikely event of such an event.

This guideline contains information on emergency plans for declared dams. It should assist declared dam owners who are preparing or amending their dam emergency plans.

2. General

2.1. Which dams need emergency plans?

All declared dams are required to have an emergency plan.

Emergency plans for low or very low consequence category dams may be comparatively simple documents that reflect the fact that people are not at risk if the dam fails.

2.2. Dams Safety Regulation 2019 requirements

Clause 11 of the regulation specifies that:

(1) An emergency plan under section 17(1) of the Act for a dam must set out the following:

(a) the consequence category of the dam,

(b) details of the material contained by the dam,

(c) a description of the circumstances that could cause a failure of the dam and the likely consequences of the failure including, for a dam categorised as extreme or high consequence:

(i) details of all credible modes of dam failure, and
(ii) details of the persons, property and infrastructure that are likely to be impacted in each scenario and the environmental damage that is likely to occur,

(d) the procedures to be followed by the owner of the dam and staff in the event of an emergency that may cause a failure of the dam, including the following:

(i) a description of the emergency warning systems and how they operate,
(ii) the different levels of emergency alerts (being levels that are consistent with those used by the State Emergency Service), the triggers for those alerts and the responses that are to occur when those alerts are triggered,
(iii) the procedures for alerting emergency services organisations of the emergency,
(iv) the persons who may be at risk if there is a failure of the dam,
(v) the persons responsible for exercising functions in the event of an emergency and the contact details for those persons,

(e) details of the emergency exercises to be undertaken.

(2) The emergency plan may include any other matter that the dam owner considers to be relevant to emergencies at the dam.

(3) For the purposes of section 17(3) of the act, the emergency plan must be updated at least once every 5 years subject to subclauses (4) and (5).

(4) The emergency plan must be updated to take account of the following changes within 30 days after the change occurs:

(a) a change to the consequence category of the dam,

(b) a significant change, since the consequence category of the dam was last determined, to the number of persons who would be put at risk if there were to be a failure of the dam,

(c) a change to the emergency management arrangements.

(5) The emergency plan must be routinely reviewed, at least annually, to ensure that a change to the contact details of a person responsible for exercising functions in the event of an emergency is updated as soon as practicable after the change.

(6) Dams Safety NSW may direct the owner of a declared dam to update the emergency plan for the dam within a time specified in the direction.

(7) The owner of a declared dam must not fail to comply with a direction under this clause.

(8) The owner of a declared dam must provide a copy of the emergency plan to Dams Safety NSW and the State Emergency Service in a form approved by Dams Safety NSW as soon as reasonably practicable after the plan is prepared or updated.

And clause 11 states:

(1) Dams Safety NSW may issue guidance material for the preparation of plans under this Part.

(2) In preparing a plan under this Part, the owner of a declared dam is to have regard to any relevant guidance material issued by Dams Safety NSW and made available on its website

2.3. Intent of emergency plan

An emergency plan is an important element of a dam safety management system.

This importance within the dam safety management system has been recognised by the inclusion of requirements for emergency plans in the Act and more detailed requirements for emergency plans in the regulation. The legislation requires that a declared dam owner develop, document and implement a stand-alone emergency plan. The emergency plan should be separate to, but part of, the dam safety management system documentation.

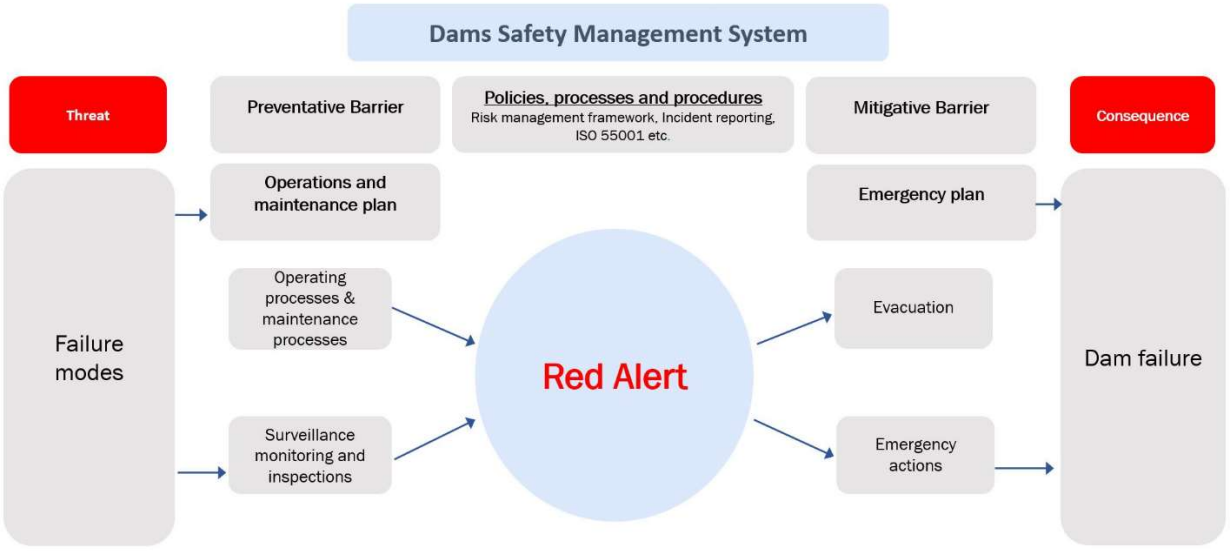
An emergency plan is a tool the dam owner, relevant emergency management group(s) and local government(s) will use during an emergency event aimed at protecting people and property.

The emergency plan provides the processes and procedures that will enable a dam owner to respond collaboratively with emergency management groups, local government(s) and emergency agencies to manage the consequences of an event.

