APPENDIX A

Dam Description/Background

A.1 DAM DESCRIPTION/BACKGROUND

Tenterfield dam is located on the outskirts of Tenterfield town centre approximately 120 kilometres northwest of Grafton, 18kilometres south of Queensland – NSW border and 545 km north of Sydney. The dam is a water supply dam. The Flood Consequence Category of the dam is assessed as HIGH A according to NSW Dams Safety Guide Sheet DSC3A (2010).

The original dam was a 13m high concrete gravity structure with a total crest length of 360m inclusive of a 202m wide overfall spillway at its centre. It was constructed by the Department of Public Works in 1930 to provide a storage capacity of about 830ML. The storage capacity was increased to 1,150ML (at FSL) in 1974 when the dam was raised by 1.83m (right abutment crest) and stabilised by a total of 97 post-tensioned ground anchors (each 13-strand).

The dam consists of fourteen blocks/sections separated by vertical movement joints, in which nine of the blocks are post-tensioned with ground anchors. The dam has no stilling basin along the overflow section of the wall.

In February 1997 and again in November 2009, lift-off tests were carried out on five and 12 respectively, of the 97 post-tensioned ground anchors at Tenterfield Creek Dam. The tests indicated loss of post-tensioning. A stability study of the dam was carried out following the 1997 tests, taking into account the results of the lift-off tests. The study was extended in March 1998 to analyse the stability of all fourteen blocks of the dam. The study went further to include a dam failure risk assessment (DPWS 1998).

NSW Dams Safety Committee (DSC) required Council to arrange for updating the stability study for Tenterfield Creek Dam taking into account the new lift-off test results obtained in 2009. A stability report presented in May 2012 concluded that the dam did not satisfy the ANCOLD Guidelines for Stability of Gravity Dams and that the situation was likely to deteriorate given the questionable performance of the post-tensioning cables and on the grounds of continuing corrosion and demonstrated loss of load (Black & Veitch 2012).

Additionally, Tenterfield Creek Dam does not meet the current NSW Dams Safety Committee (DSC) requirements for flood or earthquake handling capacity and hence Council is now faced with having to take substantial steps towards improving the stability of the dam to meet the requirements of the DSC.

Subsequently, NSW Public Works was engaged in 2014 to prepare a Concept Design report to upgrade Tenterfield Creek Dam, to meet current NSW DSC requitements.

Refer to "**Summary Information Sheet for Emergency Agencies**" in the main document for Basic Dam Data.

APPENDIX B

Glossary of Terms & Abbreviations

B.1 GLOSSARY OF TERMS

Abutment	That part of the valley wall against which the dam is constructed.
Australian Height Datum (AHD)	A system of control points for height based on a network of levelling measurements which covered the whole of Australia and which was fitted to mean sea level as measured at tide gauges distributed around the Australian coast, over the period 1968-1970.
ANCOLD	Australian National Committee on Large Dams.
Annual Exceedance Probability (AEP)	The probability of a specified magnitude of a natural event (e.g. earthquake or flood) being exceeded in any year.
Appurtenant Works	All ancillary structures of a dam including, but not limited to, spillways, inlet and outlet works, tunnels, pipelines, penstocks, power stations and diversions.
Base of Dam	The general foundation area of the lowest portion of the main body of the dam.
Catchment	The land surface area which drains to a specific point, such as a reservoir.
Collapse	The physical deformation of a structure to the point where it no longer fulfils its intended purpose.
Council	Usually the dam owner or Local Water Utility
Consultant	A Company Department or Organisation, with qualified professional engineers, capable of providing advice on the design, construction, maintenance and operation of large dams.
Dam	Any man made barrier, temporary or permanent, including appurtenant works which does or could impound, divert or control water, other liquids, silts, debris or other liquid-borne material.

Dam Crest	Frequently used to denote top of dam. However, the term Crest is usually applied to the level at which water may overflow the spillway section of the dam. The term "Top of Dam" is preferred to denote uppermost surface of the dam proper, excluding parapets, handrails, etc. – See Spillway Crest
Dam Crest Flood (DCF)	The flood event which, when routed through the reservoir, results in a still water level, excluding wave effects, which for an embankment is the lowest point of the embankment crest.
Dam Owner	Any person, organisation or legal entity who owns a dam. Legal opinion indicates that the dam owner is that person, authority or legal entity that owns the land on which the dam structure is situated.
Dams Safety Committee (DSC)	The New South Wales Dams Safety Committee is a statutory corporation of the New South Wales Government in Australia. It was created under the Dam Safety Act 1978, and has functions under that Act and the Mining Act 1992. Its main function is to ensure the safety of dams within the State.
Dam Safety Emergency Plan (DSEP)	A continually updated document incorporating instructions and maps that, together with ongoing public education, outlines the actions to be taken by a dam owner to deal with the emergency situation or unusual occurrence at a given dam or reservoir.
District Emergency Management Officer (DEMO)	Local controller of an emergency under the control of the State Emergency Operations Controller (SEOCON).
Duty Officer, SEOC	NSW Police first point of contact in an emergency.
Failure (Dam)	The uncontrolled release of the contents of a dam. The failure may consist of the collapse of the dam or some part of it, or excessive seepage or discharges in cases where hazardous substances are being stored.

Emergency	An emergency in terms of dam operation is any condition which develops unexpectedly, endangers the integrity of the dam or downstream property and life and requires immediate action.
Failure	The uncontrolled release of the contents of a reservoir through collapse of the dam or some part of it, or the inability of a dam to perform functions such as water supply, prevention of excessive seepage or containment of hazardous substances.
Foundation	The undisturbed material on which the dam structure is placed.
Freeboard	The vertical distance between the surface of the stored water and the top of the dam. Examples of freeboards are the distances from the top of the dam to the normal full supply level (normal freeboard), and the design flood level (flood freeboard).
Full Supply Level (FSL)	The level of water surface when the reservoir is at maximum operating level, excluding periods of flood discharge.
H & V	Horizontal and Vertical e.g. 3H:1.5V describes the steepness of slope.
Hazard	That which has the potential for creating adverse consequences such as loss of life, property and services damages and environmental effects (also see Risk).
Height of Dam	Normally this is the difference in level between the natural bed of the stream or watercourse at the downstream toe of the dam or, if it is not across a stream, channel or watercourse, between the lowest elevation of the outside limit of the dam, and the top of the dam. (See definition "Top of Dam".)
Imminent Failure Flood (IFF)	The flood event which, when routed through the reservoir just threatens failure of a dam. The reservoir is assumed to be initially at FSL.

Incremental Flood Consequence Category (IFCC)	An assessment category of incremental losses of life, property and infrastructure (but not including the value of the dam itself) as a consequence of dam failure due to inadequate spillway capacity (see DSC13 for details) - used in the ANCOLD Guidelines for selection of the RDF.. Where IFF is greater than PMF, IFF is taken to be the PMF.
Incident	An event which could deteriorate to a very serious situation or endanger the dam.
Inspection (Dam)	A careful/critical viewing and examination of all visible aspects of a dam.
LHS/RHS	Left Hand and Right Hand Side looking downstream, i.e. in the direction of flow.
Local Flood Plan (LFP)	Plans prepared by SES for the management of flood mitigation measures and to cover the evacuation of the population in the flood zone.
Local Water Utility (LWU)	Usually the dam owner.
Maintenance	The routine work required to maintain existing works and systems (civil, hydraulic, mechanical and electrical) in a safe and functional condition.
Maximum Credible Earthquake (MCE)	The earthquake which produces the most severe ground motion conditions at the site under the currently known tectonic conditions. This earthquake is analogous to the PMF.
Maximum Design Earthquake (MDE)	The maximum design earthquake that the dam is designed to withstand. Some, possible major, damage to the structure is to be expected but the dam must not fail.
Monitoring	The observing of measuring devices that provide data from which can be deduced the performance and behavioural trends of a dam and appurtenant structures, and the recording and review of such data.
Operator	The person, organisation, or legal entity, which is responsible for the control, operation and maintenance of the dam and/or reservoir and the appurtenant works.

Operation Basis Earthquake (OBE)	The earthquake which is expected at most to occur once in a lifetime of the structure. Sensibly the OBE would be the earthquake with an AEP of between 1 in 100 and 1 in 200. For such earthquake the dam must not suffer significant damage and all components are to remain functional.
Outlet Works	The combination of intake structure, screens, conduits, tunnels and valves that permit water to be discharged under control from the reservoir.
O&M Manual	Operations and Maintenance Manual - The collection in *One Document* the complete accurate and current operating and maintenance instructions for the dam and its appurtenant works.
Prescribed Dam	A dam is PRESCRIBED under the NSW DAMS SAFETY ACT 1978 on the recommendation of the Dams Safety Committee and is usually based on size and hazard ratings.
Population at Risk (PAR)	All those persons who would be directly exposed to flood waters within the dambreak affected zone if they took no action to evacuate. Note: *The PAR may be much greater than the potential loss of life as PAR is determined by the floodwater inundation area in the dambreak affected zone. The floodwater may be as little as 100mm deep. However loss of life would generally not be expected unless the floodwater is greater than about 300mm deep with a velocity of flow greater than about 1m/s.*
Potential Loss of Life (PLL)	PLL is the product of 'Fatality Rate' and 'Exposed Population At Risk' (PAREX) to determine the potential loss of life downstream of the dam if the dam was to fail.
Probable Maximum Flood (PMF)	The flood resulting from **PMP** and, where applicable, snow melt, coupled with the worst flood-producing catchment conditions that can be realistically expected in the prevailing meteorological conditions.

Probable Maximum Precipitation (PMP)	The theoretical greatest depth of precipitation for a given duration that is physically possible over a particular drainage basin.
Recommended Design Flood (RDF)	The flood event which has the recommended annual exceedance probability or magnitude and which produces the highest flood surcharge for the dam. In the ANCOLD guidelines the RDF is selected for the appropriate IFCC.
Reservoir Capacity	The total or gross storage capacity of the reservoir up to FSL excluding flood surcharge.
Risk	A measure of the probability and severity of an adverse event as either the product of probability and consequences, or in a non product form (See also Hazard).
Safety Check Flood	The "limit state" overall safety flood relating to potential extraordinary flood events in the safe limit of dam integrity (previously called Imminent Failure Flood).
Spillway	A weir, conduit, tunnel or other structure designed to permit discharges from the reservoir when water levels rise above the full supply level (FSL) and to convey flood-waters safely pass a dam.
Spillway Crest	The uppermost portion of the spillway overflow section.
Supervisory Control & Data Acquisition (SCADA)	A electronic system for the automatic collection and transfer of monitoring data to a central control point.
State Emergency Operations Controller (SEOC)	Authority that assumes control of an emergency if it is not under the control of a combat agency.
State Operations Communications Centre (OCC)	State Emergency Service, first point of contact for SES in an emergency.

