



Kentucky Creek Dam

Dam Safety Emergency Plan

Uralla Shire Council

2021-10-29



Uralla

Document control record

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CHART 1: Decide the Alert Level

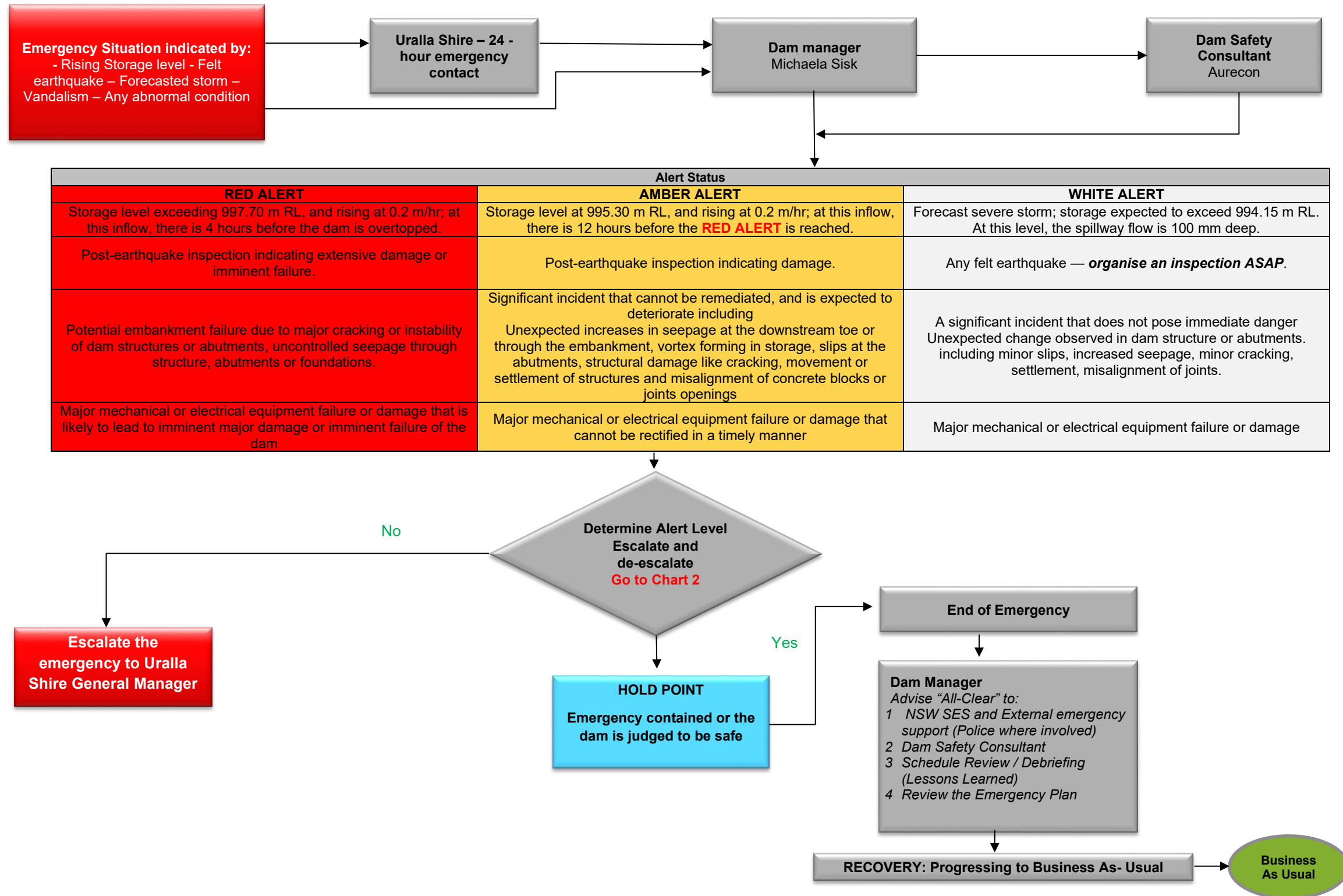
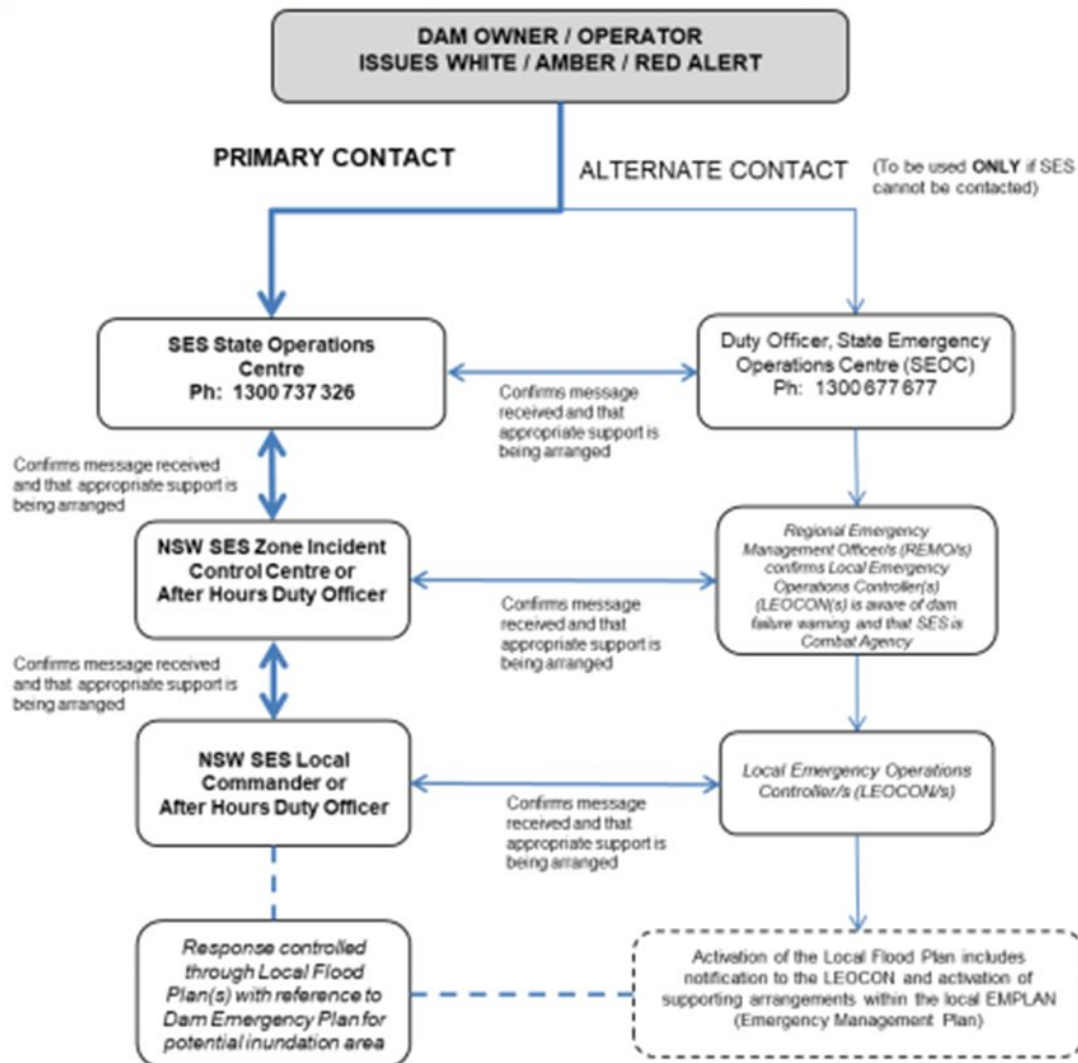


CHART 2: NSW SES Notification Arrangements

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



Notes:

