NSW GOVERNMENT | Public Works
NSW Water Solutions

MID-WESTERN REGIONAL COUNCIL

Dam Safety Emergency Plan for REDBANK CREEK DAM

Covering:

- Flooding
- Earthquake
- Other Emergency Situations

Dams & Civil

Report No.: DC09096
Date: February 2010

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EXECUTIVE SUMMARY

The NSW Department of Services, Technology and Administration (DSTA), Dams & Civil Unit was commissioned by Mid-Western Regional Council to prepare a Dam Safety Emergency Plan (DSEP) for Redbank Creek Dam.

Redbank Creek Dam is located on Redbank Creek, south of Mudgee, NSW and was constructed in 1898. The dam is a single curvature concrete arch structure with a two stage overflow spillway. The low level sill is 30m in length and is 0.3m lower than the high level sill which is 43m in length. The total length of the dam crest is 152m and is approximately 15m high. The main catchment area for Redbank Creek Dam is 4.6km2. With the addition of Marks Creek, the catchment totals to 6.8km2. However, the supply from Marks Creek is limited by the volume of water supplied through the 420mm VC pipeline, which is approximately 853m long. The dam has a storage capacity of approximately 180ML at FSL.

The responsibilities of persons and organisations involved with this emergency management are detailed in **Section 2**. They are identified as Mid-Western Regional Council as the dam owner, DECCW-OW, NSW SES, NSW Police, DSTA - Dams & Civil Unit and NSW Dam Safety Committee.

The two major possible causes of dam failure are failure due to extreme flood levels and failure due to Sunny Day failure (rapidly deteriorating structural deficiency induced by extreme earthquake).

Emergency situations are identified through the **Red, Amber** and **White Alert** levels for a flooding event and through a **Red** and **White Alert** for an extreme earthquake event or other emergency situations.

The notification procedures for flooding, earthquake and other emergency situations outline the people/authorities to be notified by the dam owner/operator during an emergency situation. In particular, the DECCW-OW, NSW SES and NSW Dam Safety Committee. Refer to Flow charts for notification procedures for the above 3 emergency situations. Refer to **Sheet 3** for Emergency Communications Directory.

A Dambreak Study was carried out for Redbank Creek Dam in 1992 to simulate the failure of the dam and determine the flooding conditions in the area downstream of the dam. BOSS DAMBRK was used to model the study area and complete the simulation. Inundation maps are then prepared and the consequences of dam failure to assess the hazard rating for the dam. Refer to **Appendix C** for flood wave arrival time/warning time available to residences.

This plan also details preventative actions both prior to and following the development of emergency situations. Available surveillance, monitoring and warning systems are identified. This plan determines where appropriate, adverse time response, alternate sources of power and communication, emergency supplies and resources. It also provides coordinating information and actions to lower the reservoir or limit inflows and outflows.

SECTION 1 GENERAL INFORMATION

1.1 INTRODUCTION AND STATEMENT OF PURPOSE

The NSW Dams Safety Committee (DSC) under its statutory obligations of the Dams Safety Act 1978 ensures that all dams in NSW are designed, constructed, maintained and operated to a standard to minimise the risks to the community.

The DSC requires **ALL** prescribed dam(s) to be covered by a Dam Safety Emergency Plan (DSEP). This is endorsed by the Department of Environment Climate Change & Water – Office of Water (DECCW-OW) through its statutory obligations under the Local Government Act 1993 of overseeing the NSW Local Water Utilities (LWU) dam safety program.

This document covers preparedness in relation to the occurrence of an emergency condition at Redbank Creek Dam and provides information necessary for emergency agencies to manage a downstream evacuation in the unlikely event of a potential dam failure.

The document has been prepared in line with the requirements of:

- Australian National Committee on Large Dam's (ANCOLD) Guidelines on Dam Safety Management, 2003;
- Dams Safety Committee's information sheet DSC 12.

This document details:

a) The type, size and location and hazard rating of the dam;

b) The Population at Risk (PAR) and downstream areas under various flood events;

c) 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;

d) The persons and organisations to be notified in the event of an emergency situation;

e) The procedure for identification, evaluation, and classification of potential emergency conditions;

f) Local area communications network and alternative communications procedures to be used if the local area network fails;

g) Local area alarm systems to warn the Population at Risk (PAR)

h) Available access to the dam under normal and varying emergency conditions

i) Other necessary information to protect the Population At Risk (PAR) and mitigate flood damage;

j) Actions, Responsibilities and Communications protocols;

k) Location of materials and plant to be readily available during an emergency;

l) Preventative actions,; and

m) Temporary and permanent remedial measures to be taken to maintain/return the structures to a safe operational condition.

The document identifies emergency conditions that may result in dam failure. It describes procedures to be followed to investigate and provide warning of emergency conditions to appropriate emergency managers, so that they can implement preparedness and response measures for the protection of downstream persons and property.

The document also provides direction for operating staff in the situation 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 is to be used to activate the Mudgee Local Disaster Plan as prepared by the State Emergency Service (SES). It is not intended as a replacement for the Mudgee Local Disaster Plan. Instead it presents a plan of procedures to complement the needs of the Mudgee Local Disaster Plan.

1.2 ENDORSEMENT STATEMENT

REDBANK CREEK DAM - **DAM SAFETY EMERGENCY PLAN**
ENDORSEMENT STATEMENT

This document has been prepared for Mid-Western Regional Council by the NSW Department of Services, Technology and Administration (DSTA), Dams & Civil Unit in consultation with Mid-Western Regional Council operational personnel, the State Emergency Service (SES), NSW Dam Safety Committee (DSC) and Department of Environment Climate Change & Water – Office of Water (DECCW-OW).

The Mid-Western Regional Council, State Emergency Service, NSW Dam Safety Committee and Department of Environment Climate Change & Water hereby endorse that the notification and responsibility details contained within this document are in accordance with the agreed protocols established between the Mid-Western Regional Council, State Emergency Service, NSW Dam Safety Committee and Department of Environment Climate Change & Water.

.....
[redacted]
Water Supply Manager, Mid-Western Regional Council
Dated:

.....
[redacted]
Director, Emergency Risk Management
NSW State Emergency Service
Dated:

.....
[redacted]
Director for Water Utilities Branch, DECCW-OW
Dated:

.....
[redacted] Executive Engineer for NSW DSC
Dated:

1.3 CONTROL DOCUMENT – DISTRIBUTION LIST

DSEP FOR REDBANK CREEK DAM
CONTROL DOCUMENT DISTRIBUTION LIST

Designation/Organisation	Control Copy Number
Master Manual, Mid-Western Regional Council, Mudgee	001
Mid-Western Regional Council, Mudgee (for internal distribution)	002 - 004
Department of Environment Climate Change & Water (DECCW) – Office of Water (OW), Sydney	005
New South Wales Dam Safety Committee (DSC), Parramatta	006
NSW Department of Services, Technology and Administration Dams and Civil Unit, Sydney	007 - 008
NSW State Emergency Service (SES) State Headquarters, Wollongong (For internal distribution to appropriate SES Regions and Units)	009 - 011
State Emergency Operations Centre (SEOC) (For internal distribution in accordance with the number of SEOC District Emergency Management Officers (DEMO) involved)	012

NOTES:-

1. Mid-Western Regional Council is responsible for circulating any amendments to the DSEP internally and to the DECCW-OW, DSC, SES and SEOC.
2. The NSW SES State Operations Communication Centre (SOCC) and Police Duty Officer, State Emergency Operations Centre (SEOC) are then responsible for circulating any amendments internally to any holders of the DSEP nominated by the SES and SEOC.
3. It is the **responsibility of each Organisation to acknowledge receipt of the amendments** and advise Mid-Western Regional Council that the relevant pages have been replaced and the DSEP document has been updated accordingly.

1.4 AMENDMENTS TO CONTACT DETAILS

DSEP FOR REDBANK CREEK DAM
AMENDMENTS TO CONTACT DETAILS

All amendments to the DSEP contact details are to be entered and certified on the table below by Mid-Western Regional Council then all the relevant pages together with the amended table forwarded to **ALL** the Organisations on the Document Distribution List.

CONTACT DETAILS						ENTERED BY
Date	**Organisation**	**Title**	**Name**	**Phone/E-mail**	**Page Nos**	**Name (Print Name)**

NOTES:-

1. It is the **responsibility of Mid-Western Regional Council to advise each Organisation immediately of any changes** to his organisational structure, his personnel and relevant contact numbers.
2. It is the **responsibility of each Organisation to advise Mid-Western Regional Council immediately of any changes** to their organisational structure, their personnel and relevant contact numbers.
3. It is the **responsibility of Mid-Western Regional Council to contact each Organisation annually to check that there have been no changes** to their organisational structure their personnel or relevant contact numbers.
4. It is the **responsibility of each Organisation to acknowledge receipt of the amendments to the contact details** and advise Mid-Western Regional Council that the relevant pages have been replaced and the DSEP document has been updated accordingly.