State of Emergency	As defined by the State Emergency and Rescue Management Act, 1989 - Section 33 (1): If the Premier is satisfied that an emergency constitutes a significant and widespread danger to life or property in New South Wales, the Premier may, by order in writing, declare that a state of emergency exists in the whole, or in any specified part or parts, of New South Wales in relation to that emergency.
Tailwater Level	The level of water in the discharge channel immediately downstream of the dam.
Top of Dam	The elevation of the uppermost surface of the dam proper, not taking into account any camber allowed for settlement, kerbs, parapets, guardrails or other structures that are not a part of the main water retaining structure. This elevation may be a roadway, walkway or the non-overflow section of the dam.

B.2 ABBREVIATIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ANCOLD	Australian Committee on Large Dams
DCF	Dam Crest Flood
DEMC	Police - District Emergency Management Controller, Tenterfield
DEMO	District Emergency Management Officer
DEOCON	District Emergency Operations Controller
DFL	Dam Flood Level
D/S	Downstream
DSC	Dam Safety Committee
DSEP	Dam Safety Emergency Plan
FCC	Flood Consequence Category
FSL	Full Supply Level
IFF	Imminent Failure Flood
IFCC	Incremental Flood Consequence Category
LEMO	Local Emergency Management Officer, Tenterfield Shire Council - SES
LEOCON	Local Emergency Operations Controller, Tenterfield - Police
LFP	Local Flood Plan -SES
LWU	Local Water Utility
PAR	Population at Risk
PLL	Potential Loss of Life
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation

PRM	Probabilistic Rational Method
SCADA	Supervisory Control and Data Acquisition
SCF	Safety Check Flood
SDCC	Sunny Day Consequence Category
SEOC	State Emergency Operations Centre
SES	State Emergency Service
OCC	State Operations Communication Centre
UHF	Ultra High Frequency
U/S	Upstream
VHF	Very High Frequency

APPENDIX C

Dambreak Study Summary

C.1 DAMBREAK & PLL STUDY SUMMARY

C.1.1 Background

A Dambreak study was prepared on behalf of Tenterfield Shire Council by the NSW Public Works Department in 1996. From this study it was recommended that the consequence classification for the dam be designated as HIGH for incremental and sunny day dambreak flooding.

The Dams and Civil Section of NSW Public Works was engaged by Tenterfield Shire Council to carry out a revised Dambreak Study and Probable Loss of Life (PLL) Study for Tenterfield Creek Dam in 2013. Hydraulic simulations of dambreak floods for the dam were carried out and five flood scenarios were examined as:

1. Sunny Day Dambreak (SDDB);
2. Dam Crest Flood (DCF);
3. DCF Dambreak (DCFDB);
4. PMF; and
5. PMF Dambreak (PMFDB).

In October 2012, Council engaged DHI to carry out a Flood Study for Tenterfield. The study examined a range of flood events from the 1 in 10 AEP event to the Probable Maximum Flood (PMF) event. A MIKEFLOOD model was developed for the DHI 2012 Study. This was utilised to assist with the full construction of the dambreak hydraulic model for the study area and analysis carried out for the 2013 Dambreak and PLL Study.

The main objectives of the study were to determine the existing Sunny Day and Flood Consequence Categories for Tenterfield Creek Dam. These Consequence Categories allowed the Maximum Design Earthquake (MDE) and the Acceptable Flood Capacity (AFC) to be established for the dam.

Subsequently, the PLL analyses were carried out in accordance with Graham's and Hill et al's Method with the computed PAR estimates and MIKEFLOOD modelling results.

C.1.2 Description of the Dambreak Flood Model

The MIKEFLOOD model consists of a MIKE11 (1D) model and a MIKE21 (2D) model that run together in parallel. The MIKE21 model was constructed to analyse flood plain storage and complex local flow paths in 2D while the MIKE11 model was constructed to analyse inline hydraulic structures in 1D, such as existing bridges over Tenterfield Creek.

The coverage of DHI's MIKEFLOOD model stretch from Tenterfield Creek Dam up north to Geyers road, some 10 kilometres southeast of Wallangarra on the Queensland-NSW border. Separate flood dambreak models were constructed by NSW Public Works on MIKE11 with the resulting routed outflow hydrographs inserted into DHI's MIKEFLOOD model.

C.1.3 PAR Results

The following tables summarise the PAR findings.

Table C-1 Non-Itinerants PAR Estimates

Event	Sunny Day	DCF	PMF
Total Dambreak	51	315	372
No Dambreak		187	258
Incremental		128	114

Table C-2 Fixed-Itinerants Total Weekly Weighted PAREX Estimates

Event	Sunny Day	DCF	PMF
Total Dambreak	48	136	161
No Dambreak		114	125
Incremental		22	36

Table C-3 Total PAR Estimates

Event	Sunny Day	DCF	PMF
Total Dambreak	99	451	533
No Dambreak		301	383
Incremental		150	150

C.1.4PLL

Refer to the following Tables for summaries of the PLL estimation results.

Table C-4 Non-Itinerants Final Weekly Weighted PLL Estimates

Event	Sunny Day	DCF	PMF
Total Dambreak	0.68	8.07	13.60
No Dambreak		0.13	0.41
Incremental		7.94	13.19

Table C-5 Fixed-Itinerants Final Weekly Weighted PLL Estimates

Event	Sunny Day	DCF	PMF
Total Dambreak	1.67	8.36	8.95
No Dambreak		0.08	0.30
Incremental		8.28	8.65

Table C-6 Total Final Weekly Weighted PLL Estimates

Event	Sunny Day	DCF	PMF
Total Dambreak	2.34	16.43	22.55
No Dambreak		0.21	0.71
Incremental		16.22	21.84

C.1.5 Dambreak Flooding Conditions

Refer to the Inundation maps following this Appendix.

C.1.6 Warning Time

Refer to the January 2014 Tenterfield Creek Dam Dambreak and PLL Study for details.

C.1.7 Damage and Losses Assessments

The level of Severity of Damages and Losses of the Sunny Day and PMF dambreak events was assessed with ANCOLD's Table 2 (ANCOLD 2012) and was determined to be "Major".

C.1.8 Consequence Categories

The Consequence Category for Tenterfield Creek Dam was considered HIGH B for the Sunny Day Consequence Category (SDCC) and HIGH A for the Flood Consequence Category.

<Insert Inundation Maps >

APPENDIX D

Flood Study Summary

D.1 INFLOW OUTFLOW HYDROGRAPH

The inflow hydrograph results from an extreme rainfall event referred to as the Probable Maximum Precipitation (PMP). The PMP is the greatest depth of precipitation for a given duration that is considered physically possible over a particular drainage area.

The critical Inflow/Outflow Hydrograph was determined to be for the 2 hour duration for the PMP Duration.

Reservoir routing of the estimated PMF inflow hydrographs were undertaken using the height-storage of the dam and height-discharge of existing spillway data.

The Probable Maximum Flood (PMF) from the different deviation PMP's were tested to identify which gave the largest peak outflow which is of relevance to the safety of the dam and thus to examine the sensitivity of the outflows to model parameter values. Depending on the dam storage and spillway characteristics, the PMP that produces the largest PMF peak inflow may not be the same PMP that produces the largest peak outflow. The PMP that results in the largest peak outflow is regarded as the "critical" PMF.

The critical storm results are tabulated below, and the PMF hydrographs are shown in **Figure D-1**.

Table D-1
Flood Routing Results

Critical PMP (mm)	Storm Duration (Hrs)	PMF		MFL @ RL (m AHD)	Time to Peak (Hrs:mins)
		Inflow (m^3/sec)	Outflow (m^3/sec)		
370	2	1198	1197	881.97	1:52

D.2 STORAGE CAPACITY

The original dam provided a storage capacity of approximately 830ML. The storage capacity was increased to 1,150ML (at FSL) in 1974 when the dam was raised by 1.83m (left abutment crest).

The dam storage volume versus height relationship for Tenterfield Creek Dam is shown at **Figure D-3**.

D.3 SPILLWAY RATING CURVE

The original dam was a 13m high concrete gravity structure with a total crest length of 360m inclusive of a 202m wide overfall spillway at its centre.

A rating curve for the spillway (up to the Dam Crest level) is shown at **Figure D-2**.