The dam's operations and maintenance plan should include the preventive measures to address the risks associated with operating and maintaining the dam under normal, abnormal and extreme loading operation conditions. The emergency plan includes emergency response measures to be taken once an alert trigger has been reached (refer to section 4.6).

See Figure 1, which depicts a simplified 'bow tie' diagram for a dam, where dam failure mode risks are reduced (harm is prevented) by appropriate operations and maintenance processes documented in the operations and maintenance plan. If a failure mode risk, however, has not been dealt with appropriately, or extreme conditions occur, it may lead to a red alert and imminent dam failure. The emergency plan then describes activities designed to minimise harm due to dam failure.

Figure 1, Dam safety management system, operations and maintenance plan, and emergency plan



The emergency plan should include procedures to:

- protect a dam in the event of an emergency which may threaten the dam's function[1]
- notify the NSW SES during potential dam failure emergencies, and
- provide relevant information to assist the NSW SES in its emergency planning for areas affected by dam flooding.

The emergency plan outlines the actions of owners and their staff at dams in response to a range of possible emergency situations.

The emergency plan needs to be rigorously implemented by dam owners as an important part of the safety management system for their dam.

3. Developing an emergency plan

3.1. Key steps

Dam owners should consult the NSW SES at an early stage during the preparation of draft emergency plans to:

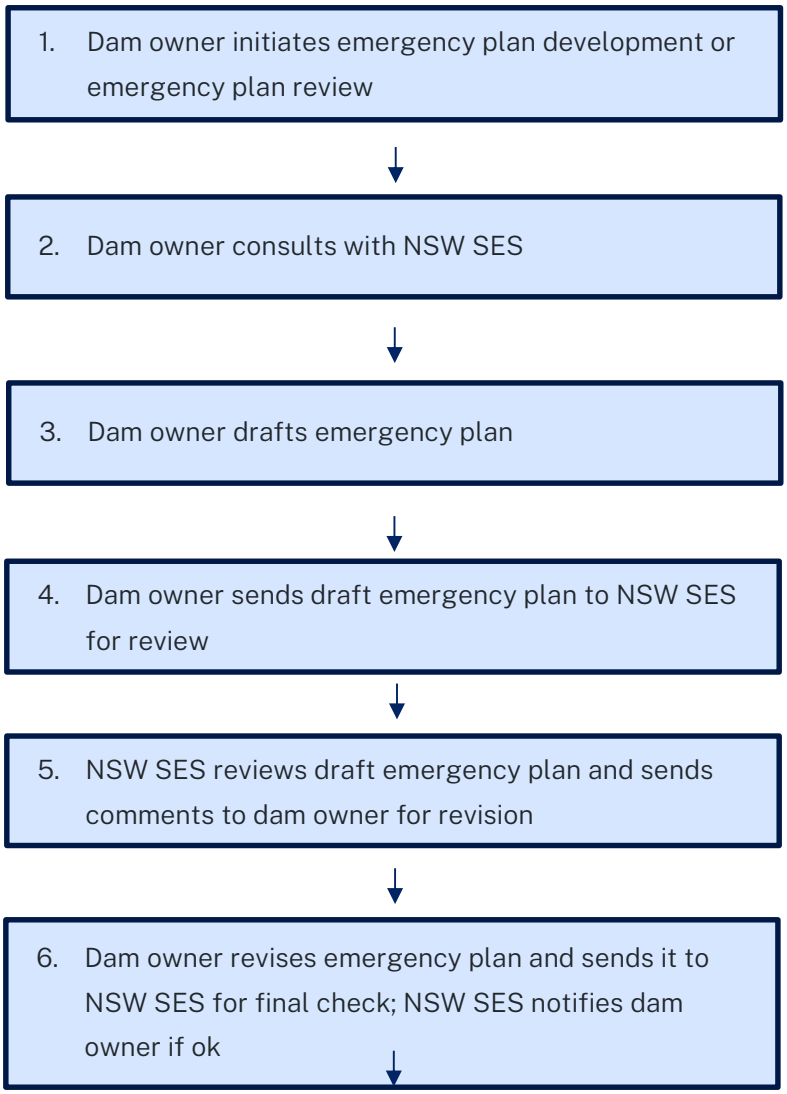
[1] The dam operations and maintenance plan is the principal document that includes the measures and operating procedures to be taken in abnormal and extreme loading operation conditions. The operations and maintenance plan should set out the roles and responsibilities of, and actions required by, operations, maintenance staff and contractors to ensure any operating requirements, associated operational checks, inspections and corrective maintenance or remedial works are triggered during and after abnormal and extreme events. The emergency plan may reference the operations and maintenance plan for these measures.

- jointly determine dam failure alert levels to allow maximum warning time with minimal false alarms[2] (i.e. white, amber and red alert levels); refer to section 4.6
- jointly determine appropriate warning protocols for downstream populations at risk (particularly warning arrangements for non-itinerant persons immediately downstream of dams)[3]
- identify and prioritise the relevant entities that have a role in the implementation of the emergency plan and
- confirm notification arrangements.

The key steps outlined in Figure 2 should be followed to ensure a proper external consultation and review process for the emergency plan.

The extent and content of emergency plans will vary between dams depending on local conditions.

Figure 2 - Key steps in emergency plan development



[2] Realistic warning times need to be provided so that the emergency response can be initiated in time

[3] Noting that it is the responsibility of the NSW SES to warn populations at risk in a flood situation

7. Dam owner distributes the emergency plan, including copies to NSW SES and Dams Safety NSW

4. Contents of an emergency plan

This section describes the content that the dam owner should include in the emergency plan.