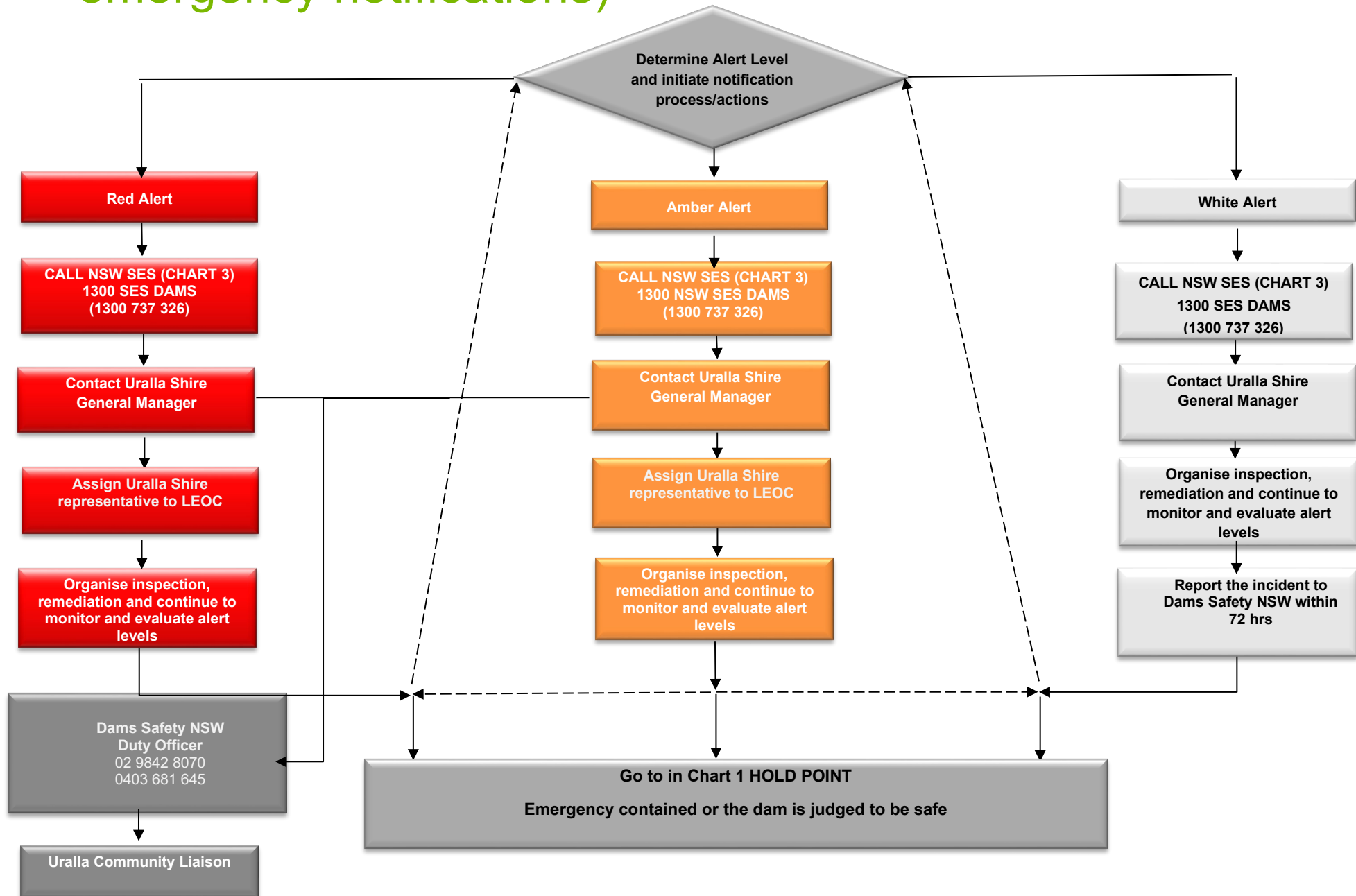
1. Dam owners should only contact the SEOC if the SES State Operations Centre (SOC) cannot be contacted.
2. The first priority for notification is to contact the NSW SES State Operations Centre. If unavailable, contact the SEOC. At each level, the contact agency should notify the alternate contact at 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 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 SES for review of the emergency management arrangements (see section 3.1 of this guideline).

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

*SES is referring to NSW SES in this document

**Reference, Dams Safety NSW Guideline Emergency Plans, September 2020, Appendix 2

CHART 3: Subsequent actions for Uralla Shire staff (after emergency notifications)



Summary Sheet for Emergency Agencies

Dam Owner	Uralla Shire Council
Dam Type	Concrete gravity dam
Dam Contents	Water
Dam Location	On Kentucky Creek at Waterworks Rd, 7.2 km by road southwest of Uralla; GDA2020 MGA coordinates (Zone 56) 351,668 m E, 6,605,913 m N. (-30.670278, 151.451467)
Safety Status	Spillway is undersized The spillway doesn't meet the Acceptable Flood Capacity (AFC) of 1 in 10,000 AEP for a significant consequence category dam
Notification Protocols	<ul style="list-style-type: none"> • See Charts 2 & 3 • Dam owner to notify SES by telephone of Alert Level. • The presence of automatic alarm systems is unknown. • BoM warnings are at: http://www.bom.gov.au/nsw/warnings/index.shtml?ref=hdr
Inundation Area	It is unknown whether an inundation system has been prepared. There are currently no houses identified as likely to be inundated. Below the dam, Kentucky Creek flows northwards through open, undulating country. It crosses Green Gully Road at 1.4 km below the dam, and Kingstown Road at 4.6 km below the dam. North of Kingstown Road, it is called Rocky River. 1 km below the Thunderbolts Way bridge, the river flows out into open country.
Local Flood Plan Name	To be advised
Full Supply Level (FSL)	994.05 m RL (top of raised spillway) — AT THIS LEVEL, THE DAM WILL START TO SPILL.
Dam Crest Flood Level	998.50 m RL, after the 1984 raise, at the top of the abutment wing walls. At this level, the entire dam wall will be overtopped. There is potential for destabilisation and possible failure of the abutment wing walls, releasing a significant additional flood surcharge.
Flood of record	No definitive information on the flood of record was provided by the council. Heavy rain occurred on 3 August 2016 — water rose to 700 mm above “the dam” It is understood that this is above the concrete spillway level (ie the Full Supply Level), the flood of Record = 994.76 m RL.
Maximum Design Flood Level (PMF)	Inflow:2,000 cubic m/s With 2,000 cubic m/s outflow, modelling shows the earth abutment overtopped at the abutment level by 0.3 m
Dam Crest Level	998.50 — crest of wing walls on abutments
Dam Height	16.64 m, including raised wing walls towards abutments.
Catchment Area	132 square km

Storage Capacity at FSL	500 ML
Spillway Design Discharge	1,850 cubic m/s — 1 in 2,000 year
Sunny Day Consequence Category	SIGNIFICANT
Flood Consequence Category	SIGNIFICANT

ALERT TRIGGER LEVELS	
WHITE ALERT	Forecast severe storm; storage expected to exceed 994.15 m RL. At this level, the spillway flow is 100 mm deep.
	Any felt earthquake — organise an inspection ASAP.
	A significant incident that does not pose immediate danger (including minor slips at the embankments, longitudinal and transverse cracking, movement or misalignment, marked increase in turbidity or volume of seepage flow).
	Major mechanical or electrical equipment failure or damage
AMBER ALERT	Storage level at 995.30 m RL, and rising at 0.2 m/hr; at this inflow, there is 12 hours before the RED ALERT is reached.
	Post-earthquake inspection indicating damage.
	Significant incident that cannot be remediated, and is expected to deteriorate (including significant slips at the embankments, longitudinal and transverse cracking, movement or misalignment, increase in turbidity or volume of seepage flow).
	Major mechanical or electrical equipment failure or damage that cannot be rectified in a timely manner
RED ALERT	Storage level exceeding 997.70 m RL, and rising at 0.2 m/hr; at this inflow, there is 4 hours before the dam is overtopped.
	Post-earthquake inspection indicating extensive damage or imminent failure.
	Potential embankment failure due to uncontrolled seepage, major cracking, slumping, slips, instability of the concrete structure etc.
	Major mechanical or electrical equipment failure or damage that is likely to lead to imminent major damage or imminent failure of the dam

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1 Introduction

1.1 Purpose

This Plan covers preparedness in relation to the occurrence of an emergency condition at Kentucky Creek Dam and provides information necessary for emergency agencies to manage a downstream evacuation in the unlikely event of a potential dam failure. The location and description of Kentucky Creek Dam are given in Appendix B.