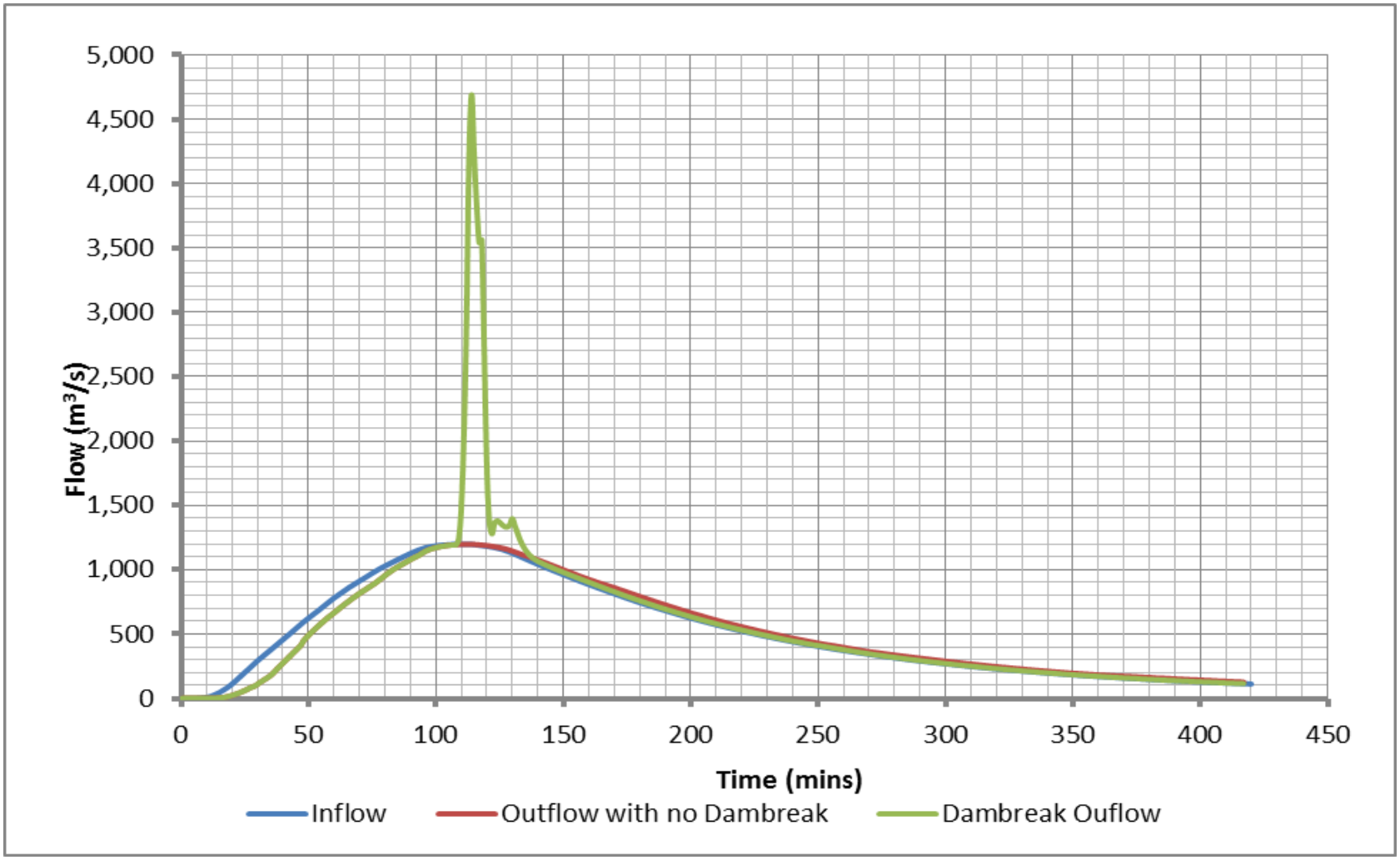

Figure D-1 Tenterfield Creek Dam**, PMF Hydrographs**

Ref: Dambreak & PLL Study, NSWPW 2014

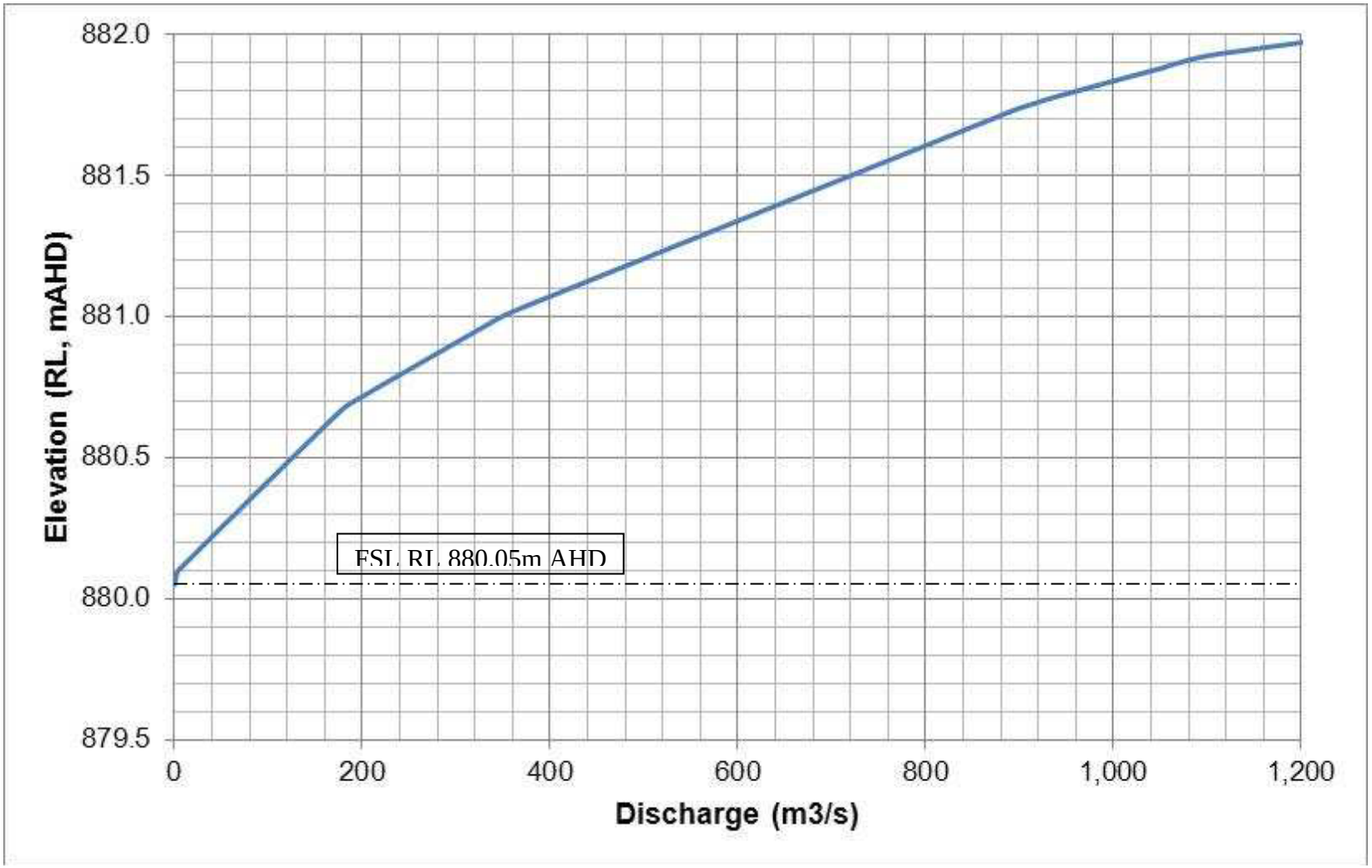

Figure D-2 Tenterfield Creek Dam **Spillway Rating Curve**

Ref: DHI, 2012

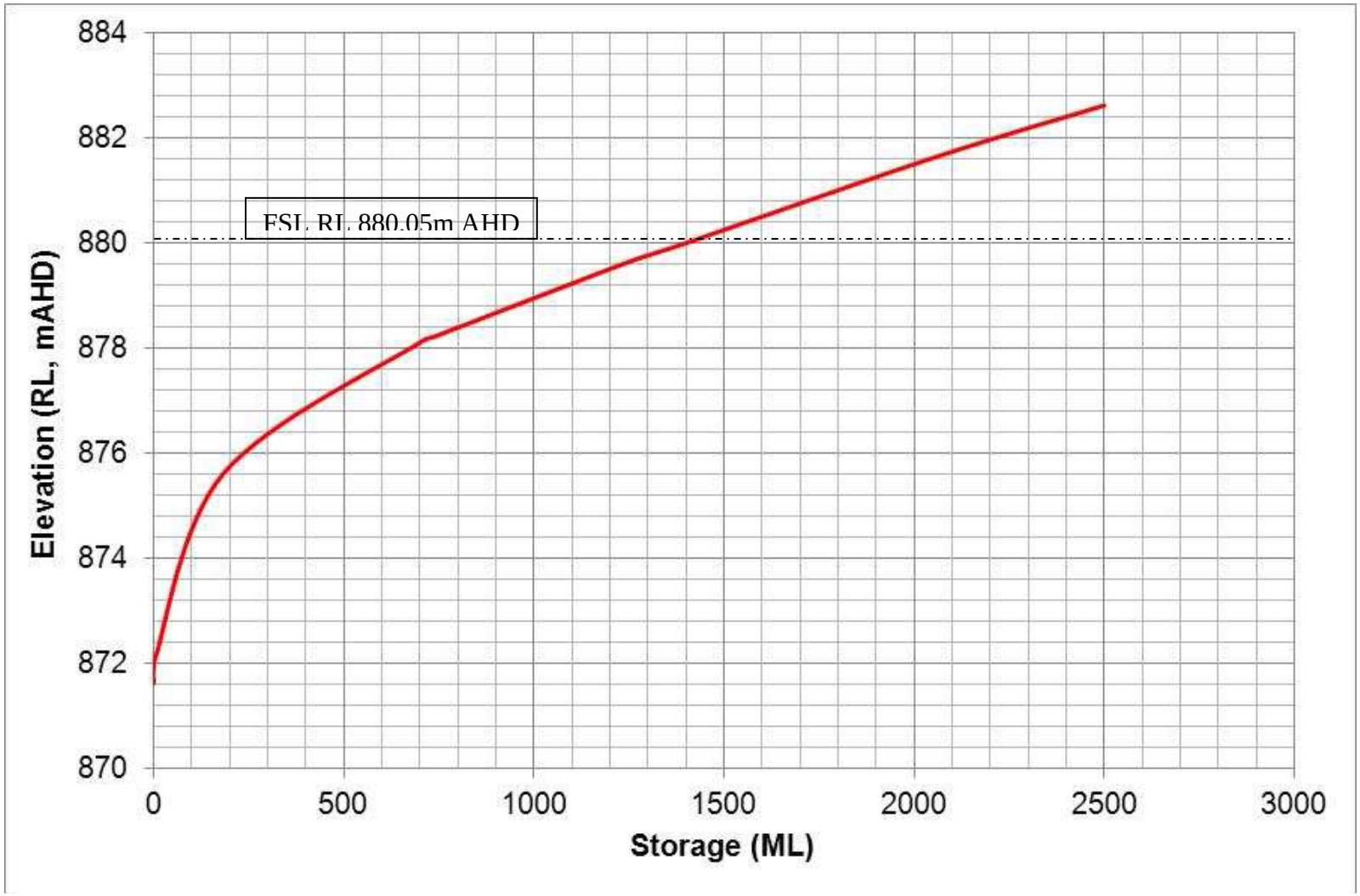

Figure D-3 Tenterfield Creek Dam **Storage Capacity Curve**

Ref: **NUWS, 2014**

APPENDIX E

Emergency Dewatering Procedures

E.1 ACTIONS TO LOWER THE RESERVOIR OR LIMIT INFLOWS OR OUTFLOWS

Lowering the storage level is the single most useful preventative action. However, it is really only useful for Sunny Day failure modes, because flood inflows far exceed the release capacity.

It may be necessary during an emergency with the consent from the Technical Services Director, to lower the Tenterfield Creek Dam storage level to decrease seepage and/or loading on the structure to minimise the impact of any failure. This would only be an option when an emergency condition was identified in its early stages.

The outlet works at Tenterfield Creek Dam comprise an outlet tower with 250mm dia. suction main outlet and a 600mm dia. scour line. Prior to and during emergency lowering of the storage level, the Technical Services Director shall keep the NSW Public Works informed of storage levels, discharges and anticipated discharges.

Wherever time permits, the communication pathways given in **Charts 1**, **2**, **3** and **SES Flow Chart No.1** found in **Section 2** of this document are to be followed, but where a situation develops too rapidly to follow procedures, operating staff must take whatever action they consider appropriate, such as alerting the Population at Risk (PAR) directly.

E.1.1 Tenterfield Creek Dam Release Constraints

The main issue that needs to be considered with regard to the lowering of the storage level is the maximum possible release constraints through the outlet works. The rate of release from the Dam is governed by the water level at the time of the proposed drawdown. However, as dewatering is generally only possible in a Sunny Day failure mode, it is assumed the storage in Tenterfield Creek Dam is at Full Supply Level (FSL).

There are two constraints that need to be considered when examining the lowering of storage level. These are:

1. Maximum possible releases from Tenterfield Creek Dam; and

2. Flooding impacts downstream.

E.1.2 Maximum Possible Releases from Tenterfield Creek Dam

The storage level of the dam at the time of any emergency will govern the rate of release through the scour valve during drawdown.

The scour line comprises a separate 600mm dia. pipe through the dam wall at RL 869.61m AHD (centre of pipe). The outlet connects to two gate valves which need to be replaced.

All of the current valves (250mm dia. suction main and two 600mm scour valves) are manually operated. The scour line is rarely exercised and is for emergency drawdown of the storage.

E.1.3 Flooding Impacts Downstream of Tenterfield Creek Dam

Refer to Appendix C for details.