A suggested contents list for the emergency plan is included in Appendix 4.

4.1. Dam information - general

The emergency plan should include general information that will be useful to dam staff and emergency agencies in an emergency.

This information needs to include the consequence category of the dam and a description of the contents of the dam. Other general information on the dam is also useful to include in the emergency plan as it can provide useful context for emergency agencies (see 4.2 below).

4.2. Summary information sheet

Dams Safety NSW expects each dam owner to complete the summary information sheet in Appendix 1 of this guideline and include it at the front of each emergency plan.

This summary information sheet has been designed to be used by the NSW SES, other emergency agencies (and dam staff) in an emergency. Its inclusion at the front of each emergency plan allows it to be quickly and easily accessed by the NSW SES in an emergency. This need was highlighted by the extreme rain events in NSW in 2021 and 2022, where the NSW SES needed fast access to dam information.

For some dams the summary information sheet will contain sufficient information to satisfy the dam 'general information' requirements for the emergency plan.

4.3. Responsibilities for emergency functions

The emergency plan should clearly set out the roles and responsibilities for all personnel involved in an emergency. These can be included in a summary table, or described throughout the emergency plan procedures.

The emergency plan should include a range of responsibilities and procedures for emergency response that aim to minimise the consequences of dam failure, including the formation of a crisis committee and/or an emergency response team, where appropriate.

The plan should include procedures for the prompt evacuation of employees of the dam owner (if applicable).

Consideration should also be given to including a representative of the dam safety design team in the crisis committee/emergency response team.

Trained and experienced dam operators are a valuable dam safety resource, particularly in emergencies and their value is enhanced when they are readily available to attend the dam site for emergency actions. The emergency plan and on-call trained staff, have particular importance for those dams with controlled spillways (e.g., gates, fuseplugs). Accordingly, dam owners should carefully consider the appropriateness of their staffing arrangements, particularly for emergency situations.

4.4. Dam failure scenarios

The emergency plan must set out a description of the circumstances that could cause a failure of the dam and the likely consequences of the failure.

For high and extreme consequence dams, the emergency plan needs to describe details of all credible modes of dam failure[4], the details of the persons, property and infrastructure that are likely to be impacted in each failure mode and the environmental damage that is likely to occur. Depending on the consequence category of the dam, this is usually determined by a dambreak study[5].

***Note**:*

This guideline uses the term 'failure scenario'. A failure scenario is associated with a 'credible mode of failure'.

A key aspect of the regulation is the risk framework that is to be established as part of the dam safety management system (clause 14 of the regulation). As well as other risks that need to be addressed through the application of the risk framework, application of the framework will identify those dam failure risks that are addressed through the implementation of the emergency plan.

4.4.1. Dambreak study – information for inclusion in the emergency plan

The emergency plan should summarise the dam failure scenarios and impacts within the dambreak study with enough detail to enable the dam owner and emergency agencies to respond appropriately to emergency scenarios. The emergency plan should also include the dambreak study inundation maps.

The emergency plan may also include the full dambreak study as an appendix to the emergency plan, if appropriate.

[4] The study should justify why failure modes have been included as credible

[5] Refer to Appendix 2 for further information on dambreak studies

4.4.1.1. High and extreme consequence category dams

For high and extreme consequence dams where non-itinerant persons could be at risk, a dambreak study is conducted which includes dambreak inundation information (e.g. mapping, depths, timing - including differences in exposure and timing between day and night). In the context of this guideline non-itinerant persons include:

- residents in dwellings, hotels, motels, boarding houses, hospitals, caravan parks, established camping grounds and the like and
- persons occupying places of work, schools, day care centres and the like, including workplaces of limited duration such as mines or construction sites.

4.4.1.2. Significant consequence category dams

For some significant consequence category dams where only itinerant persons may be at risk (e.g. campers, bushwalkers, fishermen, the homeless, etc.) the emergency plan aims to minimise risks to the itinerant persons. The emergency plan may not need to include such aspects as dambreak analysis, inundation mapping or emergency authority warning, but will need procedures to maximise the safety of itinerant persons. The emergency plan should be in line with prudent dam operation practice to maximise the safety of the dam, having regard to the consequences of dam failure and value of the dam as an asset. Where it is practicable to warn and evacuate itinerant persons, appropriate provisions should be included in the emergency plan.

4.4.1.3. Low and very low consequence dams

For low or very low consequence category dams where people are not at risk if the dam fails, the emergency plan may not need to include a full dambreak analysis, inundation mapping or emergency authority warning. The emergency plan may need to include the measures to be taken to deal with the infrastructure, environmental, health, social or economic damage for each failure scenario that the dam owner identifies. These measures would include procedures for alerting the appropriate authorities and for minimising the consequences of dam failure.

4.4.1.4. Dry flood retarding basins

Dry flood retarding basins require analysis according to 4.4.1.1and 4.4.1.2 above (depending on consequence category) but will typically reflect flood threats only.

4.4.2. Inundation maps

The emergency plan failure scenarios should include inundation maps which identify the area likely to be affected by each scenario.

The intent of the mapping is to assist in the identification of people and/or property that may be harmed as a direct result of an event.

Mapping is vital for the effectiveness of the emergency plan as it visually defines the extent of the inundations arising from potential dam emergency events.

Dam owners are encouraged to consult with local government(s) and the NSW SES regarding the maps (and complexity of the associated modelling) to achieve consistency of terms and alignment with relevant emergency management plan(s). For example, the NSW SES may prefer maps to show the expected height of water over a road instead of an absolute peak water elevation to Australian Height Datum. The NSW SES should also be consulted on the preferred geographic information system (GIS) format.