1.5 AMENDMENTS TO TEXT ITEMS

DSEP FOR REDBANK CREEK DAM
AMENDMENTS TO FLOW CHARTS, TEXT ITEMS & DRAWINGS

Approved amendments or additions to the text of the DSEP are to entered and certified in the table below by Mid-Western Regional Council then all the relevant pages together with the amended table forwarded to **ALL** the Organisations on the Document Distribution List.

AMENDMENT		SECTION		ENTERED BY	
Date	**Number**	**Item Description**	**Page No**	**Name (Print Name)**	**Date**

NOTES:-

1. It is the **responsibility of the Dam Owner to circulate all proposed amendments** to the flow charts, text pages and drawings of the DSEP to all affected organisations for approval prior to forwarding the approved amendment(s) to all the organisations on the document distribution list.
2. It is the **responsibility of each Organisation to acknowledge receipt of the amendments,** and advise Mid-Western Regional Council that the relevant pages have been replaced and the DSEP document has been updated accordingly.
3. The flow charts text pages and drawings of the original document should show the date the document was issued in the footer.
4. Any subsequent amendments to flow charts text pages and drawings should show the date of the amendment in the footer of the affected page.

SECTION 2 NOTIFICATION FLOW CHARTS

2.1 GENERAL

The main purpose of the following notification procedures is to ensure that timely warning is provided to the responsible persons in the event of a potential dam failure or incident, and to provide information that is relevant to the emergency response. A secondary purpose is to provide communication pathways for emergencies generally and to ensure proper reporting of all emergencies.

Emergency situations are categorised on the basis of severity, with each category having corresponding responses/alerts for the particular emergency condition (i.e. flooding, earthquake or other emergency).

The prime means of detecting the development of a potential emergency condition is through regular inspection of the dam by the Water Supply Manager or relevant Mid-Western Regional Council Staff, and inspection and monitoring activities of the DECCW-OW.

The two major possible causes of dam failure are:

- Failure due to extreme flood levels overtopping the concrete arch dam;
- Failure due to a rapidly deteriorating structural deficiency such as may be induced by an extreme earthquake. (This is the so-called “Sunny Day” failure, i.e. not induced by an inflow flood).

Although Redbank Creek Dam is currently in good condition, an unsafe or emergency condition could occur at any time due to extreme natural events. Failure from a cause not related to extreme natural events is always a possibility although the probability of occurrence is extremely low.

Careful judgement is needed in reacting to emergencies. Whenever time permits, the communication pathways given in these procedures are to be followed. These ensure that decisions will be made by senior, responsible persons and will be based on the best available specialist advice. The procedures are designed to avoid unnecessary warnings to the public.

Notification of a dam safety emergency to the public will cause alarm, anxiety, resentment, and disruption to normal activities and expense. Evacuation greatly heightens these effects.

In cases where an emergency situation is developing so rapidly that to follow the alert protocols would endanger the public, operational personnel must take any action they consider appropriate, such as alerting the Population at Risk (PAR) directly. **The Owners and Operational Personnel must at all times consider public safety as paramount.**

2.2 NOTIFICATION FLOW CHARTS

The procedures to be followed for each alert are summarised in the notification flow charts for flooding, earthquake and other emergency conditions (i.e. Sunny Day Failure or bomb threat). Refer to **Charts 1**, **2**, **3**, **Tables I**, **II**, **III** and **SES Flow Chart No.1** (Ref. **Figure 2-1**). These flow charts which provide a quick reference are found at the end of **Section 2** of this document. For a descriptive outline of the notification procedures for the three emergency conditions, refer to **Appendix K**.

The flow charts summarise the persons/organisations to be notified and the prioritised order of notification in the event of an emergency situation. Although each emergency condition will be evaluated and responded to individually, the action for most emergencies will be similar. The notification flow charts set out the mandatory reporting that is required. Beyond these mandatory reportings, those involved may make any contacts they judge to be appropriate within their normal authority.

2.3 SES NOTIFICATION FLOW CHART

The **SES Flow Chart No.1** (Refer to **Figure 2-1**) has been adopted from the NSW Dams Safety Committee (DSC) Information Sheet DSC12-1. This flow chart provides details/protocols on notifying SES State Headquarters, SES Region(s), NSW Police and the NSW State Emergency Operations Centre (SEOC). Note however that the primary contact nominated for this DSEP, during an emergency (Refer to **Notification Flow Charts 1-3**):

- SES State Operations communication Centre (SOCC) or;
- Police Duty Officer, SECO on the 24 hour phone number;

Dam owners should make every attempt to call the SES SOCC in the first instance. Use of the protocols in the **SES Flow Chart No.1** must be followed if the SES SOCC cannot be contacted. The SES/Police are responsible for notifying the other emergency response agencies as per the **SES Flow Chart No.1**.

The State Emergency Service (SES) is the designated Combat Agency for floods in NSW and in all local government areas where a significant riverine or flash flood threat exists; the Service has produced flood plans which are sub-plans of their respective local disaster plans (DISPLAN). Potential dam failure can best be managed through the activation of the local flood plan(s). In some cases, where dams are particularly at risk of failure (i.e. deficient flood capacity or known structural problem), special additional planning may be incorporated into the local flood plan to account for potential dam failure.

2.4 SUPPLEMENTARY TABLES & NOTES

****It is recommended that laminated copies of DSEP Flow Charts, Table 2-2 - Water Levels and Corresponding Alerts and Supplementary Notes (Section 2.4.2) are to be carried in the vehicles of ALL Mid-Western Regional Council Operational Personnel.**

2.4.1 Supplementary Tables

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. Refer to **Appendix C** for how PMP are determined.

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. The outflow hydrograph is derived from the reservoir routing of the estimated PMF inflow hydrograph. 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 in **Table 2-1**:

Table 2-1 Flood Routing Results

Critical PMP		PMF			
Total Rainfall (mm)	Storm Duration (Hrs)	Inflow (m^3/sec)	Outflow (m^3/sec)	Storage Level @ Max RL (m AHD)	Time to Peak (Hrs:mins)
439	1.5	323	326	539.5	1:18

2.4.2 Alert Levels

These alerts (Refer to **Table 2-2**) should be activated in sequence as the storage level rises during the course of a major flood event and sent to the SES as they occur.

Table 2-2 Water Levels and Corresponding Alerts & Time Intervals

Alert	Height above Spillway (m)	Storage level (m AHD)	Interval (mins)
WHITE (FSL)	0	538.16	0
AMBER	0.5	538.66	20
RED	0.94	539.1	30

NOTE: *Where a situation develops too rapidly to follow the procedures, operating staff must take whatever action they consider appropriate such as alerting the* ***Population at Risk (PAR) directly****. Any doubts should be resolved in favour of protecting public safety.* ***The Owners and Operational Personnel must at all times consider public safety as paramount.***

The alert levels were derived from reservoir routing of the critical PMF inflow hydrograph through the spillway arrangement at Redbank Creek Dam, using the dam storage and spillway rating curves with the initial water level set at the spillway level. **Table 2-2** indicates the storage level and discharge level over the spillway for each Alert.

Flood routings indicate that the warning times between alert levels being triggered may be very short (less than 10 minutes). Therefore, the alert levels provided in **Table 2-2** are not based on warning times. The **Red** and **Amber Alert**s set at RL 539.1m and RL 538.66m respectively to provide a minimum of 0.5m between Alerts. The **White Alert** was set at FSL of RL 538.16m.

Timely implementation of the **Alert Levels** is a crucial for the effectiveness of the DSEP and the effectiveness of warning systems which are imperative for minimising loss of life and property damage.

Note: The hydrograph data was obtained from Redbank Creek Dam Flood Study, September 2006. Storage and spillway data was obtained from Redbank Creek Dam Augmentation, Downstream Flood Behaviour, October 2005.

2.4.3 Supplementary Notes

General

During an emergency, Mid-Western Regional Council must consult with DECCW-OW MDS regarding any temporary repairs to the dam and appurtenant works or the requirements for additional inspections and/or monitoring.

Flood Emergency

The flood emergency 'over notification' to the SES & DSC should not be issued until the rain has stopped, the flood is receding and the storage level has fallen below the **White Alert** level.

DECCW should be advised when the spillway ceases to operate and routine inspections have resumed.