E.1.4 Operating Outlet System

The outlet works at Tenterfield Creek Dam comprise an outlet tower with 250mm dia. suction main outlet and a 600mm dia. scour line. The suction main outlet supplies water to the water treatment plant which is very near the dam. The suction main is fed by a trunnion arm arrangement allowing selective withdrawal from FSL RL 880.054m AHD to approximately the level of the trunnion hinge at RL 871.44m AHD. The trunnion is adjusted via a wire rope, pulley and winch. The winch is located on top of the outlet tower on an overhead operating platform.

E.1.5 Emergency Dewatering Line Operation

Emergency dam dewatering will be required when there is a potential Sunny Day dam failure. Examples of emergency situations, where emergency dewatering procedures could be used, are provided in **Section E.1.6** of this document.

Table E-1, below, indicates the number of days required to dewater Tenterfield Creek Dam from the relevant level assuming there are no inflows into the storage and outlet systems are functioning. It is estimated that it will take approximately one week to dewater Tenterfield Dam.

Table E-1
Emergency Dewatering

Storage Level (m AHD)	Dewatering Time, No Inflow (No. of days)
878.4 (FSL)	168
876	142
874	116
872	91
870	65
868	39
866	14
865	empty

Note this could cause minor flooding downstream depending on downstream tributary inflows.

E.1.6 Examples Requiring Emergency Dewatering

The two following examples have been used to illustrate the cases that require emergency dewatering. Also, a typical approach that should be taken when a situation develops too rapidly to follow standard procedures is given.

Localised Seepage

If pools of water form at the downstream toe of the dam and the water gushing out is discoloured and/or of high turbidity then follow these steps:

1. Activate **Red Alert** response.
2. Follow emergency dewatering procedures outlined in the Tenterfield Creek Dam Operations and Maintenance Manual.
3. Form a 2 m diameter sandbag ring around the localised seep.
4. Place concrete sand into the circle of sandbags.
5. Place 20 mm nominal size of well graded concrete aggregate over the concrete sand.

The volume of sand and gravel to be placed has not been given because the volumes used will be dependent upon the size and hydraulic head of the leak. The height of sand and concrete aggregate over the emerging

flow should be high enough for the weight of water within to balance the hydraulic pressure (i.e. the sandbags should be placed at a level where no leakage is visible over the side of the wall).

Appendix F contains a recommended list containing potential sources of materials.

Appearance of Major Structural Cracks

If significant cracking of the concrete face of the dam is observed with displacement of concrete sections or joints in the wall and water is exiting from the cracks, then follow these steps:

1. If cracks are evident at the dam crest or at the downstream toe of the dam, then follow these steps:

    a. Activate ***Red Alert*** response.

    b. Follow the emergency dewatering procedures outlined in the Tenterfield Creek Dam Operations and Maintenance Manual.

    c. Contact the NSW Public Works, for advice.

2. The following assessments should be made by the Technical Services Director when a ***seep/leak*** is detected on the downstream side of the dam:

    a. Is the leak coming from the dam toe?

    b. Is it a generalised leak or a localised leak?

    c. Is the water from the leak clear or turbid?

    d. How much seepage is occurring?

    e. Is the seepage increasing, decreasing or not changing?

Once the seepage location and colour is identified then NSW Public Works, Dams & Civil Technologies Section should be contacted and advised on the type of leak detected. The operator should have the above questions answered and be ready to repeat them to NSW Public Works. NSW Public Works will give advice on the best method of ameliorating the problem. If the leak is localised the method described under **Localised Seepage** above should be adopted.

Where a situation develops too rapidly to follow the above procedures, operating staff must take whatever action they consider appropriate. The above two actions are to be used as a guideline.

APPENDIX F

PLANTS & MATERIALS

F.1 SOURCES OF CONSTRUCTION MATERIALS AND EQUIPMENT

Potential sources of construction materials and equipment are listed in Communications Directory located in the main document.

F.2 MATERIALS TO BE STORED AT THE SITE

The materials to be stored on the site for an emergency situation are listed in **Table F-1**.

Table F-1
Materials to be Stored at the Site

Material	Quantity	Inspection Frequency
Sand Bags	20	Yearly
Sand	0.5m^3	Yearly
Gravel	0.5m^3	Yearly
Emergency Lighting	2	Yearly

The above materials are obtainable from suppliers listed in Error! Reference source not found.

APPENDIX G

Standard Forms

SHEET G-1 COMMUNICATIONS LOG - Tenterfield Creek Dam Date:_____ Sheet ___ of ___

DATE	TIME	FROM	TO	DISCUSSION	ACTION

Signed: _____ Date: _____ Position: _____

SHEET G-2, Tenterfield Shire Council Tenterfield Creek Dam
Visual Inspection Report

APPENDIX A TENTERFIELD SHIRE COUNICL DAM INSPECTION REPORT						
AREA Inspection		CONCRETE MASONRY DAM (MON, WED, FRI)		CHECK (√) A.1 ACTION NEEDED		
	ITEM NO.	CONDITION	OBSERVATIONS	MONITOR	INVEST–	REPAIR
UPSTREM FACE	1,	SURFACE CONDITION				
	2,	CONDITION OF JOINTS				
	3,	UNUSUAL MOVEMENT				
	4,	ABUTMENT–DAM CONTACTS				
	5,	SURFACE CONDITIONS				
DOWNSTREAM FACE	8,	CONDITION OF JOINTS				
	9,	UNUSULAL MOVEMENT				
	10,	ABUTMENT–DAM CONTACTS				

	11,	DRAINS				
	12,	LEAKAGE				
CREST	15,	SURFACE CONDITION				
	16,	HORIZONTAL ALIGNMENT				
	17.	VERTICAL ALIGNMENT				
	18.	CONDITION OF JOINTS				
	19.	UNUSUAL MOVEMENT				
GENERAL SITE OBSERVATION	20.	SITE SECURITY				
	21.	GROUND MAINTANANCE				
	22.					
	23.					
	24.					

ADDITONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE–

TENTERFIELD SHIRE COUNCIL

TENTERFIELD CREEK DAM

DAM INSPECTION REPORT

INSPECTION DATE:	**INSPECTION TIME:**
INSPECTORS ATTENDING:	
ADDITIONAL PERSONNEL ATTENDING:	
WEATHER CONDITIONS:	
RAINFALL FOR PRECEEDING WEEK (mm):	
WATER LEVEL BELOW SPILLWAY:	
CONDITION OF STRUCTURE:	
CONDITION OF STORAGE AREA:	
ANY DETERIORATION TO AREAS ON CREST:	
CONDITION OF TRUNNION:	

V-NOTCH WEIR:

LEFT SIDE V-NOTCH WEIR FLOW (ml/min):

RIGHT SIDE V-NOTCH WEIR FLOW (ml/min):

CONDITION OF V-NOTCH WEIR (REMOVE DEBRIS):

TURBIDITY (f.t.u.): **pH:**

CALCIUM HARDNESS (mg/lt):

REMARKS:

Note: "Other than normal" observations to be reported IMMEADIATELY to the Manager, Water and Waste.

Inspector(s):		**Manager, Water and Waste:**	
Signed:		**Signed:**	
Date:		**Date:**	

TENTERFIELD SHIRE COUNCIL

TENTERFIELD CREEK DAM

250 Dia. VALVE INSPECTION REPORT

(Note this inspection should be carried out every 6 months for the Gate Valves)

INSPECTION DATE: _____ **INSPECTION TIME:** _____

INSPECTORS ATTENDING: _____

ADDITIONAL PERSONNEL ATTENDING: _____

250 Dia. Valve in Valve Chamber:

(VAG Valve)

Note: This maintenance requirements are located in Appendix D of the Operation and Maintenance Manual.

Check Condition of Paint: _____

Check Bolt & Nut Condition: _____

Check Shaft for Leaks: _____

Check Valve Opens and Closes: _____

Maintenance Scheduled: _____

250 Dia. Valve Outside Plant Building:

Note: This maintenance requirements are located in Appendix E of the Operation and Maintenance Manual.

(Challenger Valve)

Check Condition of Paint:	
Check Bolt & Nut Condition:	
Check Shaft for Leaks:	
Check Valve Opens and Closes:	
Maintenance Scheduled:	

REMARKS:

Note: "Other than normal" observations to be reported IMMEADIATELY to the Manager, Water and Waste.

Inspector(s):		**Manager, Water and Waste:**	
Signed:		**Signed:**	
Date:		**Date:**	

TENTERFIELD SHIRE COUNCIL

TENTERFIELD CREEK DAM

SCOUR VALVES INSPECTION REPORT

(Note this inspection should be carried out every 6 months for the Gate Valves and every month for the Butterfy Valve or sooner if required due to an event)

INSPECTION DATE: _____ **INSPECTION TIME:** _____

INSPECTORS ATTENDING: _____

ADDITIONAL PERSONNEL ATTENDING: _____

600 Dia.Gate Valve:

(VAG Valve)

Note: This maintenance requirements are located in Appendix D of the Operation and Maintenance Manual.

Check Condition of Paint: _____

Check Bolt & Nut Condition: _____

Check Shaft for Leaks: _____

Check Valve Opens and Closes: _____

Maintenance Scheduled: _____

_____

600 Dia. Butterfly Valve:

(VAG Valve)

Note: This maintenance requirements are located in Appendix D of the Operation and Maintenance Manual.

Monthly Oil Level Check : _____

Monthly Pressure @ Pressure Gauge Check :	
Monthly Automatic Return to Open Position:	
Check Bolt & Nut Condition:	
Check Shaft for Leaks:	
Check Valve Opens and Closes:	
Maintenance Scheduled:	

REMARKS:

Note: "Other than normal" observations to be reported IMMEADIATELY to the Manager, Water and Waste.

Inspector(s):		**Manager, Water and Waste:**	
Signed:		**Signed:**	
Date:		**Date:**	

A.2 TERRORISM AND/OR SABOTAGE THREATS TO THE DAM: QUESTIONNAIRES

The following provides a procedure for handling potential threats to the dam. This appendix has been divided up into 3 different types of threats that each has a relevant questionnaire that should be followed by a generic checklist during an emergency. These are:

SHEET G-3: Bomb Threat

SHEET G-4: Armed Threat

SHEET G-5: Threat to Water Supply

SHEET G-6: Checklist

BOMB THREAT
SHEET G-3

If you receive a telephoned bomb threat, follow the instructions below:

- Signal to a colleague and if possible, have someone else listen to the line to help you remember important facts later.
- Ask someone else to call Police on another line so that an attempt can be made to trace the call.
- Try to keep the caller on the phone until Police arrive on site.

Ask the caller these questions:

1. When is the bomb set to go off?

   .....

2. Where is the bomb?

   .....

3. What kind of bomb is it?

   .....

4. What does it look like?

   .....

5. What will make it explode?

   .....

6. Why are you doing this?

   .....

7. How did you place it?

   .....

8. Who are you? Name? .....

   Address? .....

Date: ..... Time: ..... How long did the call last? .....

- Inform Duty Officer
- Inform Technical Services Director.

Complete details on Sheet G-5.

ARMED THREAT
SHEET G-4

If you receive an armed threat, follow the instructions below:

- **ENSURE YOUR OWN AND OTHER PEOPLE'S PERSONAL SAFETY AS A MATTER OF PRIORITY**.
- Disengage from any dangerous situation or threatening conversation as quickly as possible and withdraw from the scene.
- Call the Police and give details of the threat.
- Report the incident to the Technical Services Director as appropriate.
- Advise Duty Officer and all other staff on site (on and off duty).