The accuracy and limitation of the information supplied on the maps and how best to use the map(s) should be specified and described on the maps and within the emergency plan. This is discussed further below.

The following may need to be considered:

- where there is a concurrent inflow near the dam, discussion with the NSW SES and other stakeholders should occur to identify if reliable mapping of outflows is feasible and/or adds value to the emergency plan.
- each dam failure scenario should be linked to inundation mapping contained within the emergency plan, developed at a scale sufficient to be used for identifying downstream-inhabited areas that could be or are likely to be within the area subject to the dam emergency events. Topographic maps or photo images may assist in the preparation of the map(s). Dam failure scenarios should also be linked to a gauge height at key warning gauges (where relevant). This will allow the NSW SES to use the information in wider emergency planning.
- the detail and number of maps provided should be directly related to the failure scenarios identified within the emergency plan. However, this does not necessarily mean there should be an individual map for each potential event. For instance, a sunny day piping failure might produce essentially the same impacts as a sunny day embankment instability and the one map may be appropriate for both types of event
- a key map may be required where it is necessary to use multiple maps to adequately represent the impacted area for a particular event and to enable quick reference during the management of an event.

The text within the emergency plan and the event inundation maps should adequately cover access to the dam at relevant times by relevant staff and emergency access routes or paths to higher ground for the general public in the event of evacuation being required.

4.5. Emergency warning systems

Monitoring and emergency warning systems should be based on monitoring the conditions that are indicated by the potential dam failure modes. The monitoring method, including insitu and remote sensing technologies, should be chosen based on the dam type, location and response time required to act in an abnormal or extreme loading operation condition.

The emergency plan should describe the monitoring and warning systems that are in place for the dam, how they operate, and include the procedures to follow when an event is detected by dam monitoring systems. Alternatively, the emergency plan may refer to the procedures if they are included as part of the dam's operations and maintenance plan.

If the NSW SES is unable to warn downstream populations due to time or resource constraints, then the dam owner should establish alternate appropriate measures such as improved warning systems, including gauges, sensors and associated telemetry and notification systems.

Owners of extreme and high consequence category dams (excluding retarding basins) should have in place automatic telemetered monitoring of the storage level in their dams (and preferably rainfall and seepage monitoring) to:

- keep dam owner staff apprised of this key surveillance information
- assist in the early detection of incidents at dams
- provide maximum warning times for any emergency response required in relation to dam incidents.

Owners of extreme and high consequence category retarding basins should have in place automatic telemetered monitoring of rainfall at a location near the basin in lieu of, or in addition to, monitoring of basin storage level.

Owners of remotely located extreme and high consequence category embankment dams should consider a range of available telemetered monitoring devices to maximise warning times of potential incidents, such as piping at these dams.

Dam owners should also consider seismic monitoring or access to seismic network information for their dams, as appropriate.

4.6. Emergency service notifications and alerts

4.6.1. Notification – general

Notification and alert arrangements have been developed in consultation with the NSW SES and are represented in the flow chart in Appendix 3.

The dam owner should also liaise with the Local Emergency Management Officer[6] to ensure any contact details of agencies other than the NSW SES (if any are included) are correct.

The NSW SES has agreed on a protocol to assist owners and operators of declared dams to determine the emergency management contact procedures for inclusion in an emergency plan.

[6] Refer to https://www.nsw.gov.au/rescue-and-emergency-management/state-emergency-management-plan-emplan

The contact procedures are followed when the owner/operator of a dam activates the State's emergency management arrangements due to a potential or imminent failure of the dam (or one of its control structures) that will endanger the community.

The procedures for alerting emergency services organisations of the emergency must be documented in the emergency plan. Including an emergency service notification flowchart in the emergency plan (refer to Appendix 3) is the preferred way to do this.

The importance and priority for contacting the NSW SES 24-hour contact number is to be stressed. The number is:

- contained in the Appendix 3 flowchart
- a dedicated number for dam failure emergencies only
- for internal use and
- not to be distributed to the public.

The primary contact in the event of alerting emergency services for dam failure is the NSW SES State Operations Centre. The alerts need to be provided by telephone, preferably by an actual person relaying a message (rather than an automated message). The NSW SES cannot receive SMS messages and considers it an unreliable technology for life threatening situations.

Each alert is communicated to the NSW SES through its State Operations Centre. However, subsequent liaison between the dam owner and an appropriate NSW SES Incident Controller, at a NSW SES Zone or Local Headquarters (to be advised by the NSW SES during emergency plan preparation), will be established to ensure effective communication during an emergency situation.

Dam owners notify all appropriate staff and agencies, including the NSW SES, when the dam failure emergency is over, or if the dam failure alert was a false alarm. The NSW SES will issue an Advice Warning advising "Reduced Threat: Return with Caution" to the community at risk where appropriate.

4.6.2. Alert triggers

Dam failure alerts (i.e. white, amber and red) are used to trigger emergency response actions. The conditions that define each of the alert levels need to be listed in each emergency plan.

Consequences and responses escalate as the alert level migrates from white to red. Table 2 briefly outlines some of the possible defining conditions and likely NSW SES responses associated with each alert. Where possible, emergency alert levels should be based on quantitative thresholds to remove ambiguity.

Estimated timings between alert levels should be provided, in addition to the flood wave travel timings. These may be contained in dambreak studies but should also be provided in the emergency plan.

Each alert level should also link to procedures within the operations and maintenance plan, or response procedures in the emergency plan, that aim to prevent an abnormal or extreme condition from becoming an emergency, or to mitigate consequences if an emergency occurs.