This Plan details:

- The responsibilities of persons and organisations involved in the surveillance, maintenance, and operation of the dam, and the persons/organisations responsible for activating the Plan.
- The procedure for identification, evaluation, and classification of potential emergency conditions.
- The persons to be notified in the event of an emergency situation.
- Access and communication procedures.
- The area which would be inundated by a dam failure.
- Preventative actions and contingency items.

The main purpose of the Plan is to ensure that timely warning is provided to the appropriate authorities in the event of a potential dam failure situation, and to provide relevant information for use in the emergency response to that situation. The Plan identifies emergency conditions at the dam and describes procedures to be followed to investigate those conditions and provide warning to appropriate emergency managers in the event of a potential dam failure, so that they can implement measures for the protection of downstream persons and property.

The plan also provides direction for operating staff in the handling of unsafe or emergency conditions where dam failure is unlikely, so that the dam can be returned to a safe condition with minimal delay.

The Dam Safety Emergency Plan (DSEP) may be used to activate the Local Disaster Plan and/or the Local Flood Plan. It is not intended as a replacement for either of these plans since all plans may be utilised in an emergency situation.

1.2 Authority

This DSEP has been produced by the Dams Group at Aurecon's Sydney office, which is Uralla Shire Council's dam safety consultant. The current dam safety consultant engaged by Uralla Shire Council is responsible for ensuring that the dam has a Dam Safety Management System, which is consistent with the requirements of the regulator, Dam Safety NSW (DSNSW); and which is supervised by suitably qualified personnel, in accordance with the guidelines established by the Australian National Committee on Large Dams (ANCOLD).

This DSEP has been prepared in consultation with staff of Uralla Shire Council; for approval by the NSW State Emergency Service (SES), and DSNSW.

The DSEP is approved by the Technical Director, Energy on behalf of Aurecon, and authorised by the Manager, Water & Wastewater (MW&WW) for Uralla Shire Council.

1.3 Notification Flow Charts

Three flow charts (Charts 1 – 3) are included at the beginning of this document. They illustrate the flow of information and decision making to be followed in an emergency (Figure 1). They summarise the decisions to be made, personnel to be notified, and the prioritised order of notification in an emergency.

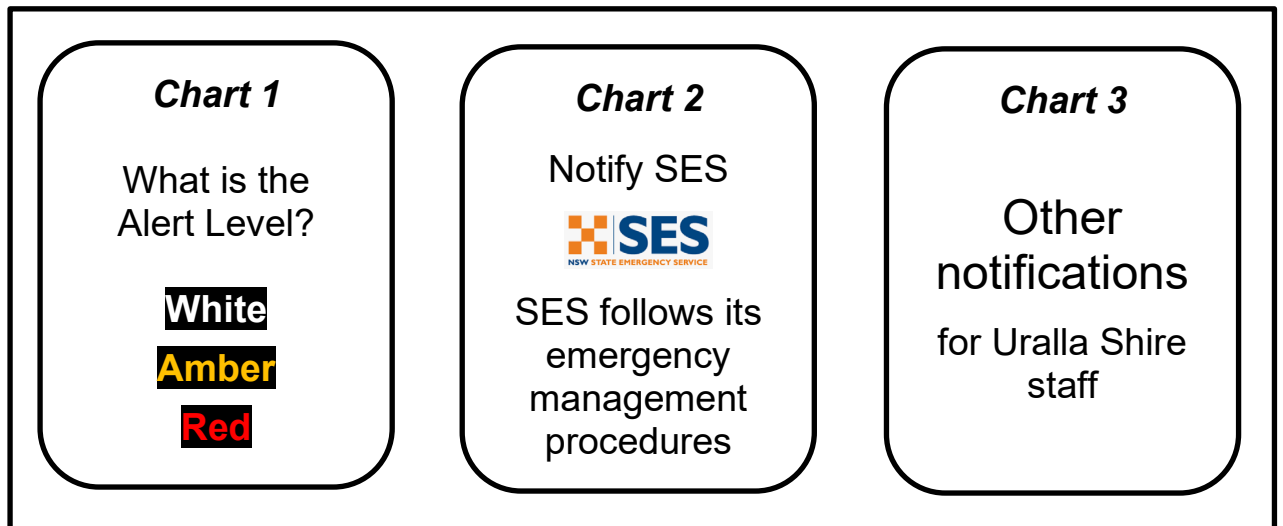


Figure 1 Emergency management process, Kentucky Creek Dam

The charts are followed sequentially:

- Chart 1 shows the decision-making process, and the criteria, for deciding what the Alert Level is.
- Chart 2 shows the procedure for notifying SES, the lead agency for managing dam failure. Once notified, SES has its own procedures to communicate with other organisations, and to mobilise assets. The details of the SES process are not part of the scope of this plan. The chart includes contingency steps, in the case the SES cannot be notified.
- Chart 3 shows other notifications that Uralla Shire staff are required to make, once SES has been notified.

1.4 Summary Sheet

A summary sheet is included at the beginning of this document to provide a quick reference for Uralla Shire Council and emergency service personnel in the event of a dam incident.

1.5 Definitions

Common abbreviations used in the report are tabulated below.

AEP	Annual Exceedance Probability — the probability of exceedance of a given magnitude storm, flood, or earthquake within a one-year period.
DSEP	Dam Safety Emergency Plan
IFF	Imminent Failure Flood — the flood event, which when routed through the dam, threatens failure of the dam.
LEOC	Local Emergency Operations Centre
MWWW	Manager, Water & Wastewater Services for Uralla Shire Council.
PMF	Probable Maximum Flood — the flood hydrograph resulting from the probable maximum precipitation coupled with the worst flood producing catchment conditions that can be realistically expected in the prevailing meteorological conditions.
FSL	Full Supply Level — the elevation at which the dam starts to spill water over the spillway.
PMF	Probable Maximum Flood — an estimate of the largest flood that could be generated in the Kentucky Creek catchment area.

2 Responsibilities

Dam Safety Management at Kentucky Creek Dam is conducted in accordance with Chart 4: Dam Safety Management Responsibility Chart, and Table 1, below.