Record the following details:

- Was the threat made by an individual or more than one person?

  .....

- What was the weapon used? .....
- Describe the person/people:

  Articulate/Incoherent Male/Female Possible Age? .....

  Accent? .....

  Emotion? (angry/calm/other) .....

  Description? (height/build/weight/hair colour/clothing/beard/glasses)

  .....

  .....

  Did you recognise the person/people? (who?) .....

- Where was the threat made?

  .....

- Where did the person go?

  .....

- Was there a vehicle?

  .....

- Who or what was the target of the threat? Be as exact as possible.

  .....

  .....

Date: ..... Time: ..... How long did the call last? .....

- Inform Duty Officer
- Inform Technical Services Director.

Complete details on Sheet G-5.

THREAT TO WATER SUPPLY
SHEET G-5

If you receive a telephoned threat to the water supply, e.g. by poisoning, follow the instructions below:

- Signal to a colleague and if possible, have someone else listen to the line to help you remember important facts later.
- Ask someone else to call Police on another line so that an attempt can be made to trace the call.
- Try to keep the caller on the phone until Police arrive on site.

Try to ask the caller these questions:

1. What was added to the water?

   .....

2. How much (i.e., what volume of chemical, number of bacteria, etc.)?

   .....

3. What strength (e.g. of chemical)?

   .....

4. When was it put into the water (dam, reservoir)?

   .....

5. Where was it put into the water?

   .....

6. How did you put it into the water?

   .....

7. Why have you done this?

   .....

8. Who are you? Name? .....

   Address? .....

Date: ..... Time: ..... How long did the call last? .....

- Inform Duty Officer
- Inform Technical Services Director.

Complete details on Sheet G-5.

THREAT TO WATER SUPPLY
SHEET G-5

- What was the wording of the threat? Be as exact as possible.

  .....

  .....

  .....

  .....

  .....

- Caller's voice (circle as appropriate)

  Loud/Soft Fast/Slow Clear/Muffled

  Articulate/Incoherent Male/Female

  Emotion? (angry/calm/other) .....

  Accent? .....

  Speech impediment? .....

  Possible age? .....

  Did you recognise the voice? (Who?) .....

Did the caller seem familiar with the dam? Yes/No

Was the message read out? Yes/No

Was it a taped message? Yes/No

Was the call local, mobile or STD? Local/Mobile/STD

Were there any background noises from: Street/House/Office/Factory/Car/Traffic

Animal/Voices/Machinery/Music/PA system/Other? .....

.....

Your name/position/organisation: .....

.....

APPENDIX B

ROUTINE INSPECTION

B.1 OPERATIONS AND MAINTENANCE MANUAL

An Operations & Maintenance (O&M) Manual exists for Tenterfield Creek Dam. The O&M manual details up-to-date operating, maintenance and overhaul instructions for the dam and its appurtenant structures. Its purpose is to ensure adherence to approved operating procedures regardless of the passing of time and changes in operating personnel. The instructions also enable responsible persons unfamiliar with conditions at Tenterfield Creek Dam to operate the dam during an emergency situation or at other times as may be necessary.

The manual was prepared primarily for dam operation staff and their supervisors who are assigned the responsibility for the physical operation and maintenance of the dam.

B.2 TENTERFIELD CREEK DAM INSTRUMENTATION AND ROUTINE MONITORING

There is no instrumentation systems incorporated in the actual dam or appurtenant works, apart from the rainfall and storage levels which are recorded automatically by a telemetry system. Therefore visual inspections are used to monitor the condition of the concrete structure. Refer to the attached **Sheet G-2** for an example of a "Visual Inspection Report" Sheet to be used at this Dam.

Instrumentation readings and recordings are carried out as per the O&M Manual and according to the following minimum schedule (in accordance with the Australian National Committee on Large Dams Guidelines on Dam Safety Management – ANCOLD August 2003).

B.2.1 Seepage Readings

Installation of a new seepage weir to measure the flow from the right abutment was recommended in the 2013 dam surveillance report. Installation of the weir should be connected to the telemetry system to continually monitor the seepage flow rate.

Seepage readings (L/s) should be recorded in a table with storage RL (mAHD) and rainfall (mm) values for each day of the WTP water Sheet V:\Tenterfield W.T.P\Copy of WATER 2009-onward (Autosaved) Current Version.xlsx. At the end of each month, values from the table should be plotted on a graph. Abnormal responses relative to the plotted trends and after taking account rainfall effects shall be dealt with as in the following paragraphs.

An observation that would be of serious concern when taking seepage measurements would involve a change in the colour/clarity of seepage water from clear to turbid on the total amount of seepage, where the change is not related to fluctuating water levels, rainfall or seasonal variations.

If the changes discussed above are observed, the Tenterfield Shire Council Technical Services Director is to contact the SES. Tenterfield Shire Council should then contact the NSW Public Works, Dams & Civil Technologies and other persons as given on **Chart 1** and **SES Flow Chart No.1** (found at the end of **Section 2** of this document) as required by the relevant alert responses.

B.2.2 Rainfall and Storage

Rainfall and the reservoir inflows and levels are recorded automatically with the data transferred by a telemetry system to the council and SES offices/depots for normal operation and flood emergency alarms with the latter being activated in accordance with the Alert levels.

Rainfall records as well as storage water level records should be summarised annually.

B.2.3 Routine Visual Inspections

Tenterfield Shire Council operation and maintenance staff currently visit Tenterfield Creek Dam daily, carrying out a brief inspection of the dam. The operator completes the inspection report (i.e. **Sheet G-2**) on a monthly basis. The records are kept available for review by the dam surveillance consultant at their audit inspections.

In accordance to the latest recommendations of the ANCOLD Guidelines, routine visual inspection of the dam is to be made at least twice weekly and preferably daily by the operator.

The operator's first job shall be to inspect the significant structures of the dam. The main areas for inspection are:

i. Dam Crest - for impact damage, debris accumulation, movement.

ii. U/s & d/s face - for misalignments, tilts, differential movements or cracking.

iii. Downstream Toe - wet spots, seepage or springs.

iv. Service Spillway - for cracks, settlement, seepage, misalignment.

v. Outlet Works - vandalism or interference with discharge or release system.

vi. Seepage Areas - significant flow variation or turbidity.

vii. Abutments - for signs of rock movement or new seepage.

The whole of the dam, including both faces of the dam crest and the service spillway, should be inspected systematically so that all areas are covered. Any changes or unusual observations are to be recorded. Photographs taken at 6-monthly intervals (preferably taken in the same position) will assist in detecting change. All photographs should be dated, labelled and securely stored ready for future reference.

In the event of an unusual occurrence, such as a large inflow (i.e. storms causing a sudden increase in storage level), a rapid drawdown of the storage, or of a felt earthquake, an additional more intensive check of the dam is required. This inspection shall include inspection for turbidity of flows through the seepage points.

In the case of an earthquake particular attention is to be given to the flat area downstream of the dam toe, looking for new seepage. The crest should then be inspected for distortion and settlement and then checked by survey. For further guidance on action to be taken in the case of earthquakes refer to **Section B.3** of this appendix.

In the case of a rapid drawdown of the storage, the upstream face should be carefully checked for signs of instability.

The observations that would be of serious concern when making dam or spillway inspections are listed in **Table C-1**, of this document. If any of the observations discussed under **Table C-1** are evident then the relevant emergency alert is to be initiated by the Technical Services Director.

B.2.4 Reports of Unusual Occurrences/Emergencies

An unusual occurrence is defined as an event taking place, or a condition developing which is not normally encountered in the routine operation of the dam and reservoir. It may endanger the dam or necessitate either a temporary or a permanent revision of the operation procedures.

Floods to a level that constitute an emergency, cracking of the dam, earthquakes, a rapid increase and/or turbidity in seepage, and failure of any portion of the structures or related equipment are typical unusual occurrences. A rapid drawdown of the storage may also constitute an unusual occurrence.

Reports of unusual occurrences should be submitted, immediately after they are detected, to Tenterfield Shire Council Technical Services Director. A copy of the report is to be submitted at the same time to the NSW Public Works, who will then determine what further investigation or additional reports are required.

An appropriate entry is to be made in the "Communications Log" (i.e. **Sheet G-1** in **Appendix G**).

B.3 EARTH TREMOR/EARTHQUAKE EMERGENCY PROCEDURES

B.3.1 Assess the Severity of the Tremor

The following procedures shall be initiated if a tremor is felt, or if the *Environmental System & Services* (previously the Seismology Research Centre) notifies you that a tremor has been detected in the Tenterfield area. Refer to the attached description of the Modified Mercalli Scale in **Table B-2** to estimate its rating on this scale, based on the felt affects at the dam. Then follow the procedures below depending whether the assessment is less than MM4 or greater then MM4 (if instruments have detected the tremor, they will give a Magnitude in Richter Scale units, which are different from the Mercalli Scale).

If the earthquake falls into one of the following magnitude/distance categories, then the procedures for tremors greater than MM4 should be followed. Tremors greater than MM4 include but are not limited to:

Richter Magnitude > 4.0 within 25km radius

Richter Magnitude > 5.0 within 50km radius

Richter Magnitude > 6.0 within 80km radius

Richter Magnitude > 7.0 within 125km radius

Richter Magnitude > 8.0 within 200km radius

(NOTE: Magnitude indicated refers to the Richter Scale)

B.3.2 If the Tremor is LESS than MM4

Carry out a full inspection in accordance with the Tenterfield Creek Dam "Visual Inspection Report" Sheet (see **Sheet G-2**), if the tremor occurs in daytime, or at first light following a night-time tremor.

During a visual inspection read all seepage points. Note any pronounced changes in the rate of flow and colour of seepage water - both increases and decreases from the normally recorded values.

If the inspection finds some changes due to the tremor, notify the NSW Public Works, Dams & Civil Technologies immediately. If there is no effect from the tremor, notify them of its occurrence at the next convenient opportunity.

B.3.3 If the Tremor is EQUAL TO or GREATER Than MM4

The Post-Earthquake Response Procedures, as outlined in Table B-1 should be implemented in the event of a seismic tremor equal to or greater than MM4.