The alert levels relate specifically to the warning and evacuation tasks to be performed by emergency managers with respect to communities at risk downstream. As far as possible, the alert levels should be set to maximise the amount of warning time available. When preparing emergency plans dam owners should liaise closely with the NSW SES to ascertain warning requirements which are dependent on the population at risk and emergency services resources (amongst other things). Some emergency plans will require alert levels that proceed directly from White to Red if adequate time does not exist between the three alert levels to both warn and evacuate the downstream population at risk. The decision to omit the Amber Alert Level in these cases, and the general setting of Alert Levels, should be undertaken in consultation with the NSW SES.

Table 2 - Typical dam failure alert protocols

Alert Level	Typical Defining Conditions	NSW SES Response	NSW SES Warning Product[7]
White	Structural defect detected (e.g. crack, piping), heavy rainfall[8] event, or an unusual operational event[9]	Notification of support agencies. Monitoring at-risk areas downstream. Check operational readiness	This is a preliminary alert to assist the NSW SES in its preparations and is not a public alert
Amber	Failure possible if storage continues rising or structural defect not fixed	Warn downstream population at risk to prepare to evacuate	NSW SES Watch and Act – Prepare to Evacuate
Red	Failure imminent or occurred	Evacuation of downstream population	NSW SES Emergency Warning - Evacuate Now/Before xx time

[7] This is a 'typical' NSW SES warning response [product]; however, the issuance, or not, of any warning product will be dependent on a risk assessment and the response strategy chosen at the time

[8] 'Heavy' should be quantified in the emergency plan according to each dam's circumstances

[9] This could include gate maintenance, or other operational activities that are not normal

			OR NSW SES Emergency Warning – Move to higher ground
Alert Cancelled	Dam failure emergency is over, or alert was a false alarm	Provide update to downstream population	NSW SES Advice - Reduced Threat: Return with Caution

White Alert (advisory warning)

This is an advisory alert to the NSW SES identifying a dam defect that may lead to failure if not remediated, or a flood that is forecasted to cause a storage level condition that the dam has not yet experienced. For example, the flood is expected to exceed the 'flood of record'. The White Alert condition would trigger heightened monitoring of the dam until the defect has been remediated, or the flood and storage condition has receded below the level selected for the white alert. A white alert should also be considered if operating the dam in an unusual way, for example if control equipment is not operational due to maintenance, and advice to the NSW SES is prudent.

Amber Alert - (possible failure condition developing)

This level should be selected for a dam defect that is not responding to remedial efforts and will possibly lead to dam failure. This level should also be selected when there is a high level of confidence that the flood may lead to a Red Alert condition if the conditions continue to escalate as forecast. This condition will likely involve selecting an appropriate storage level and a corresponding 'rate of rise' of the storage taken from the extreme hydrograph.

Red Alert (failure imminent)

This alert should be selected for an imminent dam failure due to the detected dam defect reaching a critical level, or if the flood will cause the storage to exceed the dam crest level and overtopping will likely lead to failure of the embankment/dam structure.

4.6.3. Dams Safety NSW notification and involvement

Clause 19 of the regulation requires that dam owners report incidents to Dams Safety NSW. Consequently, emergency plans need to include provisions for prompt notification to Dams Safety NSW of any actual or potential emergency which may have implications for the safety of the dam.

Dam owners should call Dams Safety NSW on **0403 681 645** at the Amber Alert stage.

The telephone notification needs to be followed up by submitting a written report within 72 hours.

The reporting form can be found on the Dams Safety NSW website.

4.7. Emergency exercises

The emergency plan needs to include the details of emergency exercises to be undertaken to test the emergency plan for the declared dam.

These should include how:

- they are scheduled
- they are planned
- they are carried out
- recommendations for improvement of the emergency plan are recorded and actioned
- the records are kept.

The emergency plan should include a schedule of planned exercises. The schedule should be provided to the NSW SES for planning purposes, with sufficient lead time to allow NSW SES involvement in the exercise (see 4.7.2 below and clause 22 (4) of the regulation: '*As far as is reasonably practicable, the practical emergency exercises should involve relevant agencies identified in the emergency plan for the dam').*

Guidelines on how to conduct an exercise can be found on the Australian Institute for Disaster Resilience (AIDR) website at: https://knowledge.aidr.org.au/resources/handbook-3-managing-exercises/

The regulation requires exercises to be undertaken every three years (and a practical exercise for high and extreme consequence dams every five years).

Good practice would also include an annual seminar, or 'run-through' of emergency procedures, with key onsite staff, to help familiarise them with emergency systems and procedures and measures for emergency preparedness. An annual seminar would also assist in identifying the equipment, resources and materials required to respond in an emergency.

4.7.1. Three-yearly exercise

A declared dam owner must carry out an emergency exercise at least once every 3 years.

This exercise may be in the form of a classroom exercise where an actual physical response to the simulated emergency is not required.

The exercise needs to involve staff who are involved in the operation of the dam and who would be involved in an emergency response.

The AIDR handbook describes these exercises as 'discussion' or 'hypothetical' exercises.

4.7.2. Five-yearly practical exercise for extreme and high consequence dams

A declared dam owner of an extreme or high consequence must carry out a practical emergency exercise at least once every 5 years.

This exercise needs to involve staff who are involved in the operation of the dam and (as far as practicable) the range of emergency agencies that are identified in the emergency plan (usually the NSW SES).

Exercises should be planned as early as possible to allow time for all relevant emergency agencies to schedule their attendance.

The AIDR handbook 3 may be useful as a guide to plan and execute the emergency exercise.

4.7.3. Records

Dam owners need to keep records of emergency exercises. Records include the exercise participants, scenario, exercise results and any required corrective actions to the emergency plan. This may be best included in an emergency exercise evaluation report (see AIDR handbook 3 for a suggested evaluation report template). The report should be made available to all agencies involved in the exercise.