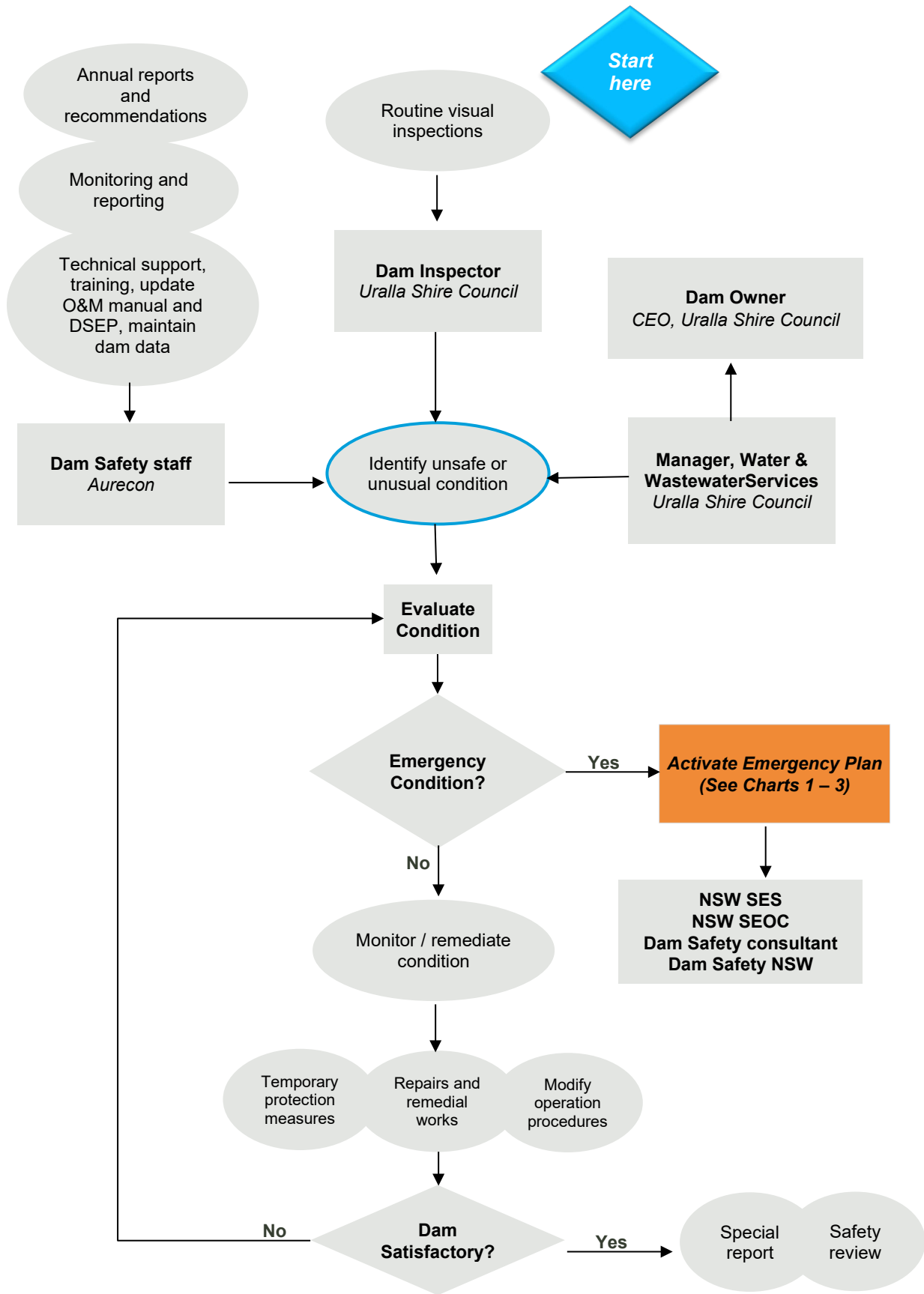
Responsibilities of persons and organisations are detailed in Table 1 below.

Table 1 Responsibilities

Organisation	Responsible Position(s)	Emergency Responsibilities	General Responsibilities
Uralla Shire Council	General Manager, Uralla Shire Council	<ul style="list-style-type: none"> Overall responsibility for dam safety Ensure Uralla Shire Council has adequate budget and resources to maintain the safety of dams. Advise CEO and/or the relevant Ministers 	Dam Owner
	Manager, Water Waste & Sewerage Services (MW&WW)	<ul style="list-style-type: none"> Activation of Emergency Response Liaison with SES Liaise with LEOC Identification, evaluation, and reporting of unsafe conditions, provision of local support services. 	Inspection, maintenance, operation of dam
	Uralla Shire – 24 hr emergency contact	<ul style="list-style-type: none"> First contact. To notify: MW&WW Follow procedures on Charts 1 – 3 	24 hr contact
	Dam Surveillance Staff	Identification and reporting of unsafe conditions	Dam routine inspections, instrument monitoring, maintenance, dam operation, reporting
Aurecon	Dam Safety staff	<ul style="list-style-type: none"> Assist in identification of emergency condition and determination of potential for embankment failure Advise on alert level Provision of technical support and advice for emergency operations 	Formulation, implementation, and supervision of Dam Safety Management System Dam safety management
NSW State Emergency Service (SES)	Duty Officer	Initiate appropriate emergency actions to safeguard persons in downstream areas	Primary Contact
	Duty Officer		Alternate Contact

Organisation	Responsible Position(s)	Emergency Responsibilities	General Responsibilities
NSW State Emergency Operations Centre (SEOC, at NSW Police)		Initiate appropriate emergency actions to safeguard persons in downstream areas	(to be used only if NSW SES cannot be contacted)
Dams Safety NSW	Chief Executive Officer	<ul style="list-style-type: none"> ■ Liaison with Ministers on necessary actions 	Regulatory oversight of dam safety practices at dam

CHART 4: Dam Safety Management Responsibility Chart



3 Emergency Identification and Evaluation

The main means of identifying the development of a potential emergency condition is through regular inspections of the dam by the council’s dam surveillance staff and the MW&WW. Manly Hydraulics Lab (MHL) collects water level data at the dam on behalf of Uralla Council. The high-water alert for the monitoring station is currently not working. However, Council is planning to undertake upgrades to the telemetry and SCADA system of the dam and water treatment plant. ,

In order to maintain the dam in a safe condition and detect any potential emergency conditions as soon as they begin to develop or become apparent, the following types of inspection are undertaken:

Routine Visual Inspections — carried out weekly by Uralla inspection staff under the direction of the MW&WW, aimed at detection of deficiencies in the dam which may lead to an emergency condition, e.g., uncontrolled seepage, instability, etc.

Annual Inspection — carried out annually by the dam safety consultant’s staff, at which time a thorough onsite inspection is undertaken together with a detailed evaluation of data.

Special Inspection — carried out for a particular purpose, usually when some problem arises, or an unusual condition occurs or is noticed.

Emergency Inspection — carried out usually after significant flood events, felt earthquakes, or other incidents, which have resulted in abnormal loading conditions on part of the dam.

Audit Inspections — carried out by the dam safety consultant’s staff at irregular intervals, depending on conditions at the dam.

If during any of these inspections, or at any other time, an unsafe or unusual condition is noted, the MW&WW will be notified immediately, so that an evaluation of the situation can be carried out and a determination made on the condition of the dam by staff of Uralla Shire and the dam safety consultant. Examples of conditions that require further evaluation include:

- Cracking
- Slips and/or slumps
- Increased or new areas of seepage
- Any signs of movement or depressions
- Any felt earthquake

If the MW&WW and the dam safety consultant determine that the unusual condition will NOT lead to failure of the embankment in the short term, they will take the necessary steps to have the unsafe condition rectified.

If the MW&WW and the dam safety consultant decide that an unsafe condition may lead to a dam emergency situation, they will activate the Emergency Plan (Charts 1 – 3). In the first place, they will decide the appropriate alert level, using Chart 1.

Each of the Alert Levels has a different significance, in terms of the dam emergency, and the response to it. These are summarised in Table 2.

Table 2 Dam Safety Alert Levels

Alert Level	Typical Defining Conditions	SES Response	SES Warning Product
White	Heavy rainfall, elevated storage level Felt earthquake Structural defect detected Major mechanical or electrical defect	Notification of support agencies. Monitoring at-risk areas downstream. Check operational readiness.	This is a preliminary alert to assist the SES in its preparations and is not a public alert.