Table B-1
Post-Earthquake Response Procedures

Step No. (personnel)	Description	Action
1 (operator*)	General overall dam inspection	1. Dam operators or other staff member present at the dam shall immediately call on other staff members on duty. 2. One extra staff member contacted will notify the Tenterfield SES and SES State Headquarters (Wollongong) of a felt earthquake of greater than MM4 and that the dam is to be inspected. Refer to **Chart 2**, **SES Flow Chart No.1** and **Sheet 3 - Emergency Communications Directory** for contacts. 3. If tremor occurs in day time, immediately carry out a full inspection of the wall, pipes, valves and spillway in accordance with the Tenterfield Creek Dam Routine Inspection Sheet (see **Sheet D-1**). Inspect abutment for slips, cracks and/or change in seepage. Use all available officers who are familiar with the dam to carry out the inspection, to be able to detect and changes as soon as possible. 4. If a tremor occurs at night, use spotlights kept available at the site to inspect the crest, spillway and right abutment. Also inspect from the toe for seepage and inspect all seepage measuring points. At first light, carry out a full inspection in accordance with the Tenterfield Creek Dam Routine Inspection Sheet. Read all seepage points. 5. Note any distinct change in the rate of flow and colour of seepage water – both increase or decrease from the normally recorded values. 6. If any change is found, immediately notify the NSW Public works, Dams & Civil Technologies. If no changes are found notify them at the conclusion of inspection. 7. Notify Tenterfield SES & SES State Headquarters (Wollongong) of inspection results. **Note: If dam failure is considered imminent, proceed to Step 2, otherwise proceed to Step 3.**
2 (operator*)	Dam failure in progress or severe damage such as: • Major change to: - Seepage - Seepage turbidity - sudden, extensive	Activate Emergency Response **Red Alert** Procedure.

Step No. (personnel)	Description	Action
	cracks • Seepage through joints and cracks • Seepage through abutments • Major cracks in concrete structures • Major movement of outlet works	
3 (operator*)	Visible damage has occurred but is not serious enough to cause immediate failure of the concrete dam.	1. Activate **White Alert**. 2. Quickly observe nature, location and extent of damage - document and photographs relevant items such as depth and openness of cracks, reservoir level, mechanical function, etc. 3. Report all information to the relevant Tenterfield Shire Council staff as defined in **Table 8.1-Organisational Responsibilities**. When reporting, state coherently all necessary information, especially the extent of damage. 4. Reinspect the site and maintain communications with the NSW Public Works, Dams & Civil Technologies 5. Be prepared to make additional inspections at any time because of possible aftershocks.
4 (team**)	Thorough post-earthquake inspection by experienced Inspector(s) to be carried out after Step 1 and Step 2.	Thoroughly inspect dam crest, abutments and appurtenant works. Include all items normally examined in routine inspections. In particular check for: 1. Transverse cracks through the dam, especially near the abutments. 2. Longitudinal cracks in the dam near the crest especially at the maximum section. 3. Obvious settlement or misalignment of the dam crest - determine location. 4. Changed or new seepage - determine location, rate, turbidity; 5. Differential movement at all concrete/ interfaces - determine extent and degree of opening. 6. Damage to concrete structures, e.g. spillway, etc. 7. Damage to mechanical and electrical plant, especially equipment used for drawing down the reservoir. 8. 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.

Step No. (personnel)	Description	Action
		9. Report all findings to the NSW Public Works, Dams & Civil Technologies.
5 (operator* and/or team**)	Instrument monitoring.	Monitor all dam instrumentation. This should be carried out as soon as possible after the event by trained personnel, and the monitoring of selected instruments should be repeated at frequent intervals if the dam has been damaged, or if there are anomalous instrument readings. If condition deteriorates so that dam failure becomes a possibility, activate a **Red Alert**. If damage is not visible and if instrument readings are normal, continue to visually inspect the facilities and monitor seepage and water levels once a day for at least two days, since damage effects may be delayed.
6 (operator*)	There is no evidence of damage to the dam or appurtenant structures.	Submit a "No Damage" report. Proceed to Step 9.
7 (operator* and team**)	Primary actions (damaged dam).	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: 1. Mark all cracks and protect them from rainfall and erosion; ensure that a marking material, such as a dye or pain, is introduced into open cracks, so that crack depths can be determined later. The cracks should be mapped for future reference in assessing damage to the dam and for planning repairs. If required, construct a barrier around the crack(s) in order to comply with OH&S requirements; 2. Ensure that power supplies and communications are operational. If not, repair them or make arrangements for temporary or backup systems including portable generators, two-way radios, mobiles, telephones, etc.; 3. Monitor any turbid seepage closely and in accordance with **Chart 2** and **SES Flow Chart No.1** until the causes are determined or the cloudiness stops. 4. Be prepared to draw down the reservoir if instructed by the investigation team – check all gates, valves, etc. are operational and not damage to the outlet conduits is observed. Lowering the reservoir should NOT be carried out until these checks are made and the investigation team has determined that the draw down would not initiate any sliding on the dam's upstream face. This is particularly important where damage includes longitudinal cracks;

Step No. (personnel)	Description	Action
		5. Carry out any other instructions issued by the investigation team.
8 (operator* & team**)	Seismic aftershocks.	Be prepared to restart the Procedures if any aftershocks meet the initiating criteria.
9 (operator* 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.

* Operating/maintenance person or personnel

** Experienced inspector or engineer or team of experienced personnel with specialties pertinent to the dam structures including NSW Public Works.

Table B-2
Modified Mercalli Intensity Scale

Average Peak Velocity (cm/s)	Value Description (MM)	Intensity	Average Peak Acceleration (g = 9.8 m/s²)	Richter Scale Equivalent
	I	Not felt except by a very few under especially favourable circumstances.		0 - 4.3
	II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.		
	III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognise it as an earthquake. Standing automobiles may rock slightly. Vibrations like a passing truck. Duration estimated.		
1 - 2	IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing automobiles rocked noticeably.	0.015g - 0.02g	4.3 - 4.8
2 - 5	V	Felt by nearly everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles and other tall objects sometime noticed. Pendulum clocks may stop.	0.03g - 0.04g	
5 - 8	VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.	0.06g - 0.07g	4.8 - 6.2
8 - 12	VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.	0.10g - 0.15g	

Table B-2 continued

Average Peak Velocity (cm/s)	Value Description (MM)	Intensity	Average Peak Acceleration (g = 9.8 m/s²)	Richter Scale Equivalent
20 - 30	VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments and walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.	0.25g - 0.30g	6.2 - 7.3
45 - 55	IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.50g - 0.55g	
More than 60	X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable for riverbanks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.	More than 0.60g	
	XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.		7.3 - 8.9
	XII	Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.		

B.4 WHAT IF SITUATIONS

The following are extracts from DSC Training Materials – Data Review, Investigation, Analysis and Remedial Actions for Dam Safety, Module – Evaluation of Hydraulic Adequacy

B.4.1 Hydraulic Deficiencies

Examples of situations resulting from hydraulic deficiencies include, but may not be limited to:

- Blocked outlet pipes by siltation;
- Overtopping of dam crest due to blocked spillway/outlet system or wave action over the crest.

B.4.2 Remedial Action

Situation 1: Blocked Spillway resulting to Crest Overtopping

Emergency and temporary actions to deal with blocked spillway includes:

- Restricting reservoir elevation by maintaining or lowering the storage level by discharge flood through the outlet pipes;
- If possible, remove debris or vegetation growth in the chute spillway, the spillway approach channel and the crest of the concrete unit;
- Removing vegetation growth in the downstream channel of the outlet pipe to prevent water backing up into the outlet conduit;
- Protecting and stabilising damage areas.

Situation 2: Blocked Outlet System resulting to Crest Overtopping

Emergency and temporary actions to deal with blocked outlet pipe(s) includes:

- Restricting reservoir elevation by controlling flood discharge through the spillway;
- Minimising erosion of foundation material and stabilising spillway slabs by dumping heavy rip rap or other materials downstream of the spillway;
- Protecting and stabilising damage areas.

B.4.3 Example of the Importance of Time Response

The following example from US Department of the Interior Teton Dam Failure Review Group (1977) demonstrates how dams can fail rapidly without giving much warning. It is essential that Dam Staff familiarise themselves with this concept as illustrated below:

Failure of Teton Dam

Chronology of Failure Events

- June 5, 1976 a leak was observed at about 7:45 am, coming from the right abutment at the toe of the dam
- The leak was reported to the Supervisor, at 8:15 am he examined the flow to be 49 ML/day (0.6 m^3/s) to 73.4 ML/day (0.85 m^3/s)
- The Project Construction Engineer and Field Engineer were notified at 8:20 am, they arrived at the dam site at about 9:00 am.
- At 9:10 am, they observed a slightly turbid leak of 5 ML/day (0.06 m^3/s)
- The leak from the right abutment at the toe of the dam was re-examined at 9:30 am, and was estimated to be flowing 98 ML/day (1.1 m^3/s) to 122 ML/day (1.4 m^3/s).
- Another leak developed between 10:00 am and 10:30 am, on the downstream face of the dam. (at a higher elevation than the first leak at the toe) The wet spot quickly began to leak at a rate of 24 ML/day (0.3 m^3/s) to 36.71 ML/day (0.4 m^3/s) and erode the face of the embankment.
- At 10:30 am a loud sound of rapidly running water was heard and the erosion of embankment materials was increasing rapidly.
- Two dozers at 10:40 am began to push rock into the eroding hole and at 11:30 am the two dozers slid into the opening and were washed downstream
- Between 11:40 am and 11:50 am a sink hole developed in the downstream face of the embankment
- At 11:55 am, the embankment crest collapsed and the dam was breached at 11:57 am.

It is evident from the above that the failure sequence occurred with great speed. It took only 4 hours from the time of the first observed seepage in the immediate proximity of the dam for the dam to fail. From the time the dam was last observed to have no visible leakage, i.e. 9:00 pm on the previous night, only 15 hours were required to breach the dam.

APPENDIX C

Dam Failure Indicators

C.1 DAM FAILURE INDICATORS

There are certain circumstances and behaviour traits for concrete dams that may be indicative of the development of a potential emergency situation which might ultimately lead to dam failure. In many cases important behaviour traits are evident in advance of a critical situation from the surveillance, monitoring and warning systems installed at the dam. Relevant circumstances and behaviours traits (but are not limited to) are listed in **Table C-1** below.

Table C-1
Concrete Dam Failure Indicators

CIRCUMSTANCES	INDICATORS
Signs of Movement	Dam misalignment and differential movement
	Displacement at joints between blocks
	Wide cracks with vertical displacement
	Severe cracking with or without leaking; irregular cracking at an angle to the dam
	New leakage on downstream face
	Wetness in abutment or foundation adjacent to the toe
	New cracking over extensive area
Impact Damage	Impact damage on concrete surface leads to new significant cracking in concrete
Leakage	Major changes in leakage/seepage pattern or flow
	Water spurting or running out of joints or cracks
	Change in turbidity of seepage

Change in instrument readings:	Seepage Weir • Change in clarity of water (i.e. more turbid) • Change in amount of water not related to rainfall or storage movement.
	• Concrete deterioration that is major, sudden and extensive or has changed significantly since previous inspection
Deterioration of Construction Material	Sudden reduction of reservoir level
Changes in Reservoir Surface Condition	Whirlpools in reservoir
	Malfunction of valves and/or mechanical equipment which will affect the safety of the dam
Changes in mechanical equipment	As above
Earth Tremor	As above
Terrorism and Sabotage*	

Terrorism and Sabotage: Emergency situations that could entail terrorism or sabotage include bomb threats, armed threats and threats to the water supply. Checklists and questionnaires to follow in these situations are included in* ***Appendix G**.* ***Personal safety should always be the first priority in these situations.***

APPENDIX D

Emergency Remedial Measures

(Extracts from DSC Training Materials – Data Review, Investigation, Analysis and Remedial Actions for Dam Safety Module – Evaluation of concrete Dam Stability)

D.1 GENERAL

This section details remedial measures and preventative actions that may be implemented both prior to and following the development of an emergency situation to reduce the damage to the dam structure(s). It details provisions for surveillance and detection of an emergency situation.