4.8. Updating the emergency plan

The emergency plan must be updated at least once every 5 years.

The emergency plan also needs to be updated (within 30 days) if the declared dam consequence category changes, if there has been a significant change to the number of persons at risk, or if emergency arrangements change.

A dam owner should also update the emergency plan after an emergency exercise to incorporate any lessons learnt from the exercise.

4.8.1. Updating contact details

A review of the emergency plan needs to be carried out every year to ensure contact details (for persons responsible for exercising functions in the event of an emergency) are updated as soon as practicable after the change.

4.9. Emergency plan distribution

The owner of a declared dam needs to provide a copy of the emergency plan to:

- Dams Safety NSW and
- the NSW SES.

The emergency plan needs to be provided in electronic form, for example in portable document format (PDF) as soon as reasonably practicable after the plan is prepared or updated.

The NSW SES should be consulted on the preferred GIS format for flood extents generated in the dambreak study within the emergency plan. In addition, it would be useful for emergency managers if flood cross-sections are provided at key locations such as flood gauges, bridges and major infrastructure (ie. roads, railways, power facilities).

Note

The NSW SES has established a flood data portal to store flood information, including declared dam emergency plans (https://flooddata.ses.nsw.gov.au/). The portal provides a single location for important emergency information and includes security features to protect sensitive information. The NSW SES should be contacted for information on how to submit the dam emergency plan to the NSW SES for inclusion on the portal.

Appendix 1 Summary information sheet

Note:

1. A ‘MS Word’ copy of the information sheet is available on the Dams Safety NSW website

Dam Summary Information Sheet

General Dam Information			
Name of Dam		**Dam ID Number**	
Description/Purpose	*[Description of the dam and what it is used for/contains]*		
Above the Safety Threshold	*[Yes/No]*		
Owner			
Main Emergency Contact	*[Number – Name – Position]*		
After Hours Contact	*[Number – Name – Position]*		
Location of Dam			
River/Stream/Catchment			
Towns Impacted	*[General list of impacted towns]*		
LGA's Impacted	*[List of LGAs affected]*		

Alert Levels – Key Response Levels	
White Alert The lowest level of dam safety emergency and is assigned for unusual incidents which have the potential to threaten the dam.	*[Define conditions for a white alert]*
Amber Alert The second highest level of dam safety emergency assigned when dam integrity is compromised.	*[Define conditions for an amber alert]*
Red Alert The highest level of dam safety emergency assigned when the dam is failing, or failure is imminent.	*[Define conditions for a red alert]*

Downstream Communities and Consequences					
Downstream Communities	*[Detailed list of property/dwelling addresses affected]*				
'Sunny Day' Failure (SDF) *[Floods caused by the unexpected failure of the dam that may happen at any time and may not involve a rainfall event - including Earthquakes]*	*[Key consequences of failure]*				
Consequence Summary	Consequence Category	Population at Risk (PAR)	Potential Loss of Life (PLL)	Number of Dwellings	Flood Wave Depth and Travel Time
		[Total] *[Incremental]*	*[Total]* *[Incremental]*		
'Probable Maximum Flood' Failure (PMF) *[The extreme flood for the catchment, typically presented as with and without dam failure]*	*[Key consequences of failure]*				
Consequence Summary	Consequence Category	Population at Risk (PAR)	Potential Loss of Life (PLL)	Number of Dwellings	Flood Wave Depth and Travel Time
		[Total] *[Incremental]*	*[Total]* *[Incremental]*		

Dam Characteristics and Hydrological Information			
Type/Description		**Outlet/Spillway**	
Height		Inlet Works	
Crest Level		Outlet Works	
Crest Width		Spillway Type	
Crest Length		Spillway Gated	*[Yes/No]*
Catchment Area		Spillway Level	
Full Supply Level (FSL)		Spillway Width	
Storage Capacity at FSL		Spillway Length	
Imminent Failure Level	*[Possibly same as Crest Level]*	Spillway Design Capacity	

Freeboard allowance/Maximum		Streambed Level	

Warning and Monitoring Systems

Warning Systems	*[Describe the current warning system and how it works]*	
Monitoring Systems	*[Describe the current monitoring system, telemetric/manual etc]*	
Notification Protocols	*[Describe how and to who notifications may be sent to]*	
Bureau of Meteorology Warnings and Stream Gauges	**Bureau Warning Gauges** *[List of Bureau warning gauges]*	**Stream Gauges** *[List of stream gauges]*
NSW SES Local Flood Emergency Sub Plan Name		

Additional Information

[Description of any other information that has not been covered, or may be relevant]

References

[List of references and version number]

Prepared By	*[Name]*	**Approved By**	*[Name]*
Position	*[Company + Position]*	**Position**	*[Company + Position]*
Version Control	*[Version Number, Name, Status, Date]*		

Appendix 2 Dambreak studies

General

A dambreak study needs to be undertaken for all extreme and high consequence category dams and may be required for some significant consequence category dams (for emergency plan purposes). For new dams, the study should be undertaken in the design phase and completed six months prior to the commencement of construction or modification of the dam[10]. In any case, a dambreak study provides essential information for downstream emergency planning and also provides a basis for assessment of the dam's risk rating (in accordance with clause 15 of the regulation) and flood and sunny day consequence categories.

The scenarios to be examined in the study should include sunny day and flood dambreaks, from acceptable flood capacity up to probable maximum flood.

The study should describe the scenarios examined and, for each scenario:

- the input data and
- the methodology used and the results including
    - the extent of flooding
    - flood travel times and
    - flood water velocities, downstream of the dam, as related to residences, properties, infrastructure and environmentally sensitive areas.