Earthquake & Other than Flood or Earthquake Emergency

Earthquakes are to be assessed in accordance with the Modified Mercalli Intensity Scale (Refer to **Table 3-1**) or advice/data of recent earthquakes from Geoscience Australia web site www.ga.gov.au

The SES, DECCW-OW & DSC are to be notified by Mid-Western Regional Council that the **Red Alert** emergency is over when all the recommended remedial measures have been carried out and the danger of imminent/probable/possible failure of the structure have passed.

The DECCW-OC are to be advised by Mid-Western Regional Council that the **White Alert** emergency is over when all the necessary minor repairs have been carried out and routine inspections have resumed.

SES Responsibility

The SES is responsible for the warning and evacuation of the downstream population at risk and notifying the other emergency response agencies as per the **SES Flow Chart No.1** (Refer to **Figure 2-1**).

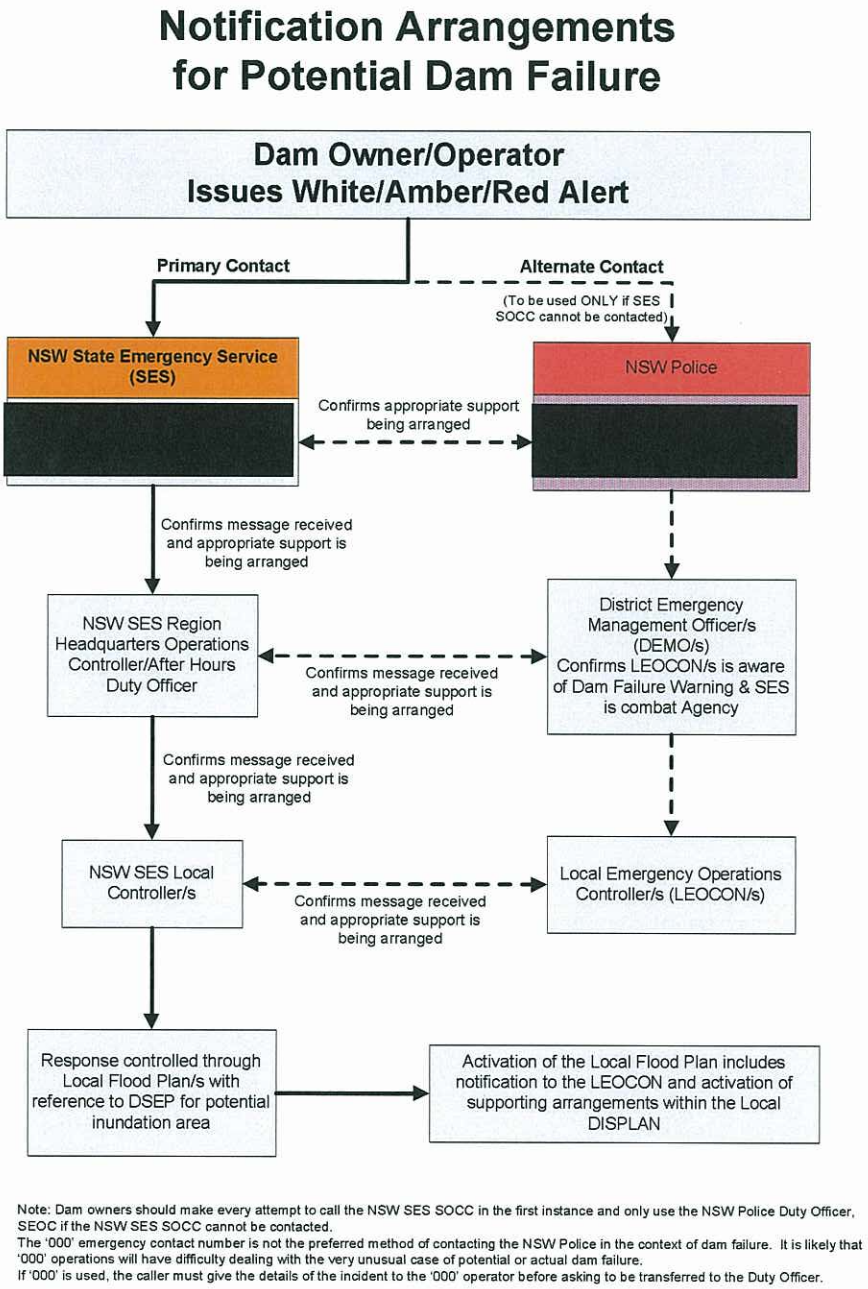


Figure 2-1 Redbank Creek Dam, SES Flow Chart No.1

It is recommended that laminated copies of the DSEP Flow Charts and Supplementary Notes are carried in the vehicles of ALL Operational personnel.