Alert Level	Typical Defining Conditions	SES Response	SES Warning Product
Amber	Failure possible if storage continues rising or defects not fixed.	Warn downstream population at risk to prepare to evacuate.	SES Evacuation Warning.
Red	Failure imminent or has occurred.	Evacuation of downstream population.	SES Evacuation Order.

The **White Alert** is used when significant incidents occur and dam failure is possible if conditions deteriorate. Its main aim is to give notice to the SES that a dam emergency may be developing, so that it can prepare for a developing emergency. As well, the alert will initiate close monitoring of the dam, and actions to return it to a safe condition as soon as possible.

The **Amber Alert** is used when significant incidents occur and dam failure is possible if conditions deteriorate. The alert's main aim is to allow the SES to warn persons at risk to prepare for evacuation. As well, the alert will initiate close monitoring of the dam, development of emergency engineering responses, and actions to return it to a safe condition as soon as possible.

The **Red Alert** is used when dam failure is imminent or has occurred. The alert's main aim is to give notice to the SES that a dam emergency is developing, so that evacuation warnings can be issued. As well, the alert will maintain close monitoring of the dam, development of emergency engineering responses, and actions to return it to a safe condition as soon as possible.

Although each emergency condition will be evaluated and responded to individually, the response for most emergencies will be similar and will follow the procedures outlined below.

The following list outlines the alert level for different incidents.

Red Alert

- Storage level exceeding 997.70 m RL and rising at 0.2 m/hr; at this inflow, there is 4 hours before the crest of wing walls on abutments is overtopped.
- Post-earthquake inspection indicating extensive damage or imminent failure.
- Potential embankment failure due to major cracking or instability of dam structures or abutments, uncontrolled seepage through structure, abutments or foundations. Major mechanical or electrical equipment failure or damage that is likely to lead to imminent major damage or imminent failure of the dam.

Amber Alert

- Storage level at 995.30 m RL and rising at 0.2 m/hr; at this inflow, there is 12 hours before the **RED ALERT** is reached.
- Post-earthquake inspection indicating damage.
- Significant incident that cannot be remediated, and is expected to deteriorate including unexpected increases in seepage at the downstream toe, vortex forming in storage, slips at the abutments, structural damage like cracking, movement or settlement of structure and misalignment of concrete blocks or joints openings. Major mechanical or electrical equipment failure or damage that cannot be rectified in a timely manner.

White Alert

- Forecast severe storm; storage expected to exceed 994.15 m RL. At this level, the spillway flow is 100 mm deep.
- Any felt earthquake — **organise an inspection ASAP.**
- A significant incident that does not pose immediate danger. Unexpected change observed in dam structure or abutments. including minor slips, minor cracking, settlement, misalignment of joints. Major mechanical or electrical equipment failure or damage.

4 Notification

Notifying emergency responders should be done as soon as the Alert Level has been decided. The process is shown on Chart 2.

For any identified Alert Level (Red, Amber, or White), the SES should be notified immediately, on 1300 737 326. Advise the operator of the dam name, location, and the Alert Level.

ONLY IF the SES cannot be contacted, call the police Duty Officer, State Emergency Operations Centre (SEOC) on 1300 677 677. Advise the operator of the dam name, location, and the Alert Level.

Once these agencies have been notified, they will initiate their own response actions, as outlined in Chart 2.

After notifying emergency responders, Uralla Shire staff will move on to Chart 3, and follow the additional notifications outlined there. Contacts include reporting up through Uralla Shire, notifying a representative to the LEOC, to liaise and provide emergency advice, and notifying Dams Safety NSW.

Emergency contacts are available in Appendix A.

Post-earthquake procedures are outlines in Appendix D.

5 Access and Communication Information

Normal access to Kentucky Creek Dam is via Waterworks Road, which runs west from the New England Highway (see Appendix B). The dam lies approximately 3 km west of the New England Highway. Travelling time from Uralla to the dam is approximately 10 minutes. Access from Uralla to the dam should remain open in most conditions.

Telephones at the dam are located in the water treatment plant (see Appendix B). During any emergency it will be necessary for an experienced observer to be in attendance at the dam, in a safe location, to communicate the condition of the dam to the appropriate authorities, via telephone if possible. Mobile phone coverage at the dam is fair and along with two-way radios should be the main method of communication.

6 Dam Failure Scenarios

The following credible failure modes are possible for Kentucky Creek Dam.

Sunny Day Failure

- Intrinsic deficiencies and defects (e.g. cracking, spalling, settlement, etc) which when remain untreated can lead to the instability of dam or the abutment
- Internal erosion of the earthfall abutment
- Earthquake induced failures.

Flood Failure

- Flood-induced sliding or toppling of the concrete wall, under extreme loads, including the failure of the foundation.
- Flood-induced internal erosion of the abutment embankments
- Overtopping and scouring of the abutment embankments, leading to failure at either abutment.

7 Flood Inundation Area

No dambreak study or inundation mapping exists for the dam. In the event of the dam failure the flood water travels along Kentucky Creek in a northerly direction through open undulating country. It crosses at 1.3km downstream of the dam and another further 3.4km downstream. The population at risk due to the failure of the dam comprises the itinerants in the form of travellers on the roads (which are expected to have low traffic flow). In the event of a flood failure the traffic on the road are expected to be minor. The closest dwellings to the creek line are located 3.4 km downstream of the dam immediately to the north of Kingstown road at the left abutment. These dwellings are not expected to be impacted by the dambreak flood as they are located at levels above the riverbed. The consequence category of the dam was assessed to be significant (1986 Kentucky Creek Dam Surveillance Report, Public works). No significant development has occurred in the downstream area which could potentially change the assigned consequence category.

8 Preventative Actions

A possible scenario for a dam failure at Kentucky Creek Dam is earthquake damage. In this case, there may not be a long warning time in which preventative measures can be taken.

It may become necessary during an emergency to lower the storage level in the dam to decrease seepage and/or loading on the structure, and to minimise the impact of any failure. This would only be an option where an emergency condition was identified in the early stages.

Access to the scour valves requires entry on foot to the toe of the dam at the maximum section, which can only be achieved safely if the dam is not spilling. By the time a White Alert is triggered, the dam is already spilling, and access will not be possible. Consequently, operation of the scour valves is not a practical strategy for managing high water levels at Kentucky Creek Dam. Instructions for lowering the storage level are given in the Operation and Maintenance Manual for the dam.

A dam inspector, having reported a potential emergency situation should await the direction of the MW&WW. Should there be some delay in contacting the MW&WW or the condition is deteriorating rapidly, the course of preventative actions set out below should be followed:

- if possible, ensure that a responsible person with portable communications equipment is left in a safe position at the dam to monitor the emergency condition;
- if possible, advise any persons immediately downstream of the dam of the condition of the dam and the need to evacuate to high ground;
- if possible, liaise with SES and Police personnel to evacuate any persons in the inundation area;
- restrict access to the dam area;
- attempt to obtain the means for emergency communications to the dam (e.g. fixed-line phones in the treatment plant, mobile phones, two way radios).
- if possible, document the emergency condition with photographs or video recording;
- keep all involved persons advised of changes in the emergency condition; and
- do not take any unnecessary risks in undertaking the above actions.

Uralla council staff are the routine weekly inspectors and may be of assistance in the event of an emergency.

In the early stages of a dam emergency, Police or SES staff should erect WATER OVER ROAD signs at the Kentucky Creek crossings on Green Gully and Kingstown Roads. In the case of imminent dam failure, the Green Gully and Kingstown Road crossings should be closed, and the Emu Crossing at Bundara should be monitored.