Depending on the severity and type of the emergency it may be possible to implement remedial measures to reduce the damage to the structure(s) by:

- Lowering the storage level (refer to **Section E** of the Appendix).
- Sealing or draining cracks
- Modifying operational procedures
- Buttressing unstable slopes
- Other actions

D.1.1 Lowering the Storage Level

When leakage or instability of the dam is the problem, it may be appropriate to draw the reservoir down. Immediate drawdown in this situation may have two major benefits:

- By reducing the hydrostatic pressures and reservoir load, drawdown my slow down or stop the process that can lead to dam failure
- By reducing the amount of impounded water, drawdown will reduce the impact drawdown if a failure does occur.

D.1.2 Sealing or Draining Cracks

When cracks in the dam or foundation are leaking to significant leakage or erosion of materials, the cracks maybe sealed to reduce the amount of leakage and to lessen the potential of erosion or piping. Crack sealing with proper crack drainage can reduce detrimental uplift pressures.

It is advisable for drainage of the cracks, so that the leaking water is conducted to a suitable location in the drainage system. Drainage alone also can be used to relieve internal pressures that tend to keep the cracks open and propagate them.

D.1.3 Modifying Operational Procedures

For abutment and reservoir rim slope instability problems, it may be possible to modify operational procedures to prevent rapid fluctuations of

the reservoir level. Such fluctuations can lead to sloughing and slope instability. When discharges are causing erosion of concrete and foundation materials at the toe of the dam, operational procedures should be modified to reduce discharges or to direct them away from affected area.

D.1.4Buttressing Unstable Slopes

Unstable reservoir slopes or excavations may require buttressing with large, free-draining material. Buttressing can be used to improve stability, control piping and allow internal hydrostatic pressures to dissipate safely.

D.1.5Other Actions

In the event of a rapidly deteriorating structural deficiency which is likely to threaten the security of Tenterfield Creek Dam (as per **Section 2** Notification Flow Charts and **Section 3** Actions, Responsibilities & Communications Directories), Tenterfield Creek Dam Staff having reported a potential emergency situation, should do the following:

1. Ensure that a responsible person with portable communication is left in a safe position at the dam to monitor the emergency condition. See **Section 5 Communication & Warning Systems**, for details of communication procedures to be used during emergency conditions.

2. Restrict access to the dam area.

3. Liaise with emergency management authorities. See **Charts 1**, **2**, **3**; **Tables I**, **II**, **III** and **SES Flow Chart No.1** for appropriate actions, and **Sheet 3 - Emergency Communications Directory**, for additional contact details.

4. If possible, document the emergency condition with photographs and/or a video camera.

5. For flooding events, monitor and record weather forecasts, streamflow information and rain gauge information.

6. Inform all involved personnel (see **Chart 1-3** found at the end of **Section 2** this document) of any change in the emergency condition.

7. Do not take any unnecessary risks in undertaking the above actions.

APPENDIX E

Notification Procedures

E.1 NOTIFICATION PROCEDURES FOR FLOODING CONDITIONS

E.1.1 Flood Response

If a storage level of RL 880.17m, RL 880.47m or RL 880.87mAHD is reached then preparations for either a **White Alert**, **Amber Alert** or **Red Alert** respectively are activated.

Once water is flowing over the spillway, the water level must be monitored at least *hourly* by Tenterfield Creek Dam Staff, keeping the Technical Services Director, the NSW Public Works and the NSW SES continually advised.

For notification flow charts for an emergency flooding condition see **Chart 1** and **Table I** (i.e. at end of **Section 2** and **3** respectively), as well as **SES Flow Chart No.1** (Refer to **Figure 2-1**) for **White Alert**, **Amber Alert** or **Red Alert** as appropriate.

Appendix D contains an inflow/outflow flood frequency curves, storage volumes versus levels and the rating curve for the spillway.

E.1.2 Notification Procedures

It is important that the responses set out below are followed strictly, wherever time permits. Adherence to these procedures will ensure that all relevant sources of specialist knowledge are available to deal with the situation, and that both risk and nuisance to the public is minimised.

The procedures in response to the various alerts are as follows:

White Alert

A **White Alert** emergency flooding condition should be reported when the storage reaches RL 880.17 mAHD (at FSL). The emergency situation should be reported to the member of Tenterfield Shire Council Staff first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Tenterfield Shire Council Staff should contact the following in the order listed:

1. NSW SES OCC (or if unavailable contact NSW SEOC Duty Officer). The SES/Duty Officer shall activate procedures as per **SES Flow Chart No.1**.

2. NSW Public Works. NSW Public Works is to arrange inspections and make plans, in consultation with Tenterfield Shire Council, for remedial action as necessary.

Additionally, Tenterfield Shire Council Staff should:

- Monitor the condition of the dam.
- Maintain contact with NSW SES, NSW Public Works and NSW DSC.
- Interrogate the Bureau of Meteorology's web site for all weather forecasts relevant to the catchment.
- Inform NSW SES & NSW DSC Executive Engineer if weather data indicates a possible escalation of alert status to **Amber Alert**.

A member of Tenterfield Shire Council Staff should continue to monitor the depth of flow over the spillway *hourly*, 24 hours a day. If the depth of flow increases to RL 880.47 mAHD over the spillway, the **Amber Alert** procedure should be activated.

Amber Alert

An **Amber Alert** emergency flooding condition should be reported when the storage reaches RL 880.47 mAHD (greater than 0.42m above the FSL). The emergency situation should be reported to the member of Tenterfield Shire Council Staff first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Tenterfield Shire Council Staff should contact the following in the order listed:

1. NSW SES OCC (or if unavailable contact NSW SEOC Duty Officer). The SES/Duty Officer shall activate procedures as per **SES Flow Chart No.1**.
2. NSW Public Works, Dams & Civil Technologies to arrange inspections and make plans, in consultation with Tenterfield Shire Council, for remedial action as necessary.
3. NSW DSC Executive Engineer who will also inform the DSC Chairperson.

This member of Tenterfield Shire Council Staff should also:

- Monitor the condition of the dam.
- Maintain contact with NSW SES, NSW Public Works and NSW DSC.
- Interrogate the Bureau of Meteorology's web site for all weather forecasts relevant to the catchment.

- Inform NSW SES & NSW DSC Executive Engineer if weather data indicates a possible escalation of alert status to **Red Alert**.

A member of Tenterfield Shire Council Staff should continue to monitor the depth of flow over the spillway *hourly*, 24 hours a day. If the depth of flow increases to RL 880.87 mAHD over the spillway, the **Red Alert** procedure should be activated.

Red Alert

A **Red Alert** emergency flooding condition should be reported when the storage reaches RL 880.87 mAHD (greater than 0.82m above the FSL). The emergency situation should be reported to the member of Tenterfield Shire Council Staff first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Tenterfield Shire Council Staff should contact the following in the order listed:

1. NSW SES OCC (or if unavailable contact NSW SEOC Duty Officer). The SES/Duty Officer shall activate procedures as per **SES Flow Chart No.1**.

2. NSW Public Works, Dams & Civil Technologies to arrange inspections and make plans, in consultation with Tenterfield Shire Council, for remedial action as necessary.

3. NSW DSC Executive Engineer who will also inform the DSC Chairperson.

A member of Tenterfield Shire Council Staff should also:

- Monitor the condition of the dam.

- Maintain contact with NSW SES, NSW Public Works and NSW DSC.

- Interrogate the Bureau of Meteorology's web site for all weather forecasts relevant to the catchment.

A member of Tenterfield Shire Council Staff should continue to monitor the depth of flow over the spillway *hourly*, 24 hours a day.

When the storage level reaches RL 881.73 m AHD (right abutment crest level), the NSW SES is again advised.

The member of Tenterfield Shire Council Staff will regularly advise the NSW SES Region of developments, following the initial alarm. Tenterfield Shire Council staff will also tune a radio station and television to monitor

the dissemination of warning messages. Enquires from the media will be directed to the NSW SES or the Police Media Liaison Unit.

E.2 EARTHQUAKE CONDITIONS

E.2.1 Earthquake Response

If a tremor is felt, the earthquake should be reported to the member of Tenterfield Shire Council Staff first available as listed in **Section 8 - Organisational Responsibilities** (Refer to **Table 3-1** or **Table H-2 and H-3** to assist with assessing the severity of the tremor using the Mercalli Intensity Scale). The relevant member of Tenterfield Shire Council Staff will routinely follow the procedure set out in the Operations & Maintenance Manual (extracts can be found at **Appendix H** of this DSEP).

If an "emergency condition or an incident" is found to exist, follow the procedures at **Chart 2** and **Table II** (i.e. at end of **Section 2** and **3** respectively) as well as **SES Flow Chart No.1** (Refer to **Figure 2-1**) for either a **White Alert** or **Red Alert.** Examples of the typical conditions at the Dam for this type of emergency condition are given at **Table B-1.**

E.2.2 Notification Procedures

It is important that the responses set out below are followed strictly, wherever time permits.

Severity of Tremor LESS than MM4

Tenterfield Shire Council staff is required to carry out a visual inspection of the dam, checking all seepage points and boreholes.

If any changes to the dam are detected, Tenterfield Shire Council staff should contact NSW Public Works, Dams & Civil Technologies and together discuss/review the results of the inspection made. If no change is detected, NSW Public Works should again be notified for recording purposes. A follow-up inspection within the next 24 hours is to be carried out by Tenterfield Shire Council.

In consultation, these parties shall determine the requirements for remedial action, as necessary.

Severity of EQUAL TO or GREATER MM4

Upon immediate inspection of the dam in accordance with **Table B-1**, "Post Earthquake Response Procedures" and Mercalli Intensity Scale (Refer to **Appendix H** or **Table 3-1** for Scale), the relevant member of Tenterfield Shire Council Staff must decide if there is an imminent

threat\occurrence of failure. If there is an imminent threat or occurrence of failure, a **Red Alert** must be activated. If there is NO imminent threat of failure, a **White Alert** is activated.

The procedures in response to the various alerts are as follows:

White Alert

A **White Alert** emergency situation should be reported to the member of Tenterfield Shire Council Staff that is first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Tenterfield Shire Council Staff should:

- Monitor the condition of the dam for 24 hours after last "after shock".
- Contact with the NSW Public Works, Dams & Civil Technologies and advise of any problem or unusual incident that poses a potential risk to the dam.

The NSW Public Works will assess the situation and in conjunction with the Technical Services Director will arrange any necessary inspections and works at the dam.

A member of Tenterfield Shire Council Staff should continue to monitor the condition of the structure, and check seepage over a 24 hour period at *3 hourly* intervals. If the Tenterfield Shire Council finds that the situation is more dangerous than was initially assessed, and it presents a risk of imminent dam failure, the Technical Services Director will then activate a **Red Alert.** If further damage is not detected, minor repairs should be completed and routine inspections resumed.