EMERGENCY NOTIFICATION FLOW CHARTS

CHART 1 - DSEP COMMUNICATIONS FLOOD EMERGENCY FLOWCHART

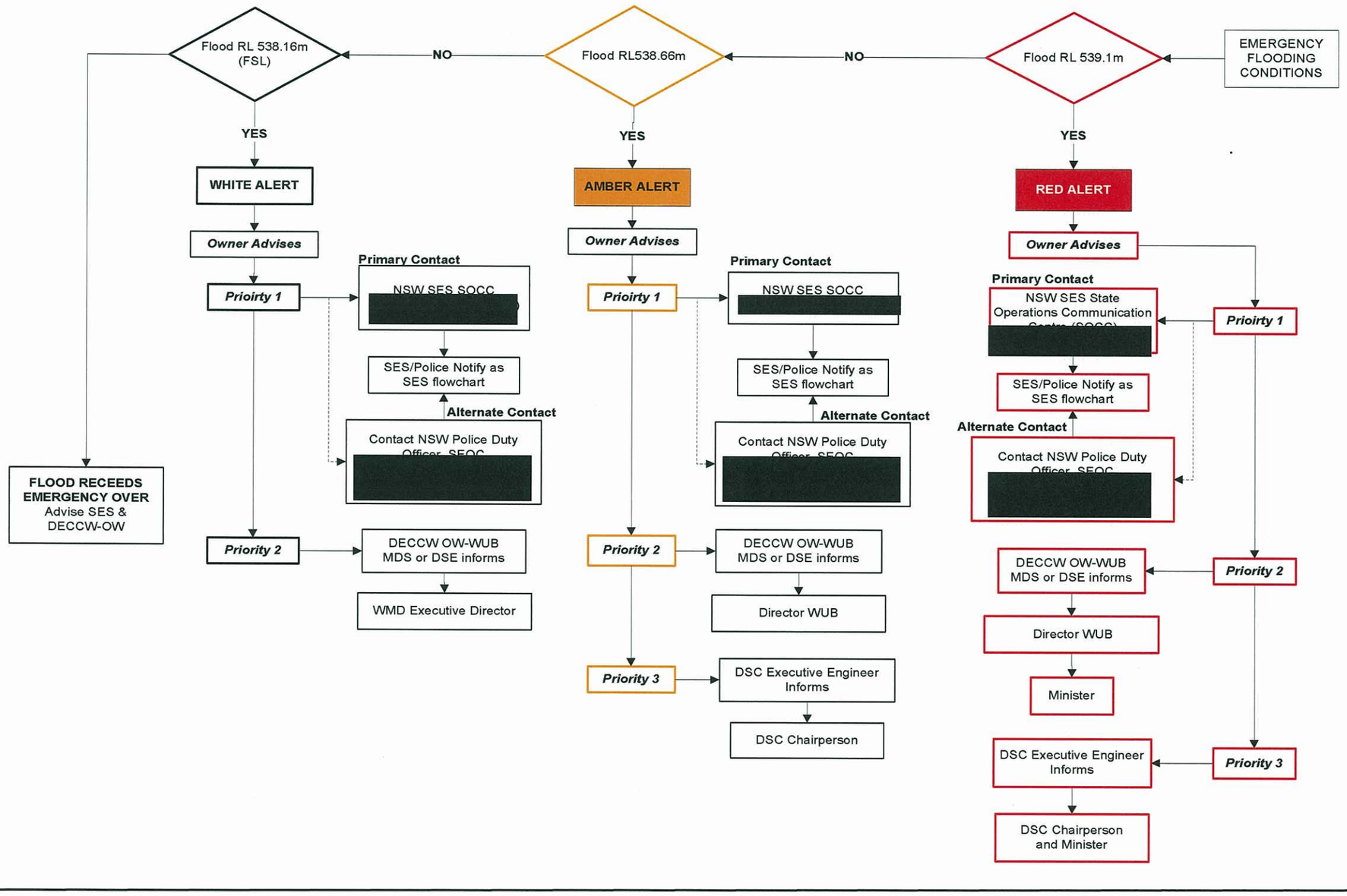


CHART 2 - DSEP COMMUNICATIONS FLOWCHART FOR EARTHQUAKE

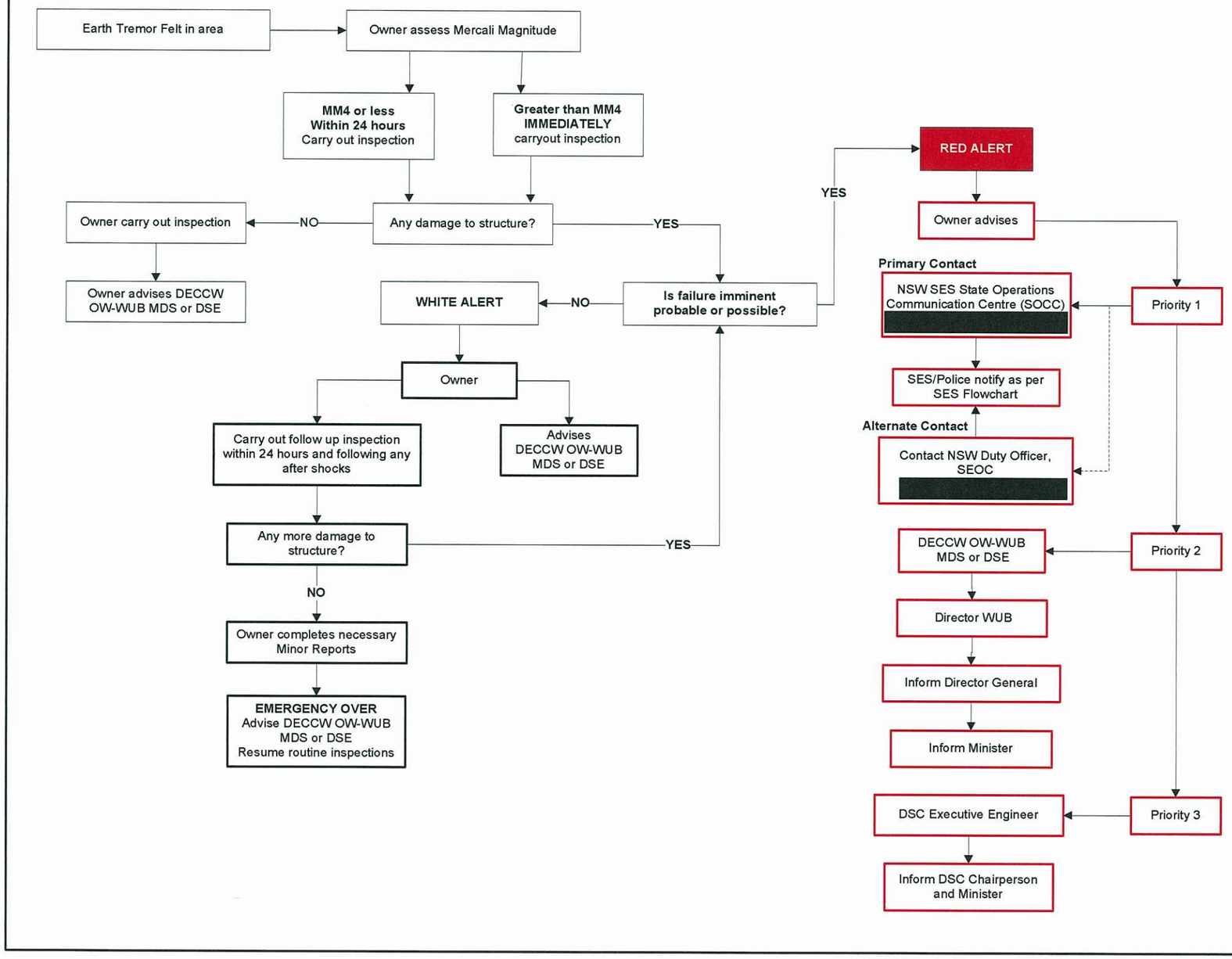
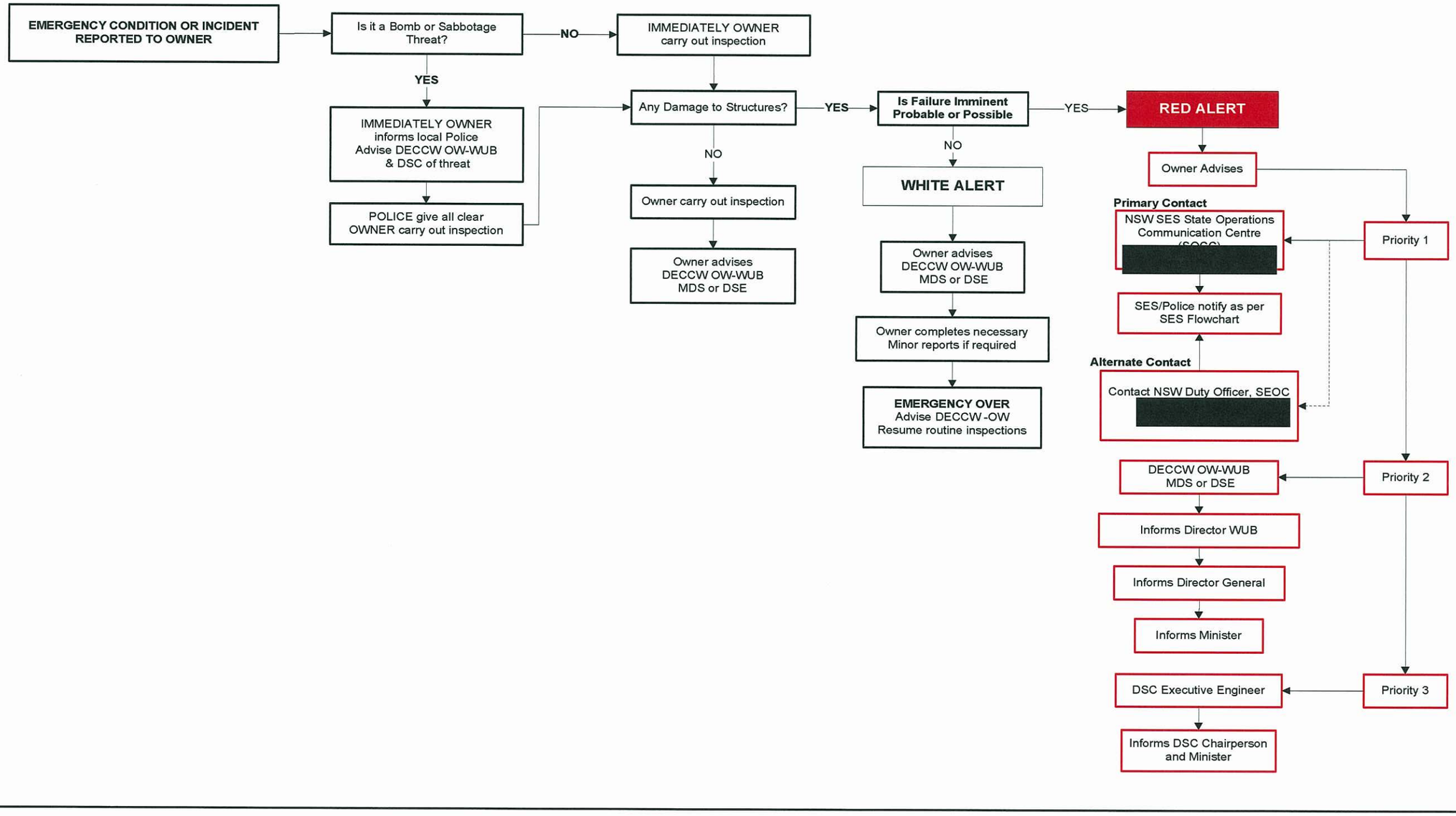


CHART 3 - DSEP COMMUNICATIONS
FLOWCHART for OTHER THAN FLOOD or EARTHQUAKE



SECTION 3 ACTIONS, RESPONSIBILITIES & COMMUNICATIONS DIRECTORIES

3.1 GENERAL

3.1.1 Notification Tables

The actions and responsibilities of emergency authorities for each flooding, earthquake and other emergency conditions (i.e. sunny day or bomb threat) are summarised in the Notification Tables (Refer to **Tables I**, **II** and **III**). These tables provide communication pathways for emergencies and to ensure proper reporting of all emergencies to authorities. They also provide a quick reference and are found at the end of **Section 3** of this document. For a descriptive outline of the notification procedures for the three emergency conditions, refer to **Appendix K**.

3.1.2 Emergency Communications Directory

The Communication Directory lists names and contact details of the responsible personnel required to be contact during a dam failure emergency. It is important that the Directory provided is maintained in a current accurate condition. As new persons take office or phone numbers or addresses change, the Directory is to be immediately updated and circulated to all manual holders, for insertion in their copy of the manual. Refer to **Sheet 3** at the end of this section for the Communications Directory.