Appendices

Appendix A

Emergency Contact List

Table 3 Emergency Contact List

Person / Organisation	Phone	Other Information
Uralla Shire Council emergency coordinator (24 hour contact)	M: 0438648473	Mick Raby (Director, Infrastructure and Development)
Uralla Shire Council LEMO	M: 0400799309	Myles McLindin (Group Manager and LEMO)
Uralla Shire Council Manager Water & Waste Water Services Dam manager	0455611924	<i>Michaela Sisk</i>
Uralla Shire Council Senior dam operator	0427 784 304 (shared on call phone)	Paul Byrne
Uralla Shire Council Dam operators		
Shane Barraclough	0427 784 304 (shared on call phone)	
Neil Cullen	0427 784 304 (shared on call phone)	
Michael McLennon	0428406517	For Bundarra Emergencies
Dam Safety Engineer Dam safety consultant Aurecon	0437 790 071 (BH / AH)	Niki Harandi 7/1-9 Shirley Street, CARLINGFORD
Primary Contact: NSW State Emergency Service	1300 SES DAM (1300 737 326) 24 hrs	
State Emergency Operations Centre (SEOC) (to be used ONLY if SES cannot be contacted)	1300 677 677 24 hrs	
Dams Safety NSW Duty Officer	0403 681 645	
Uralla Police	Ph: 02 6778 4400 Fax: 02 6778 3628	Hill Street URALLA 2358 Not open 24 hours
Armidale Police	Ph: 02 6771 0699 Fax: 02 6771 0611	96-98 Faulkner Street ARMIDALE 2350 Open 24 hours

Appendix B

Dam Location and Description

Kentucky Creek Dam is a concrete gravity dam on Kentucky Creek, 7.2 km by road southwest of Uralla. It is located at GDA2020 MGA coordinates (Zone 56) 351,668 m E, 6,605,913 m N. It is the sole water supply for the town of Uralla (Figure 2).

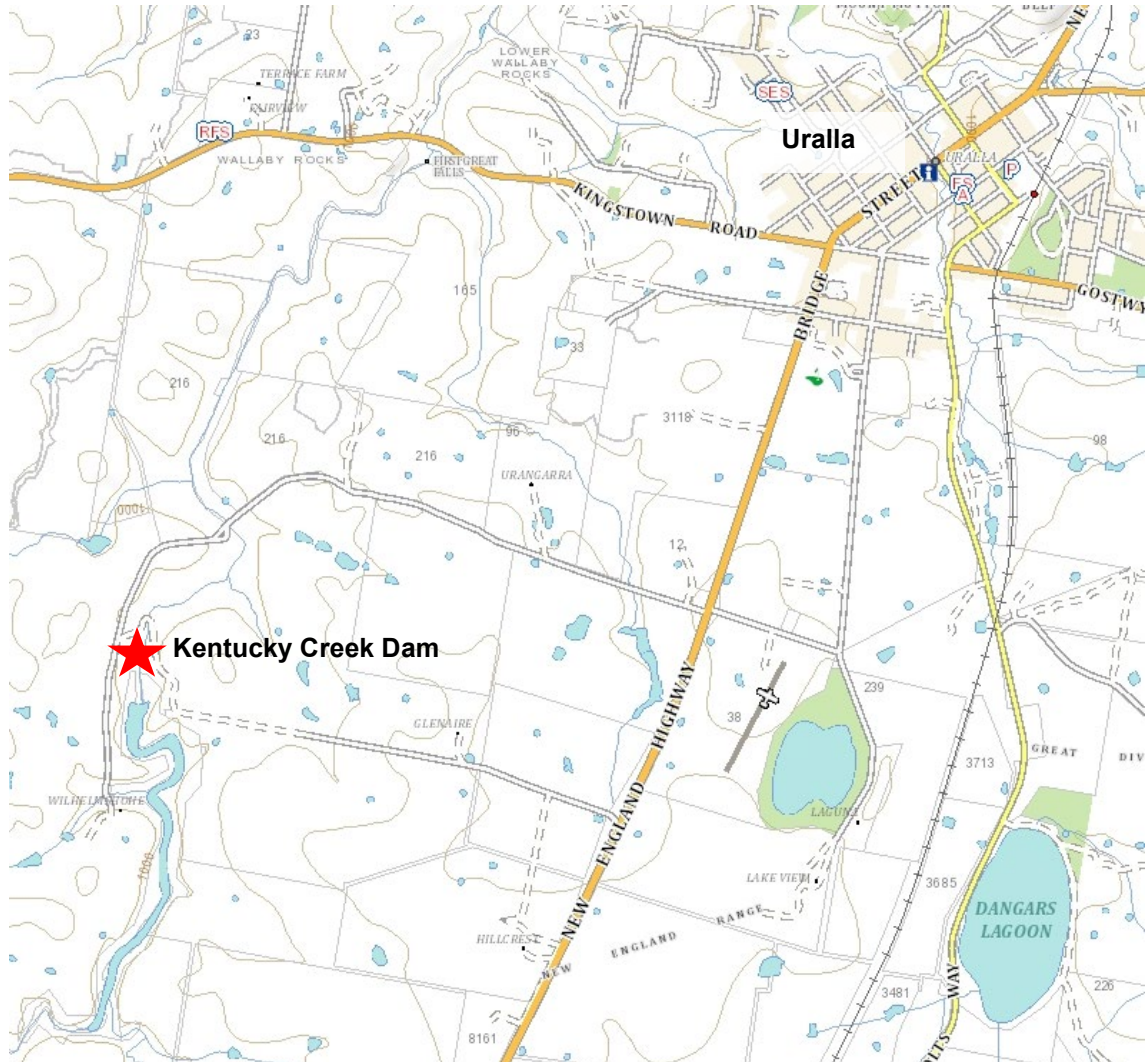


Figure 2 Location of Kentucky Creek Dam, near Uralla

Kentucky Creek Dam is a concrete gravity dam on Kentucky Creek, 7.2 km by road southwest of Uralla. It is located at GDA2020 MGA coordinates (Zone 56) 351,668 m E, 6,605,913 m N **on the** Uralla 9136-1-S 1:25,000 topographic map. The dam runs roughly east – west across north-flowing Kentucky Creek. It is the sole water supply for the town of Uralla.

The concrete gravity dam, which includes an arched dam plan, was designed and constructed in 1942 by the NSW Department of Public Works. It had a vertical upstream face, an ogee crest, and an inclined downstream face.

The dam was raised in 1984, also by the NSW Department of Public Works (1986 surveillance report). The original dam was 10.2 m high and 116 m long. After raising, the dam is 17 m high and 152 m long, with new wing walls at both ends. The raised spillway section has an irregular-shaped crest weir, with a bevelled edge on the upstream side, above a vertical upstream face. The downstream face of the raise is vertical and follows the curve of the original dam wall. The pump house toward the new right abutment was incorporated into the raised section. The raised concrete spillway is 104 m long; with the wing walls on the abutments, the dam is 152 m long. The abutment wing walls are earthen embankments, with inclined upstream and downstream faces at 1V:1.75 H slopes; the embankment sections are topped by concrete parapet walls.

The dam was constructed on granitic rock; information on foundation treatment is currently unavailable. Granite cropping out in the area downstream of the toe is slightly weathered to unweathered. The available plan and elevation of the dam (plan 82249–2A) refers to a fault in the foundation, at c. 60 m chainage — no other information is currently available on this feature.

The original spillway ran the entire length of the original crest. It had a vertical upstream face and an ogee-curved downstream face. Subsequently, in 1984, the dam was raised by construction of a concrete parapet wall on the upstream side of the original crest, which now forms the current spillway. At this time, the parapet wall was post-tensioned, with 21 tendons set into the foundation.