The dambreak study should examine effects to a point downstream where there is no longer a significant incremental threat to the interests of the community[11], including to the environment.

The study should consider several flood events (from average conditions to probable maximum flood conditions) to arrive at the most significant incremental losses from a dam breach. The extent of the dam breach analysis should extend for a sufficient distance downstream to identify material impacts and populations at risk.

The study should outline the basis of dam failure modelling. For example, with long embankment dams having large storage volumes, the potential for outflow discharges, much greater than those given by empirical formulae based on failure data, should be considered. For such dams, the

[10] Dam break scenarios are associated with the outcomes of the dam failure modes analysis undertaken in accordance with clause 15 of the regulation

[11] This may be taken to be when the difference between the dambreak and non-dambreak floods differ by 300mm or less.

possibility of multiple breach locations upon overtopping, especially if the crest surface is of uneven level, should also be considered.

For flood-related failure scenarios, consideration should be given to a feasible range of antecedent flooding conditions downstream immediately prior to dam failure. This can be a particularly significant aspect where a dam is located on a stream, which joins a main stream with a relatively much larger catchment, not far downstream. If the large stream is at normal stage, the dambreak flood may remain within the banks and not affect towns on the alluvial terraces. However, if the main stream is close to bank full stage, the dambreak flood may affect towns on the terraces.

The dambreak study will normally require at least two types of scenarios:

- a sunny day failure event to cover the potential consequences of dam failure associated with no other flooding
- a dam failure event associated with a major flood event passing through the dam and concurrent flooding downstream of the dam in the case of a dam failure associated with a flood event, the inundation mapping for the emergency plan should cover the combined inundation area from both causes. Such maps should display the inundations that would occur with and without the effects of dam failure.

The identification of events associated with dam releases that are not the result of a dam failure, but need to be mapped due to downstream hazard, should be agreed in conjunction with the NSW SES. Such flows through a spillway or otherwise are usually smaller than any flood wave arising from a dam failure and downstream conditions may be more critical as roads may be cut and irrigation activities immediately below dams may be adversely impacted.

It may not be possible to assess the incremental impact of a dam release or dam failure within a broader flood event in real time, unless calibrated models and practised procedures are in place involving all relevant entities.

Where it is found there are likely to be significant impact zones arising from releases downstream from the dam, it may prove more practicable to provide a table of critical sites in the emergency plan rather than attempt to provide more complete impact information and mapping which may not specifically apply to the particular real time situation encountered during an actual event.

It may also be appropriate in some cases to supplement the inundations shown on the inundation map/s with water surface profiles showing the elevation before failure, the peak water surface elevation after failure, and the location of structures at critical locations.

The magnitude of the particular dam failure and associated concurrent flooding for dam failure events should be clearly marked on the maps.

Inundation mapping

The scale and quality of inundation mapping should be appropriate to the potential severity of the flooding impacts. Where dwellings are at risk, base mapping would typically be at a scale of 1:10,000 with a contour interval of 2m or better accuracy. Modern survey techniques may be used (eg. LIDAR), but these may need to be validated using conventional survey techniques.

Ortho photomaps can be particularly valuable to the emergency authorities but flood extents displayed on any maps should be transparent so that essential details are not obscured.

Inclusion of the following supplementary information should be considered on the inundation map/s (as relevant to the particular dam situation):

- travel times (in hours and minutes) of the leading edge of the dam failure flood wave
- potential peak water surface elevations
- estimated duration of inundation.

For low or very low consequence dams, simplified maps depicting direct presentation of potential impacts on specific sites may be adequate.

If arrangements are in place for the dam owner to issue notification and warning messages to particular impacted people downstream of the dam and for the NSW SES to notify and warn others, the demarcation as to who will warn whom should be marked on the inundation maps.

Users of inundation mapping should be made aware of the significant limitations to the potential accuracy of this mapping and make adjustments to suit the actual circumstances of the event.

These potential limitations can include:

- the accuracy of the available terrain data and calibration data to facilitate modelling of dam hazard events and dam emergency events and the calibration of these models
- the ability to numerically model the actual physical river systems
- the magnitude and timing of any potential dam breaches may be different to that assumed in the associated modelling. For example, if the actual breach is larger or occurs more rapidly than assumed, inundation is likely to be greater
- if the breach initiates at a different lake level or location than that assumed, inundations will be different
- because the incremental impact of both a potential dam failure or dam release can be very dependent on the magnitude of downstream concurrent flooding and the distance of potentially impacted zones from the dam, the magnitude of the concurrent flooding assumed in the modelling should be specified in the mapping.