3.2 ALERT STATUS – ADVICE PROTOCOLS

When a member of Mid-Western Regional Council Staff is advising the emergency agencies by phone/radio/email in relation to the Alert status, the following communication protocol MUST be followed in the order listed:

1. "This is **Name** & **Title of Caller** from **Mid-Western Regional Council**".

2. "This is to advise that there is a flood/earthquake/other emergency at **Redbank Creek Dam**"

3. "This is to inform you that the current ALERT status at **Redbank Creek Dam** is Code"

"**White/Amber/Red**"

A "Communications Log" is included in **Appendix G**. The **caller** should log in the Communications Log the following:

- the name of the agency;
- the message recipient; and

- the date and time of the message.

Note also that after the emergency situation has passed, it should be recorded in the "Operations Log" for the Dam (Refer to Redbank Creek Dam O&M Manual).

3.3 REVIEW OF COMMUNICATION DIRECTORIES

Mid-Western Regional Council **must** carry out an Annual Review of the Communication Directories (i.e. **Table I**, **II** and **III** and **Sheet 3** Emergency Communications Directory) and advise ALL Organisations on the documentation distribution list of any changes.

All Organisations must advise Mid-Western Regional Council immediately of any changes to their structure, the names of their personnel and contact details. It is the responsibility of Mid-Western Regional Council to circulate these changes immediately to ALL Organisations on the document distribution list.

EMERGENCY NOTIFICATION TABLES

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

TABLE I-1 ACTION & COMMUNICATION DIRECTORY – FLOOD EVALUATION - WHITE ALERT

Storage RL m	Alert	Organisation	Actions	Responsible Position	Name	Phone/E-mail*
538.16	**WHITE**	Mid-Western Regional Council	Activate alert and advise as follows: **1** NSW SES State HQ or Duty Officer if SES unavailable **2** WUB- MDS or DSE if MDS unavailable. Interrogate the BoM web site for all weather forecasts relevant to the catchment. Monitor the storage continuously 24 hrs/day. Provide the MDS with regular updates of inspection surveillance & monitoring data. E-mail photos of flood emergency. React to all advice provided by MDS (**Note iii**). Provide assistance to SES if requested (**Note iv**). Maintain contact with SES, MDS. Inform the DSC if the weather data indicates there is a possibility that the flood alert could escalate to **AMBER**. Advise any change in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
		NSW SES HQ	Activate procedures for flood warnings evacuation etc. as per **SES Flow Charts No. 1**	SOCC	[redacted]	[redacted]
		NSW Police If SES unavailable		Duty Officer, SEOC	[redacted]	[redacted]
		DECCW OW-WUB	Review monitoring & surveillance data. Monitor & assess situation and carry out inspection if considered necessary. Provide technical advice on remedial measures and additional monitoring requirements to Mid-Western Regional Council if required. Maintain contact with Mid-Western Regional Council	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
		NSW DSTA (**Note** v)	Provide technical support if requested by WUB-MDS.	Principal Engineer Dams	[redacted]	[redacted]

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

TABLE I-2 ACTION & COMMUNICATION DIRECTORY – FLOOD EVALUATION - AMBER ALERT

Storage RL m	Alert	Organisation	Actions	Responsible Position	Name	Phone/E-mail*
538.66	**AMBER**	Mid-Western Regional Council	Activate alert and advise as follows: **1** NSW SES State HQ or Duty Officer if SES unavailable. **2** WUB- MDS or DSE if MDS unavailable. **3** DSC- Executive Engineer. Interrogate the BoM web site for all weather forecasts relevant to the catchment. Monitor the storage continuously 24 hrs/day. Provide the MDS with regular updates of inspection surveillance & monitoring data. E-mail photos of flood emergency. React to all advice provided by MDS (**Note iii**) Provide assistance to SES if requested (**Note iv**) Maintain contact with SES, MDS & DSC. Advise any change in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		NSW SES HQ	Activate procedures for flood warnings, evacuation etc. as per **SES Flow Charts No. 1**	SOCC	[redacted]	[redacted]
		NSW Police If SES unavailable		Duty Officer, SEOC	[redacted]	[redacted]
		DECCW OW-WUB	Inform WUD Director. Review inspection, surveillance & monitoring data. Monitor & assess situation. Carry out inspection and arrange additional technical advice if required. Provide technical advice on remedial measures and additional monitoring requirements to Mid-Western Regional Council. Maintain contact with Mid-Western Regional Council and liaise with DSC.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
		DSC	Informs DSC Chairperson. Liaise with WUB-MDS.	Executive Engineer	[redacted]	[redacted]
		NSW DSTA (**Note v**)	Provide technical support if requested by WUB-MDS.	Principal Engineer Dams	[redacted]	[redacted]

WATER SUPPLY SCHEME - DAM SAFETY EMERGENCY PLAN for REDBANK CREEK DAM

TABLE I-2 ACTION & COMMUNICATION DIRECTORY – FLOOD EVALUATION - RED ALERT

Storage RL m	Alert	Organisation	Actions	Responsible Position	Name	Phone/E-mail*
539.1	**RED**	Mid-Western Regional Council	Activate alert and advise as follows: **1** NSW SES State HQ or Police Duty Officer if SES unavailable. **2** WUB- MDS or DSE (if MDS not available). **3** DSC- Executive Engineer. Interrogate the BoM web site for all weather forecasts relevant to the catchment. Monitor the storage continuously 24 hrs/day. Provide the MDS with regular updates of inspection surveillance & monitoring data. E-mail photos of flood emergency. React to all advice provided by MDS (**Note iii**). Provide assistance to SES if requested (**Note iv**). Maintain contact with SES MDS & DSC. Advise any change in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		NSW SES HQ	Activate procedures for flood warnings, evacuation etc. as per **SES Flow Charts No. 1**	SOCC	[redacted]	[redacted]
		NSW Police If SES unavailable		Duty Officer, SEOC	[redacted]	[redacted]
		DECCW OW-WUB	Inform WUB Director Review inspection, surveillance & monitoring data. Monitor & assess situation and carry out inspection. Arrange additional technical advice if required. Provide technical advice on remedial measures and additional monitoring requirements to Mid-Western Regional Council. Maintain contact with Mid-Western Regional Council and liaise with DSC.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
			Advise DECCW Minister.	Exec Director		
		DSC	Advise DSC Chairperson. Liaise with WUB-MDS.	Executive Engineer	[redacted]	[redacted]
			Advise DSC Minister.	Chairperson	[redacted]	
		NSW DSTA (**Note v**)	Provide technical support if requested by WUB-MDS.	Principal Engineer Dams	[redacted]	[redacted]

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

Table II-1 ACTION & COMMUNICATION DIRECTORY –EARTHQUAKE EMERGENCY

Magnitude Damage	Alert	Organisation	Action	Responsible Position	Name	Phone/E-mail
Owner assesses Earth tremor as MM IV or less (**Refer Mercalli Intensity Scale**) ******No visible damage to structur**e		Mid-Western Regional Council	Carry out inspection within 24 hrs. **Damage assessed as (refer to ****).** Advise WUB Manager Dam Safety or Dam Safety Engineer (if MDS not available) of results of inspection. Carry out follow up inspection after 24 hrs. Inform MDS of any change in condition of structure.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		DECCW OW-WUB	Review details of inspections and any surveillance data. Assess situation if there is a change in the condition of the structure. Discuss escalation to Protection alert status carry out inspection if required.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	

NOTES:
i) Earthquakes to be assessed in accordance with the attached Modified Mercalli Intensity Scale or advice by the AGSO.
ii) The Owner must carry out an Annual Review of the Directory and advises All Organisations on the Document distribution list of any changes.
iii) All Organisations must advise the Owner immediately of any changes to their structure, the names of their personnel and contact details. The Owner must circulate these changes immediately to All Organisations on the Document distribution list.
iv) The Owner should consult with WUB-MDS only regarding remedial measures and additional monitoring requirements.
v) The Owner to provide assistance to the SES if requested by the SES.
vi) Owner to nominate the Consultant.
vii) The inspection details and the collection of the surveillance and monitoring data to be in accordance with the requirements of the O & M Manual or as requested by the WUB Dam Safety Manager.