The outlet works commence with a trunnion arm and associated tower near the centre of the original dam crest. The vertical trunnion tower provides access to the trunnion shaft. Water is drawn through a 200 mm trunnion arm into a 300 mm suction main, which originally ran inside a 1 m x 2 m tunnel in the dam, leading to the pump house. The tunnel was filled with concrete as part of the dam raise. At the pump house, a tower on the right abutment provides access to the outlet system. The 300 mm main emerges from the concrete-filled tunnel and passes through a cone valve. Two separate pumps are provided, with associated valves, to provide redundancy at times of outage for pump maintenance. The water is directed to the water treatment plant adjacent.

A scour valve house is located at the centre of the dam. It houses a 600 mm scour valve and a 150 mm water compensation outlet valve. Access to the scour valve house is by foot along the downstream toe of the dam. Thus, it is not possible to reach the scour valves safely, once the dam is spilling.

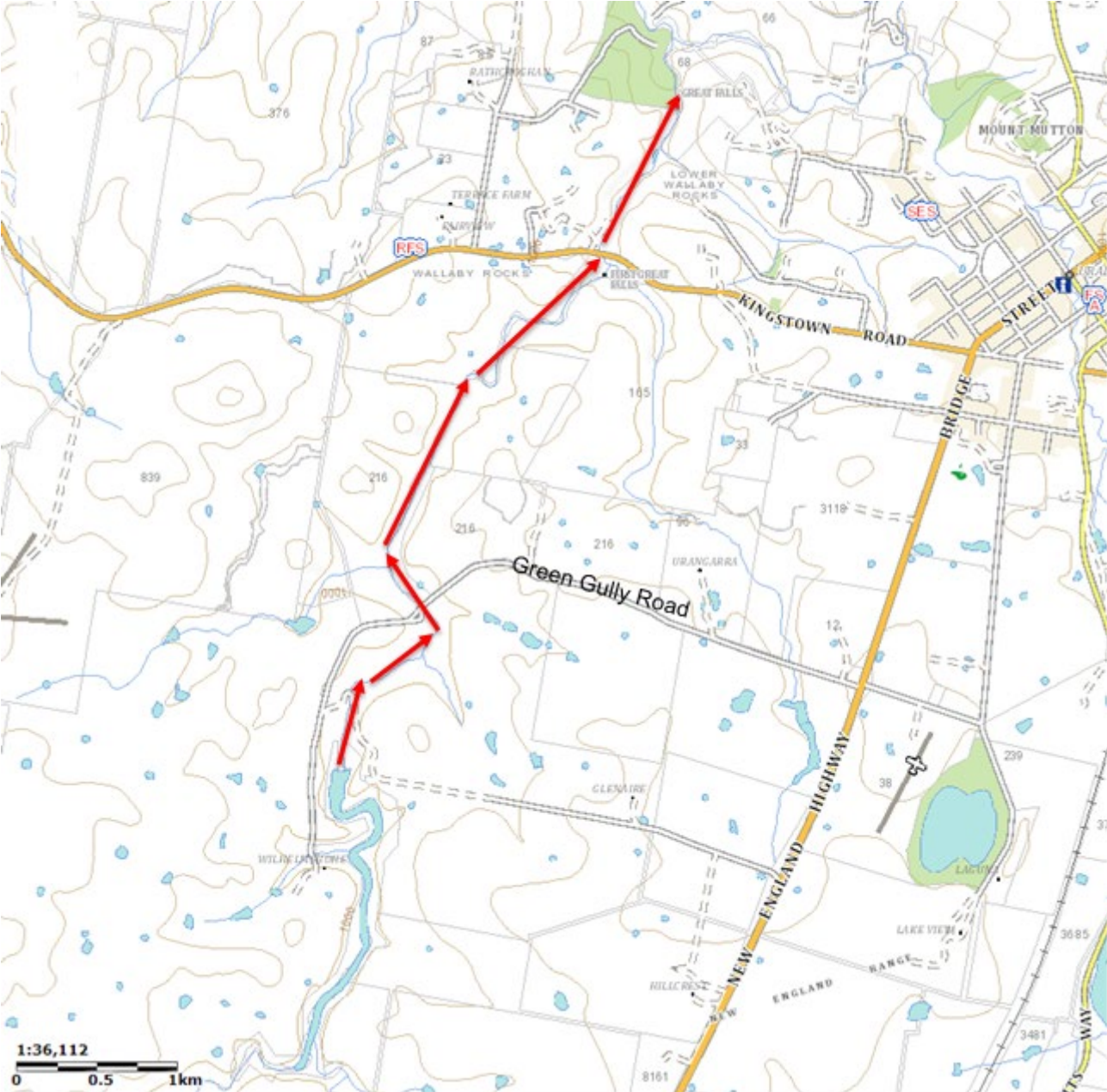
Table 4 Dam Information

Parameter	Information
Dam type:	Concrete gravity dam
Dam age:	Construction: 1942 (NSW Department of Public Works) Dam raise: 1984 (NSW Department of Public Works)
Dam height:	17 m, including the abutment wing walls
Crest length:	104.0 m concrete crest (1968 surveillance report) 151 m, including the abutment wing walls (plan 82249–2A)
Crest RL:	998.50 m RL — top of wingwalls (plan 82249–2A)
Spillway type:	Ungated ,overshot spillway that extends the entire length of the main concrete crest. The raised section of the spillway has a bevelled upstream edge, level crest, and vertical downstream face. This sits above the original ogee-curved downstream face.
Spillway level:	994.05 m RL — after dam raise, 1984 992.56 m RL — original spillway level, 1942
Full supply level:	994.05 m RL
Consequence Category	Sunny Day Failure: Significant
	Flood Failure: Significant

Appendix C

Dambreak Inundation Plan

A dambreak study or inundation mapping has not been undertaken for Kentucky Creek Dam
Figure shows the direction of floodwater travelling downstream.



Reference: SIX Maps -Visited 20/7/2020

Appendix D

Post-Earthquake Response Procedures

The Uralla Shire Council becomes aware of the occurrence of an earthquake by feeling ground shaking or by other means (eg: through media, etc) should take action required at the dam through the line of notification presented in chart 1 in the following scenarios:

- If they are aware that the earthquake has occurred with a Richter magnitude of 4.0 or greater within a 25 km radius, 5.0 or greater within a 50 km radius, 6.0 or greater within a 80 km radius, 7.0 or greater within a 125 km radius or 8.0 or greater within a 200 km radius from the dam then the dam should be inspected immediately **OR**
- If they are aware of the effects of the earthquake at the dam site, then they should immediately make an assessment of the Response Level in accordance with the table in Chart 1 and inspect the dam as per the Post Earthquake Response Procedures set out below **OR**
- If they have any doubt about the occurrence of an earthquake, the location or the effect of it at the dam then they should inspect the dams under his/her control as soon as possible.