Red Alert

The relevant member of Tenterfield Shire Council Staff should contact the following in the order listed:

1. NSW SES OCC (or if unavailable contact NSW SEOC Duty Officer). The SES/Duty Officer shall activate procedures as per **SES Flow Chart No.1**.

2. NSW Public Works. NSW Public Works is to arrange inspections and make plans, in consultation with Tenterfield Shire Council, for remedial action as necessary.

3. NSW DSC Executive Engineer, who will contact the DSC Chairperson.

After contacting the NSW SES and NSW Public Works, Tenterfield Shire Council Staff should continuously inspect the site for at least 24 hours, at *3 hourly* intervals.

The member of Tenterfield Shire Council Staff will regularly advise the NSW SES of developments, following the initial alarm. Tenterfield Shire Council staff will also tune a radio station and television to monitor the dissemination of warning messages. Enquires from the media will be directed to the NSW SES or the Police Media Liaison Unit.

E.3 OTHER THAN FLOOD OR EARTHQUAKE CONDITIONS

E.3.1 Other Emergency Responses

If an "emergency condition or incident" is found to be due to other than flooding or earthquake, follow the procedures at **Chart 3** and **Table III** (i.e. at end of **Section 2** and **3** respectively), as well as **SES Flow Chart No.1** (Refer to **Figure 2-1**), for either a **White Alert** or **Red Alert** as appropriate. Examples of the conditions for this type of emergency condition include Terrorism and/or Sabotage as are given in **Section A.2**.

E.3.2 Notification Procedures

It is important that the responses set out below are followed strictly, wherever time permits.

Upon an emergency condition or incident being reported:

- Tenterfield Shire Council Staff must **immediately** inform NSW SEOC of threat.
- Carry out **immediate** inspection of the dam **ONLY** when "all clear" received from NSW SEOC. The relevant member of Tenterfield Shire Council Staff must decide if there is an imminent threat or occurrence of failure of the Dam.
- If there is an imminent threat or occurrence of failure, a **Red Alert** must be activated otherwise a **White Alert** is activated.
- If a relevant member of Tenterfield Shire Council Staff inspects the Dam and considers there is NO damage to structure, the Staff member must then contact the NSW Public Works, Dams & Civil Technologies.

White Alert

A **White Alert** emergency situation should be reported to the member of Tenterfield Shire Council Staff that is first available as listed in **Section 8**

- Organisational Responsibilities. This member of Tenterfield Shire Council Staff should:

- Monitor the condition of the dam and complete necessary minor repairs
- Contact NSW Public Works and advise of any problem or unusual incident that poses a potential risk to the dam.

Red Alert

The member of Tenterfield Shire Council Staff should contact the following in the order listed:

1. NSW SES OCC (or if unavailable contact NSW SEOC Duty Officer). The SES/Duty Officer shall activate procedures as per **SES Flow Chart No.1**.

2. NSW Public Works. NSW Public Works is to arrange inspections and make plans, in consultation with Tenterfield Shire Council, for remedial action as necessary.

3. NSW DSC Executive Engineer, who will contact the DSC Chairperson.

The member of Tenterfield Shire Council Staff will regularly advise the NSW SES Region of developments, following the initial alarm. Tenterfield Shire Council staff will also tune a radio station and television to monitor the dissemination of warning messages. Enquires from the media will be directed to the NSW SES or the Police Media Liaison Unit.

APPENDIX F

Stream Gauges Relevant to the TENTERFIELD CREEK DAM Area

STREAM GAUGES RELEVANT TO THE TENTERFIELD CREEK DAM AREA

F.1 STREAM GAUGING STATIONS

Stream gauging stations provide valuable information on the catchment yield and response rate. The stations enable more accurate estimation of flood magnitude. They are also of benefit to any future flood warning system.

Daily rainfalls are recorded by the Bureau of Meteorology (BoM) at a number of their rainfall gauging stations in the vicinity of Tenterfield. The stream gauges relevant to the Tenterfield Creek Dam area are included in **Table F-1**.

Table F-1
Relevant Stream Gauges

Location	Type (A or M)*	Owner
Black Swamp Rain Gauge	Unknown	Unknown
Tenterfield Creek Rain Gauge	A	TSC**
Mount MacKenzie Rain Gauge	A	TSC
Douglas Street Stream Gauge	A	TSC
Currys Gap Stream Gauge	A	TSC
Tenterfield Dam	A	TSC
Federation Park	A	TSC
Springside	Unknown	Unknown

*A – Automatic, M – Manual
**Tenterfield Shire Council

Refer to **Figure L-1** for the gauge station locations.

In the case of a heavy rain or flood event, the data can be downloaded from the NSW Water Information web site:

http://www.waterinfo.nsw.gov.au/drr/

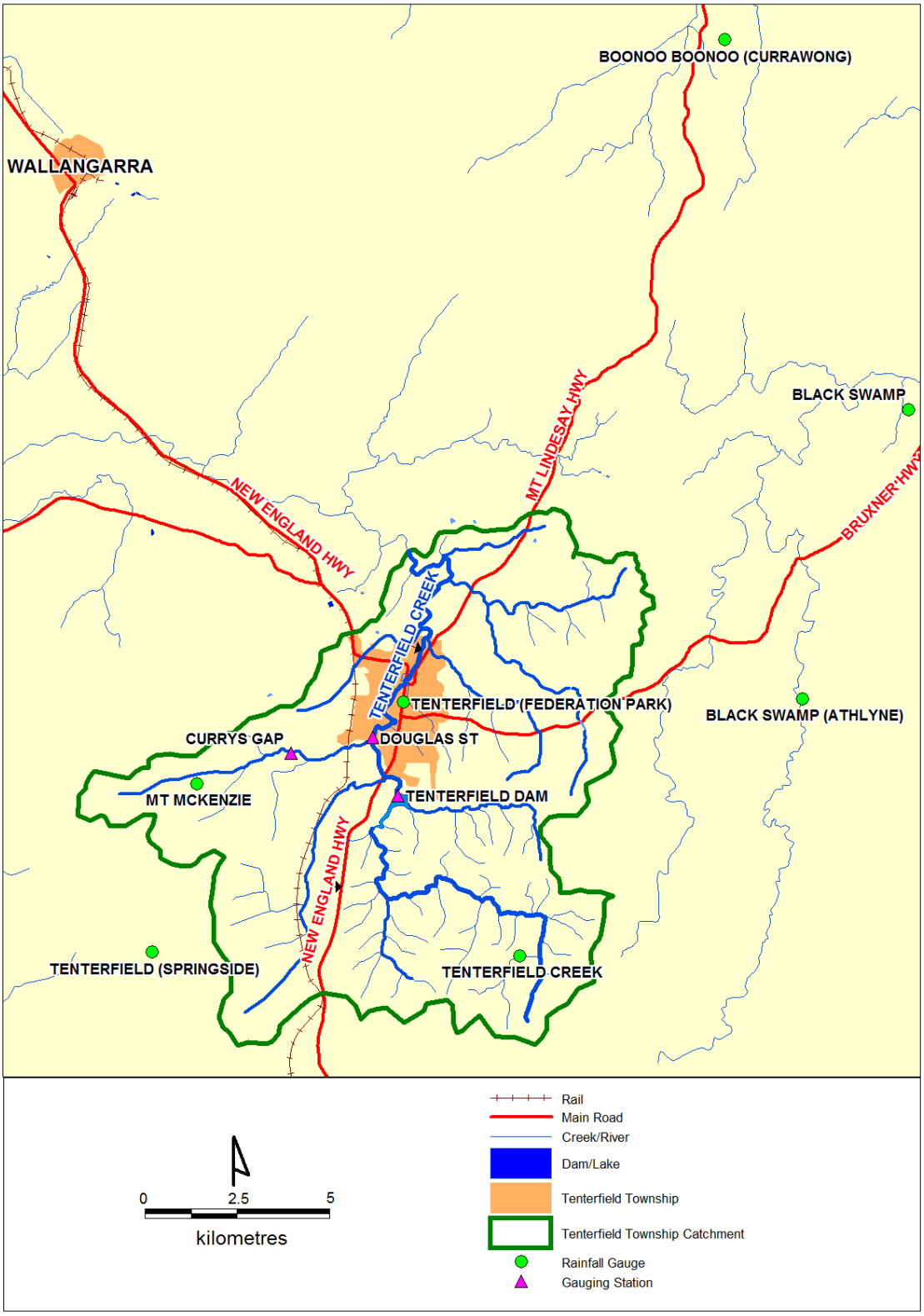

Figure L-1 Gauge Station Locations

APPENDIX G

Training, Review and Document Control

G.1 TRAINING, REVIEW AND DOCUMENT CONTROL

G.1.1 Document Control

This Emergency Plan is registered as a controlled document with the NSW Public Works, Dams & Civil Technologies Section, the Master Manual is with Tenterfield Shire Council, Tenterfield. The details are:

Document Author: NSW Public Works, Dams & Civil Technologies Section.

Document ID No.: DC15006

Document Title: Dam Safety Emergency Plan for Tenterfield Creek Dam

Document Approver: Technical Services Director, Tenterfield Shire Council

Other controlled copies of this document are located as listed in the "DAM SAFETY EMERGENCY PLAN FOR TENTERFIELD CREEK DAM, CONTROLLED DISTRIBUTION LIST" which can be found at the front of this document.

The responsible officer for the document is the Technical Services Director, Tenterfield Shire Council. This officer is responsible for ensuring that:

- the document is reviewed regularly (at least annually) for adequacy and accuracy;
- the document is updated after review if required;
- the document is approved by an appropriate senior officer;
- the distribution list and records of amendments are maintained.

The Responsible Officer will also ensure that the Dam Safety Emergency Plan is tested periodically by conducting a simulated emergency exercise. This testing is required to train participants so they do not become unfamiliar with their roles and responsibilities. It is also necessary to identify any weakness in the document.

Testing of the Tenterfield Creek Dam Safety Emergency Plan will be carried out on a yearly basis. At least every five years, a drill (e.g. field or desktop) should be conducted that is coordinated with all state and local counter disaster officials having downstream planning responsibilities in association with the DSEP.

Following testing of the document the Responsible Officer will record the results of the test and, if necessary revise and update the document on the amendment list, at the front of the Dam Safety Emergency Plan. All drawings and text pages revised and updated should be clearly labelled with the latest amendment numbers and inserted into the appropriate locations.

G.1.2Training

ALL council personnel involved in the routine inspections, monitoring and reporting of the condition of the dam should attend an appropriate course on Dam Safety and Inspections (DS&I). Any personnel who have attended a DS&I course but not within the last five years should attend a refresher course.

APPENDIX H

DRAWINGS

N:\04 Water and Waste\05 WATER\11 Dam Wall Upgrade\detail designs

N:\04 Water and Waste\05 WATER\11 Dam Wall Upgrade\FINAL Documents\02 - Buttress Design Information.zip

APPENDIX I

DSC DSEP CHECKLIST

N:\04 Water and Waste\08 Dam Safety Emergency Plan\Dam Safety Management System DSMS 2021\Dam Safety Management System DSMS 2021.docx