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

Table II-2 ACTION & COMMUNICATION DIRECTORY –EARTHQUAKE EMERGENCY – WHITE ALERT

Magnitude Damage	Alert	Organisation	Action	Responsible Position	Name	Phone/E-mail*
Owner assesses Earth tremor as greater then MM IV (**Refer Mercalli Intensity Scale**) ******Some damage may be visible but not enough to cause immediate failure of the structure**	**WHITE**	Mid-Western Regional Council	**IMMEDIATELY** carry out inspection. **Damage assessed as (refer to ****).** Activate alert and advise. WUB MDS or DSE (if MDS not available). Mark up visible damage to structure. Provide MDS with inspection, surveillance & monitoring data. E-mail photos of any structural damage. Monitor condition of structure for 24 hrs after the last 'after shock'. Take remedial action if required. React to all advice provided by MDS (**Note iv**). Inform SES & DSC of assessment and advise any possible escalation in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		DECCW OW-WUB	Review surveillance & monitoring data. Assess situation and carry out inspection if required. Provide technical advice on remedial measures and additional monitoring requirements. Request additional technical advice if required.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
		NSW DSTA (**Note vi**)	Provide technical support if requested by DECCW	Principal Engineer Dams	[redacted]	[redacted]

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

Table II-3 ACTION & COMMUNICATION DIRECTORY –EARTHQUAKE EMERGENCY – RED ALERT

Magnitude Damage	Alert	Organisation	Action	Responsible Position	Name	Phone/E-mail*
Earth tremor assessed as greater than MM IV (**Refer Mercalli Intensity Scale**) ******Major visible damage to structur**e. Failure probable, imminent or in progress	**RED**	Mid-Western Regional Council	**IMMEDIATELY** carry out inspection. **Damage assessed as (refer to ****).** Activate alert and advise as follows: **1** NSW SES State HQ or Duty Officer is SES unavailable **2** WUB-MDS or DSE if MDS unavailable. **3** DSC Executive Engineer Inform SES WUB & DSC of damage assessment. Monitor structure 24 hrs/day. Provide the MDS with regular updates of inspection, surveillance & monitoring data. E-mail photos of structural damage. React to all advice provided by MDS (**Note iv**). Provide assistance to SES if requested (**Note v**). Advise SES MDS DSC of any change in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		NSW SES HQ	Activate procedures for flood warnings, evacuation etc. as per **SES Flow Charts No. 1**.	SOCC	[redacted]	[redacted]
		NSW Police If SES unavailable		Duty Officer, SEOC	[redacted]	[redacted]
		DECCW OW-WUB	Inform WUB Director Review inspection surveillance & monitoring data. Monitor & assess situation and carry out inspection. Arrange additional technical advice if required. Provide technical advice on remedial measures and additional monitoring requirements. Maintain contact with Mid-Western Regional Council and liaise with DSC.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
			Advise DECCW Minister.	Exec Director		
		DSC	Inform Chairperson. Liaise with WUB-MDS.	Executive Engineer	[redacted]	[redacted]
			Advise DSC Minister.	Chairperson		
		NSW DSTA (**Note vi**)	Provide technical support if requested by WUB-MDS.	Principal Engineer Dams	[redacted]	[redacted]

Table 3-1 Modified Mercalli Intensity Scale (FEMA)

Earthquake Intensity (MM)	Description of Earthquake	Richter Equivalent
I.	People do not feel any earth movement	**0-4.3**
II.	A few people might notice movement if they are at rest and/or on the upper floors of tall buildings	
III.	Many people indoors feel movement. Hanging objects swing back and forth. People outdoors might not realise that and earthquake is occurring.	
IV.	Most people indoors feel movement. Hanging objects swing. Dishes, windows and doors rattle. The earthquake feels like a heavy truck hitting the walls. A few people outdoors may feel movement. Parked cars rock.	**4.3- 4.8**
V.	Almost everyone feels movement. Sleeping people are wakened. Doors swing open or close. Dishes are broken. Pictures on the wall move. Small objects move or are turned over. Trees might shake. Liquids might spill out of open containers.	
VI.	Everyone feels movement. People have trouble walking. Objects fall from shelves, pictures fall off walls furniture moves. Plaster in walls might crack. Trees and bushes shake. Some slight damage in poorly built buildings however there is no structural damage.	**4.8- 6.2**
VII.	People have difficulty standing. Drivers feel their cars shaking. Some furniture breaks loose. Loose bricks fall off buildings. Damage is slight to moderate in well built buildings and considerable in poorly built buildings.	
VIII.	Drivers have trouble steering. Houses that are not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Well built structures suffer slight damage. Poorly built structures suffer severe damage. Tree branches break. Hillsides might crack if the ground is wet. Water levels in wells might change.	**6.2-7.3**
IX.	Well built buildings suffer considerable damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks and reservoirs suffer serious damage.	
X.	Most buildings and their foundations are destroyed. Some bigger bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers and lakes. The ground cracks in large areas and rail lines are bent slightly.	
XI.	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipe lines are destroyed and rail lines are badly bent.	**> 7.3**
XII.	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.	

WATER SUPPLY SCHEME **- DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

Table III-1 ACTION & COMMUNICATION DIRECTORY - OTHER THAN FLOODING/EARTHQUAKE EMERGENCY

Emergency Condition	Alert	Organisation	Action	Responsible Position	Name	Phone/E-mail
Owner advised of Bomb threat or other incident at dam ******No visible damage to structures**		Mid-Western Regional Council	**1 IMMEDIATELY** inform Police of Threat. **2** Advises WUB Manager Dam Safety or Dam Safety Engineer (if MDS not available) of threat.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		NSW Police	Advise Owner dam site all clear to carry out inspection.	Duty Officer, SEOC	[redacted]	[redacted]
		Mid-Western Regional Council	**IMMEDIATELY** carry out inspection. **Damage assessed as (refer to ****).** Advise WUB MDS or DSE (if MDS not available) of results of inspection. Carry out follow up inspection after 24 hrs. Inform MDS of any change in condition of structure.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
		DECCW OW-WUB	Review details of inspections and any surveillance data. Assess situation if there is a change in the condition of the structure. Discuss escalation to Protection alert status carry out inspection if required.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	

NOTES:

i) The Owner must carry out an Annual Review of the DSEP and advise All Organisations on the Document distribution list of any changes.

ii) All Organisations must advise the Owner immediately of any changes to their structure, the names of their personnel and contact details. The Owner must circulate these changes immediately to All Organisations on the Document distribution list.

iii) The Owner should consult with WUB-MDS only regarding remedial measures and additional monitoring requirements

iv) The Owner to provide assistance to the SES only if requested by the SES.

v) The Owner to nominate the Consultant.

vii) The inspection details and the collection of the surveillance and monitoring data to be in accordance with the requirements of the O & M Manual or as requested by the WUB Dam Safety Manager.

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

TABLE III-2 ACTION & COMMUNICATION DIRECTORY - OTHER THAN FLOODING/EARTHQUAKE EMERGENCY – WHITE ALERT

Emergency Condition	Alert	Organisation	Actions	Responsible Position	Name	Phone/E-mail*
Owner advised of Minor explosion or other incident at dam ******Visible damage but not enough to cause immediate failure of the structur**e	**WHITE**	Mid-Western Regional Council	**1 IMMEDIATELY** inform Police of Threat. **2** Advises WUB Manager Dam Safety or Dam Safety Engineer (if MDS not available) of threat.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		NSW Police	Advise Owner no further risk of more explosions at dam. All clear to carry out inspection.	Duty Officer, SEOC	[redacted]	[redacted]
		Mid-Western Regional Council	**IMMEDIATELY** carry out inspection. **Damage assessed as (refer to ****).** Activate alert and advise. WUB MDS or DSE if MDS not available. Monitor condition of structure. Provide MDS with inspection, surveillance & monitoring data and E-mail photos of any structural damage. Take remedial action if required. React to all advice provided by MDS (**Note iii**). Inform SES & DSC of assessment and advise any possible escalation in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
		DECCW OW-WUB	Review inspection, surveillance & monitoring data. Assess situation and carry out inspection if required. Provide technical advice on remedial measures and additional monitoring requirements. Arrange additional technical advice if required.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
		NSW DSTA (**Note v**)	Provide technical support if requested by WUB-MDS.	Principal Engineer Dams	[redacted]	[redacted]