Estimation of Modified Mercalli Intensity (MMI) and response Level

Typical effects observed at the site	Intensity No. (MMI)	Response Level Required at the site
Not felt expect for a very few under especially favourable circumstances.	1	None
Felt only by persons at rest, especially on upper floors of buildings	2	None
Felt indoors, Handling objects swing. Vibrations like passing of truck. Duration estimated. May not be recognised as an earthquake.	3	(i) Inspect the dam at next routine inspection as per the Routine Inspection Checklist
Vibrations like a passing heavy truck. Sensation like an object striking walls. Windows, dishes and doors rattle, crockery clashes. Standing cars rock. In upper ranges, wood walls and frames creak.	4	(ii) Inspect the dam as soon as possible (within a few hours) on the same day of the incident
Felt outdoors, direction estimates. Sleepers wakened. Small unstable objects displaced or upset. Doors swing closed or open. Pictures move. Liquids disturbed, some spilled. Some cracked plaster.	5	(iii) Inspect the dam as soon as possible on the same day of the incident
Felt by all, many frightened and run outdoors. Please walk unsteadily. Windows dishes, glassware broken. Small items fall from shelves. Pictures off walls, furniture moved or overturns. Weak plaster and Masonry D' cracked. Trees shaken visibility.	6	(iv) Inspect the dam immediately within an hour of the incident
Difficult to stand. Notice by drivers. Furniture broken. Damage to Masonry D' some cracks in Masonry C'. Waves on water. Small slides and caving in along sand and gravel banks.	7	
Partial collapse of Masonry C', damage to Masonry B, none to Masonry A', Car steering effected. Twisting or fall of chimneys, monuments, towers and tanks. Frame houses moved if not bolted down. Tree branches broken. Cracks In wet ground and on and on slopes	8	
General panic. Masonry D' destroyed, Masonry C' heavily damaged, Masonry B' seriously damaged. General damage to foundations. Frames cracked. Underground pipes broken.	9	
Most masonry and frame structures destroyed with their foundations. Serious damage to dams. Large landslides Rails bent slightly.	10	
Rails bent greatly. All undergrounds pipes destroyed.	11	

Please Note that this is not the Richter magnitude

Near total damage. Objects thrown into the air.	12	(v) Inspect the dam immediately within an hour of the incident
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Note

Masonry A

Good workmanship, mortar and design; reinforced or bound; designed to resist lateral forces

Masonry B

Good workmanship and mortar; reinforced; but not designed in detail to resist lateral forces.

Masonry C

Ordinary workmanship and mortar; no extreme weakness; but neither reinforcement nor design against lateral forces

Masonry D

Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

Table 5 Post-Earthquake Response Procedures (Embankment Dams)

Step No.	Description	Action
1 MW&WW	General overall dam inspection	Gauge the general overall condition of the dam. If dam failure is not considered imminent, proceed to step 3.
2 MW&WW	Dam failure in progress or severe damage such as: new or greatly increased flow through embankment or foundation; evidence of active piping; progressive deformation occurring; spillway or outlet works failure which will cause overtopping; or releases are necessary for stability.	Activate relevant response in Dam Safety Emergency Plan (see Chart 1).
3 MW&WW	Visible damage has occurred but is not serious enough to cause immediate failure of the embankment	<ol style="list-style-type: none"> 1) Activate White Alert Response in Dam Safety Emergency Plan (see Chart 1); 2) quickly observe nature, location and extent of damage - document relevant items such as seeps, depth and openness of cracks, reservoir level, mechanical function, etc.; 3) Communicate all information to dam safety consultant - when reporting, state coherently all necessary information, especially the extent of damage; 4) reinspect the site and maintain communications with the dam safety consultant; 5) be prepared to make additional inspections at any time because of possible aftershocks
4 Team**	Thorough post-earthquake inspection by experienced Inspector(s)	<p>Thoroughly inspect dam embankment, abutments and appurtenant works. Include all items normally examined in routine inspections. In particular check for:</p> <ol style="list-style-type: none"> 1) transverse cracks through the embankment, especially near the abutments, 2) longitudinal cracks in the embankment near the crest especially at the maximum section, 3) obvious settlement or misalignment of the crest of the embankment - determine location, 4) slides or deformation in the upstream and downstream faces - determine location, 5) changed or new seepage - determine location, rate, turbidity, 6) differential movement at all concrete/embankment interfaces - determine extent and degree of opening, 7) damage to concrete structures e.g. spillway, outlet tower, tunnels etc., <p>Communicate findings to Dam Safety Engineer.</p>
5 MW&WW and/or team**	Instrument monitoring	No instrumentation at Kentucky Creek Dam. Skip this step
6 MW&WW	There is no evidence of damage to the dam or appurtenant structures	Prepare a report/memo outlining inspection observations. Proceed to Step 9.

Step No.	Description	Action
7 MW&WW and team**	Primary actions (damaged dam)	<p>In the event of damage to the dam, the following actions should be carried out if possible prior to the follow-up inspection and/or the implementation of any remedial works:</p> <ol style="list-style-type: none"> 1) mark all cracks and protect them from rainfall and erosion; ensure that a marking material, such as dye or paint, is introduced into open cracks, so that crack depths can be determined later; 2) be prepared to draw down the reservoir if instructed by the Dam Safety Engineer - check that all gates, valves, outlet conduits etc. are operational; 3) prepared to trench the embankment to assess the extent of damage - determine the availability of excavation equipment; 4) be prepared to excavate and repair damaged embankment - determine the availability of compaction equipment, construction materials etc; 5) ensure that power supplies and communications are operational; 6) monitor any turbid seepage closely; 7) monitor any other anomalous conditions; 8) carry out any other instructions issued by the Dam Safety Engineer.
8 Team**	Follow-up inspection (by experienced personnel)	In the event of damage to the dam, a follow-up inspection should be carried out as soon as possible by qualified personnel familiar with the dam, to confirm the extent of any damage, and determine the risk of failure, and the need for remedial measures.
9 Team**	Seismic aftershocks	Be prepared to restart the Procedures if any aftershocks meet the initiating criteria.
MW&WW and team**	Subsequent inspection	Since some damage to structures may not be readily apparent during the post-earthquake inspection, or conditions may deteriorate, over time. Carry out a subsequent inspection two to four weeks after the initial inspection if the earthquake accelerations have been recorded and are 0.05g or greater at the site, or if earthquake shaking has been felt within several kilometres of the dam.

** Experienced inspector or engineer or team of experienced personnel with specialties pertinent to the dam structures

Appendix E

Training and Review

All staff involved in inspection and management of the dam should be properly trained. In the first instance, Aurecon can offer small group training. Ideally, relevant staff should undertake a full dam safety training course, which can also be organised by Aurecon.

This emergency plan is registered as a controlled document under the AURECON Operations System. The details are:

Document ID No.:	Kentucky Creek Dam DSEP
Document Name:	Kentucky Creek Dam Safety Emergency Plan
Document Title:	Kentucky Creek Dam, Dam Safety Emergency Plan
Document Author:	David Hilyard / Susan Stupkin
Document Approver:	Niki Harandi
Document revision 5 – annual review and revision:	Michaela Sisk, Manager water and wastewater, Uralla Shire Council

The Responsible Officer for the plan is the MW&WW. This person is responsible for ensuring that:

a) the document is reviewed regularly for adequacy and accuracy;

the document is updated after review if required;

the document is approved by an appropriate senior officer;

a distribution list and records of amendments are maintained.

The MW&WW will ensure that the Dam Safety Emergency Plan is tested periodically by conducting both desktop and practical emergency exercise. This testing is required to train participants, so they become familiar with their roles and responsibilities. It is also necessary to identify any weaknesses in the plan.

Following testing of the plan the Responsible Officer will, if necessary, revise and update the plan in accordance with Dam Safety NSW Guidelines.

Appendix F

Distribution List

Table 6 Dam Safety Emergency Plan Distribution list

Organisation	Name / Role / Location	Email Address	No. of Copies
Aurecon	Niki Harandi / Senior Dam Safety Engineer	Niki.Harandi@aurecongroup.com	1
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Uralla Shire Council	Myles McLindin LEMO	mmclindin@uralla.nsw.gov.au	1
Uralla Shire Council	Mick Raby Director infrastructure and Development	mraby@uralla.nsw.gov.au	1
Dam Safety NSW	Duty officer	dsnsw.info@damsafety.nsw.gov.au	1
NSW State Emergency Service	Mark Darling / Deputy Region Controller	mark.darling@one.ses.nsw.gov.au	1
NSW State Emergency Service	Craig Ronan / State Planning Coordinator	craig.ronan@one.ses.nsw.gov.au	3
Police — Uralla	SEMO	34579@police.nsw.gov.au 36164@police.nsw.gov.au	1

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