Information Required by the NSW SES to Assist in Emergency Planning

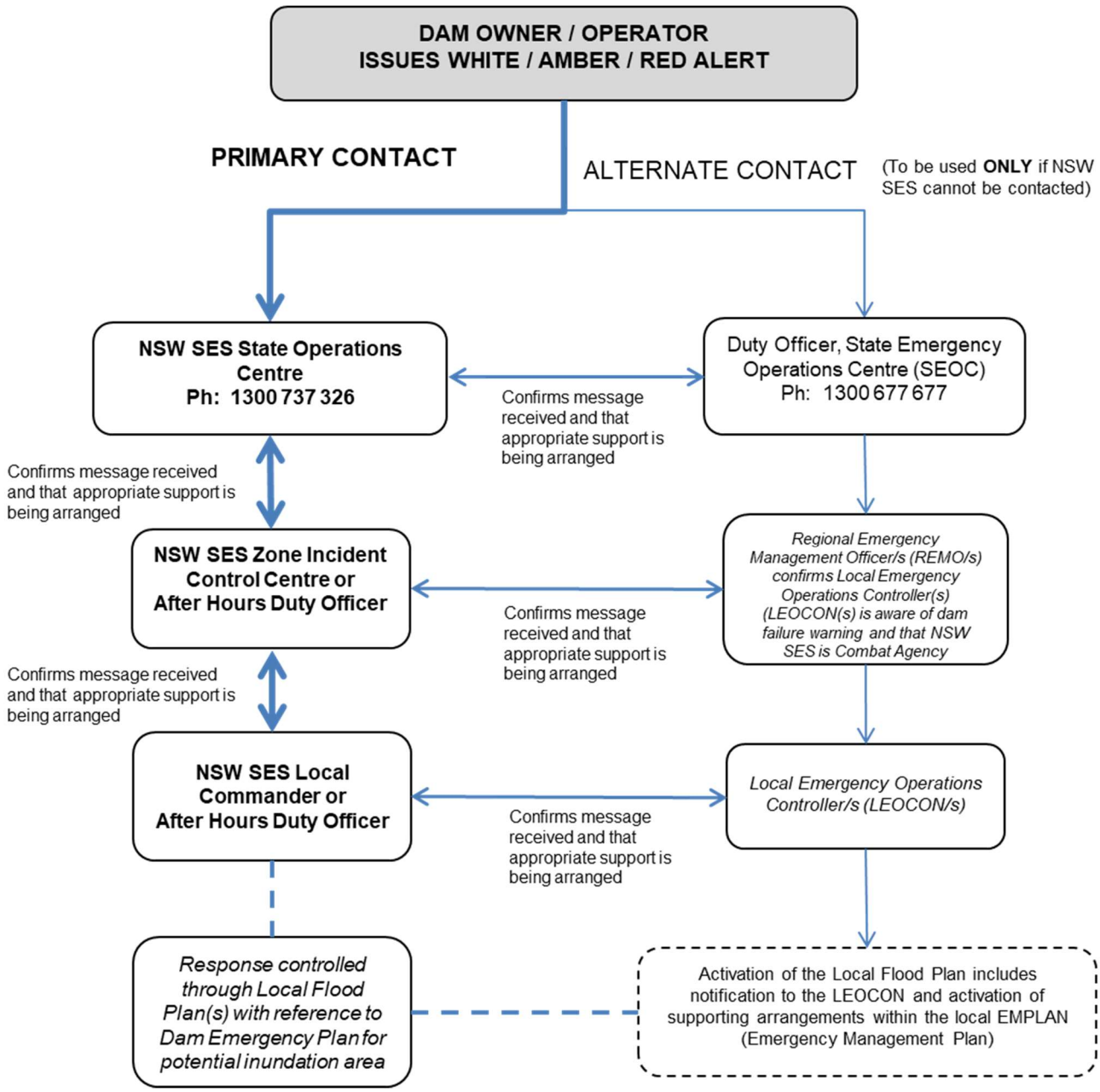
As well as the emergency plan, a complete copy of the dambreak study report should be provided to the NSW SES State Headquarters including the following information for emergency planning:

- the number of dwellings at risk for each scenario modelled (note that this is more useful to the NSW SES than potential loss of life estimates)
- the access routes affected for each scenario modelled and
- travel time information and rate of rise (preferably to the start of the flood reaching the population rather than just the time to peak to enable consideration of timing for alert levels).

The relevant GIS layers showing flood extents and other key information should also be provided. In addition, it would be useful for emergency managers if flood cross-sections are provided at key locations such as flood gauges, bridges and major infrastructure (ie. roads, railways, power facilities). As stated in 4.9 above, the NSW SES should be consulted on the preferred GIS format..

Appendix 3 Emergency service notification

(NSW SES notification arrangements for potential or actual dam failure)[12]



[12] The NSW SES amends the notification arrangements from time to time. This guideline will be changed to reflect the amendments as they occur

Notes:

1. Dam owners should only contact the SEOC if the NSW SES State Operations Centre (SOC) cannot be contacted.
2. The first priority for notification is to contact the NSW SES State Operations Centre. If unavailable, contact the SEOC. At each level, the contact agency should notify the alternate contact at the same level before making contact further down the line.
3. The triple zero (000) number for emergency services should not be used unless contact cannot be made with NSW SES or the SEOC as it is likely the triple zero (000) operators will have difficulty dealing with the very unusual case of potential or actual dam failure.
4. Dam owners should send their draft Emergency Plan to the NSW SES for review of the emergency management arrangements (see section 3.1 of this guideline).

Appendix 4 Emergency plan suggested contents

The following list covers the minimum items for an emergency plan. It is essentially a listing of the contents of this guideline reproduced here for convenience. Dam owners may include additional content in their dam emergency plans but should be aware that summary information sheets should be kept concise to aid reading and comprehension in emergency situations.

1. Summary information sheet in accordance with Appendix 1

2. Preliminary Pages – table of contents, revision sheet, authorisation signatories, and cross reference to operations and maintenance plan glossary and abbreviations

3. Emergency services notification flowchart

4. Responsibilities for emergency functions
   - including procedures to be followed by the owner of the dam and staff in the event of an emergency (as appropriate)
   - procedures to include the prompt evacuation of employees on site (if applicable)

5. Dam failure information including (depending on dam consequence category – see section 4.4):
   - cases studied
   - inundation mapping
   - flood depths
   - timing of flood events and
   - persons at risk and loss of life

6. Emergency warning systems

7. Emergency alerts and notifications
   - alerts
   - emergency services notification process and flowchart
   - notifying Dams Safety NSW

8. Emergency exercises

9. Review, update and distribution of the emergency plan