WATER SUPPLY SCHEME - **DAM SAFETY EMERGENCY PLAN FOR** REDBANK CREEK DAM

Table III-3 ACTION & COMMUNICATION DIRECTORY - OTHER THAN FLOODING/EARTHQUAKE EMERGENCY – RED ALERT

Emergency Condition	Alert	Organisation	Action	Responsible Position	Name	Phone/E-mail*
Owner advised of Major explosion or other incident at dam ******Major visible damage to structure**. Failure probable, imminent or in progress	RED	Mid-Western Regional Council	**1 IMMEDIATELY** inform Police of Threat. **2** Advises WUB MDS or DSE (if MDS not available) of threat.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
				Mechanical Supervisor	[redacted]	[redacted]
				On Call Sewer Treatment Plant Operator No. 2		[redacted]
		NSW Police	Advise Mid-Western Regional Council no further risk of more explosions at dam. All clear to carry out inspection.	Duty Officer, SEOC	[redacted]	[redacted]
		Mid-Western Regional Council	**IMMEDIATELY** carry out inspection. **Damage assessed as (refer to ****).** Activate alert and advise as follows: **1** NSW SES State HQ or Duty Officer is SES unavailable. **2** WUB MDS or DSE if MDS unavailable. **3** DSC Executive Engineer Inform SES MDS & DSC of damage. Provide the MDS with regular updates of inspection, surveillance & monitoring data and E-mail photos of structural damage. Monitor structure 24 hrs/day. React to all advice provided by MDS (**Note iii**). Provide assistance to SES if requested (**Note iv**). Advise SES MDS DSC any change in alert status.	Water Supply Manager	[redacted]	[redacted]
				Operations Engineer	[redacted]	[redacted]
		NSW SES HQ	Activate procedures for flood warnings, evacuation etc. as per **SES Flow Charts No. 1**.	SOCC	[redacted]	[redacted]
		NSW Police If SES unavailable		Duty Officer, SEOC	[redacted]	[redacted]

		DECCW OW-WUB	Inform WUB Director. Review monitoring & surveillance data. Assess situation and carry out inspection. Arrange additional technical advice. Provide technical advice on remedial measures and additional monitoring requirements. Maintain contact with Mid-Western Regional Council and liaise with DSC.	Manager Dam Safety	[redacted]	
				Dam Safety Engineer	[redacted]	
			Advise DECCW Minister	Exec Director		
		DSC	Inform Chairperson. Liaise with WUB-MDS.	Executive Engineer	[redacted]	[redacted]
			Advise DSC Minister.	Chairperson		
		NSW DSTA (**Note v**)	Provide technical support if requested by WUB-MDS.	Principal Engineer Dams	[redacted]	[redacted]

SHEET 3 - EMERGENCY COMMUNICATIONS DIRECTORY

Organisation	Person Title	Business Address	Communication Links	After Hours
COUNCIL				
Mid-Western Regional Council	[redacted] Water Supply Manager	Administration Building 89 Market Street Mudgee NSW 2850	[redacted]	[redacted]
	[redacted] Operations Engineer		[redacted]	[redacted]
	[redacted] Mechanical Supervisor		[redacted]	[redacted]
	On Call Sewer Treatment Plant Operator No. 2		[redacted]	[redacted]
EMERGENCY SERVICES				
NSW SES State Headquarters	State Operations Communications Centre (SOCC)	6-8 Regent Street Wollongong NSW 2500		[redacted]
SES Mudgee SES Headquarters	[redacted] Acting Local Controller		[redacted]	[redacted]
	[redacted] Deputy Local Controller		[redacted]	[redacted]
Mid-Western Regional Council	[redacted] Local Emergency Management Officer (LEMO)	Administration Building 89 Market Street Mudgee NSW 2850	[redacted]	[redacted]
NSW Police	Duty Officer, SEOC		[redacted]	

Organisation	Person Title	Business Address	Communication Links	After Hours
NSW Police Force Mudgee	[redacted] LEOCON	Mudgee 2850	[redacted]	[redacted]
	Inspector Greg Spinks		[redacted]	[redacted]
Department of Environment Climate Change & Water - Water Utility Branch	[redacted] Manager Dam Safety (MDS)	Level 17 227 Elisabeth Street Sydney NSW 2000 GPO Box 3889 Sydney NSW 2001		
Department of Environment Climate Change & Water - Water Utility Division	[redacted] Dam Safety Engineer (DSE)	Level 17 227 Elisabeth Street Sydney NSW 2000 GPO Box 3889 Sydney NSW 2001		
NSW Dams Safety Committee	[redacted] Executive Engineer	Level 3, Macquarie Tower 10 Valentine Avenue PARRAMATTA NSW 2150	[redacted]	[redacted]
Department of Services, Technology and Administration, Dams & Civil	[redacted] Principal Engineer	Level 13W, McKell Building 2-24 Rawson Place SYDNEY NSW 2000	[redacted]	[redacted]
Ambulance	[redacted] Station Manager	Mudgee	[redacted]	[redacted]
NSW Fire Brigade	[redacted] Captain	Mudgee	[redacted]	[redacted]
NSW Rural Fire Services	[redacted] Acting Manager	Mudgee	[redacted]	[redacted]

Fire Control Office	[redacted]	Mudgee	[redacted]	[redacted]
Mudgee helicopters		347 Ulan Road Mudgee NSW 2850	[redacted]	[redacted]
LOCAL RADIO FREQUENCIES				
Radio 144.9 2MG			[redacted]	[redacted]
Radio 93.1 Real FM			[redacted]	[redacted]
Radio 98.7 KRR FM		50 Angus Avenue Kandos	[redacted]	[redacted]
LOCAL TV CHANNELS				
WIN TV			[redacted]	[redacted]
PRIME TV			[redacted]	[redacted]
CONSTRUCTION MATERIAL SUPPLIERS				
Furney's Plumbing and Building supplies			[redacted]	[redacted]
Mitre 10 Hardware			[redacted]	[redacted]
Bunnings Hardware			[redacted]	[redacted]
EQUIPMENT SUPPLIERS				
Adrian Ingram Cartage	[redacted]	42 School Lane Mudgee NSW 2850	[redacted]	[redacted]
Andrew Turner Excavations	[redacted]	202 Mortimer Street Mudgee NSW 2850	[redacted]	[redacted]
Countrynet Transport	[redacted]	3 Burrundulla Road Mudge NSW 2850	[redacted]	[redacted]
M.M& R Faucett	[redacted]	36 Cox Street Mudgee NSW 2850	[redacted]	[redacted]
Max Phillips Plant Hire	[redacted]	'Hillview' Edgell Lane	[redacted]	[redacted]
OTHER SERVICES				
Bureau of	Duty Meteorologists	16th Floor, Centennial		[redacted]

Meteorology (BoM)	Public Weather	Plaza 580 Elizabeth Street SYDNEY NSW 2000	

SECTION 4 INUNDATION MAPS

4.1 GENERAL

Inundation maps are required by both Mid-Western Regional Council and Emergency Management Agencies for planning the timely notification/evacuation of the downstream Population at Risk (PAR) and for mitigating the effects of a flood or dam failure.

Redbank Creek Dam Dambreak Study has been carried out by Public Works in March 1992 and in accordance with the requirements of ANCOLD and the policies of the NSW Dams Safety Committee at the time. Dambreak flooding due to dam failure has been simulated using BOSS DAMBRK, a 1989 SI Unit version. The following cases were investigated for the Study:

a) A Sunny Day failure of the dam;

b) 0.5PMF with and without dambreak

c) PMF with and without dambreak

4.2 DOWNSTREAM INUNDATION

Inundation maps have been produced from surveyed cross sections along the Redbank Creek. These maps are found at **Appendix C**.

The number of houses inundated by the various flood cases has been estimated from the flood inundation map prepared for the Dambreak Study. This information is summarised in **Table 4-1**.

Table 4-1
Number of Inundated Houses and corresponding PAR

Flooding Scenario	Number of Houses Flooded	Population at Risk
Sunny Day Dambreak	14	42
0.5 PMF	9	27
0.5 PMF +Dambreak	14	42
Probable Maximum Flood (PMF)	14	42
PMF + Dambreak	14	42

NOTE: The water levels determined by the BOSS DAMBRK (1989 SI Unit version)) model are expected to have an accuracy of about ± 1.0m.

4.2.1 Flooding Condition

For the Sunny Day Failure case, 14 dwellings are considered to be at risk of flooding.

For the 0.5PMF case, 9 dwellings are affected without dam failure and 14 with dam failure. 5 dwellings are therefore in the incremental flood hazard zone. A further 4 dwellings are inundated by less than 0.5m in the 0.5PMF case and could also be incrementally affected. Up to 9 dwellings could therefore be incrementally affected in the 0.5PMF + Dambreak case.

For the PMF case, 14 dwellings are affected with and without dam failure. However, 5 dwellings are inundated by less than 0.5m in the PMF without failure case and could be considered incrementally affected in the PMF + dambreak case.

4.3 FLOOD WAVE TRAVEL TIME

The flood wave travel time in the Study is defined as the time taken by the dambreak flood wave front to travel from the dam to a designated location. The dambreak module determined the various flood wave travel times, velocities and arrival times at critical sections downstream for the different dambreak cases in the Study. This information is critical for planning when downstream areas are to be evacuated and what escape roads are to be used. This information is summarised in **Table 4-2** below.

Table 4-2
Physical Properties of Flood Peak

Location	Distance d/s	Arrival Time	Max Depth	Vmax
Sunny Day Dambreak				
	km	min	m	m/s
No. 5 – House LHS	0.35	0.1	1.69	2.7
No. 11 – House: 26/262863	2.05	0.3	1.15	2.2
No. 12 - House: 30/262863	2.05	0.3	0.45	2.2
No. 13 - House: 31/262863	2.05	0.3	0.25	2.2
No. 14 - House: 27/262863	2.1	0.3	0.88	2.2
No. 15 - House: 28/262863	2.1	0.3	1.18	2.2
No. 16 - House: 29/262863	2.1	0.3	0.48	2.2
No. 17 - House: 40/262863	2.15	-	2.49	2.2
No. 18 - House: 39/262863	2.15	0.3	1.59	2.2
No. 20 - House: 3/516480	2.5	0.35	0.19	1.5
No. 21 - House: 4/516480	2.5	0.35	0.49	1.5
No. 22 - House: 2/514456	2.6	0.39	0.15	2.1
No. 23 - House: 1/514456	2.6	0.37	0.45	2.1
No. 24 - House: 5/23627	2.6	0.37	0.55	2.1

Location	Distance d/s	Arrival Time	Max Depth	Vmax
PMF No Dambreak				
No. 5 – House LHS	0.35	-1.1	1.42	3.5
No. 11 – House: 26/262863	2.05	-0.8	1.13	2.9
No. 12 - House: 30/262863	2.05	-0.5	0.43	2.9
No. 13 - House: 31/262863	2.05	-0.3	0.23	2.9
No. 14 - House: 27/262863	2.1	-0.7	1.06	2.9
No. 15 - House: 28/262863	2.1	-0.8	1.36	2.9
No. 16 - House: 29/262863	2.1	-0.5	0.66	2.9
No. 17 - House: 40/262863	2.15	-1.3	2.48	2.8
No. 18 - House: 39/262863	2.15	-0.8	1.58	2.8
No. 20 - House: 3/516480	2.5	-0.3	0.25	2.0
No. 21 - House: 4/516480	2.5	-0.6	0.55	2.0
No. 22 - House: 2/514456	2.6	-0.1	0.08	2.4
No. 23 - House: 1/514456	2.6	-0.6	0.48	2.4
No. 24 - House: 5/23627	2.6	-0.6	0.58	2.4
PMF Dambreak				
No. 5 – House LHS	0.35		2.76	
No. 11 – House: 26/262863	2.05		1.98	
No. 12 - House: 30/262863	2.05		1.28	
No. 13 - House: 31/262863	2.05		1.08	
No. 14 - House: 27/262863	2.1		1.67	
No. 15 - House: 28/262863	2.1		1.97	
No. 16 - House: 29/262863	2.1		1.27	
No. 17 - House: 40/262863	2.15		2.87	
No. 18 - House: 39/262863	2.15		1.97	
No. 20 - House: 3/516480	2.5		1.02	
No. 21 - House: 4/516480	2.5		1.32	
No. 22 - House: 2/514456	2.6		0.55	
No. 23 - House: 1/514456	2.6		0.95	
No. 24 - House: 5/23627	2.6		1.05	

(-) denotes flooded prior to dambreak

Further details of the 1992 Dambreak Study for Redbank Creek Dam and inundation maps are found in **Appendix C**.

SECTION 5 LOCATION MAPS/PLANS OF REDBANK CREEK DAM

5.1 GENERAL

Redbank Creek Dam is located approximately 2km south-west of Mudgee, NSW. An aerial photograph, showing the surrounding topography and a location map for Redbank Creek Dam is located at **Figure 5-1** and **Figure 5-2** respectively.

5.2 ACCESS TO REDBANK CREEK DAM

5.2.1 Access to the Dam Site

Normal access to Redbank Creek Dam is via Waterworks Road at the southern end of Oporto Road. These roads are sealed. Travel time is less than 5 mins from the centre of Mudgee. The last 200m to the dam is an unformed track and may not be trafficable by two wheel drive vehicle in poor conditions. There are council security locks on gates along the track. The tracks do not cross private property, only Council land and nature reserve NPWL.

5.2.2 Alternative Access to the Dam Site

During major flooding the crossing of Redbank Creek or Waterworks Road may be impassable. Alternative access may be possible via Bruce Road Connection to the southern end of Waterworks Road.

When flooding becomes too great and access roads to the dam site are flooded, access to the dam will be via helicopter service. Suitable area for landing a helicopter is possible on private property south of dam wall. Contact details for helicopter services are provided in **Sheet 3** - Emergency Communications Directory (see end of **Section 3**).

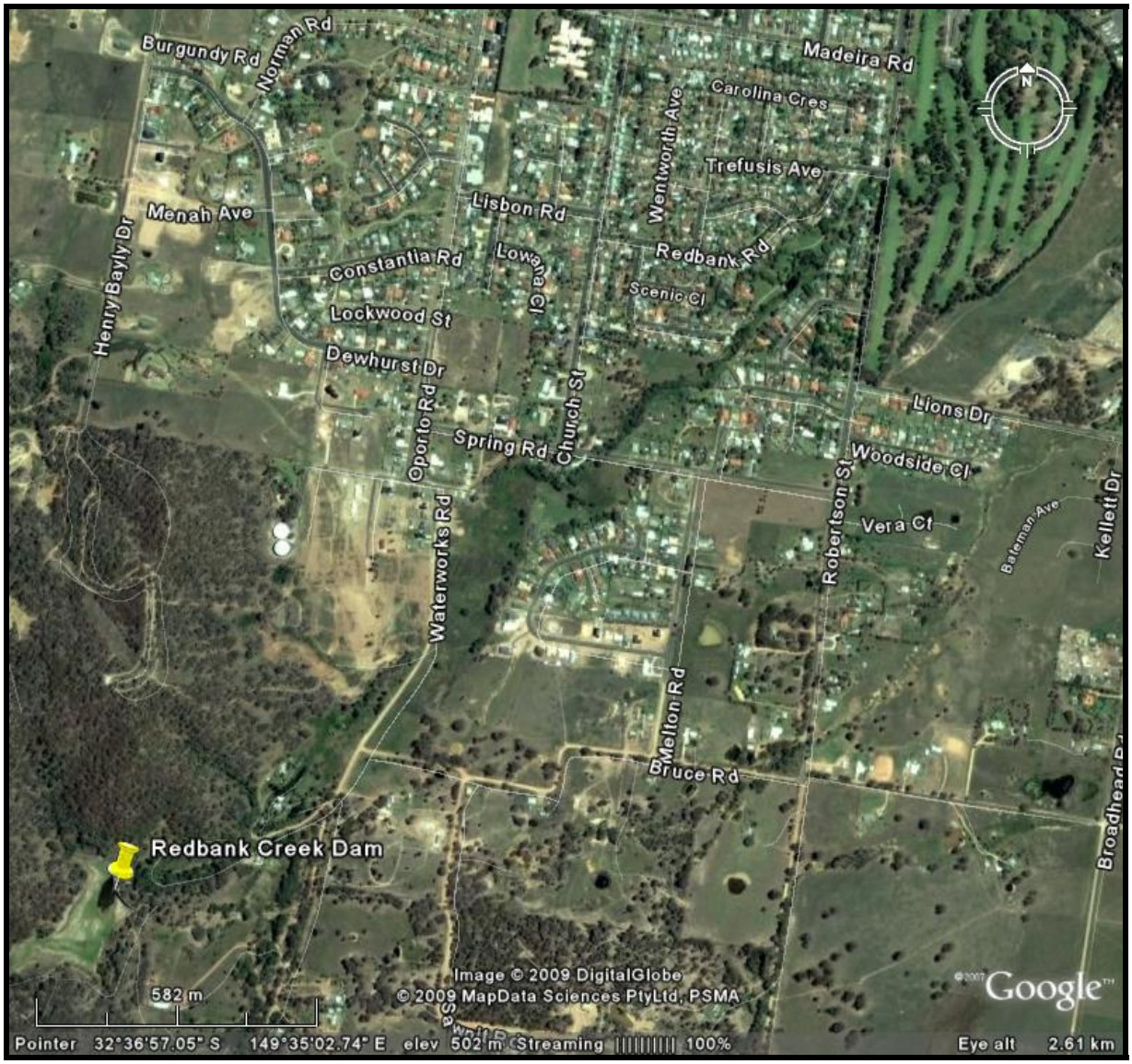


Figure 5-1 Aerial Photo of Redbank Creek Dam

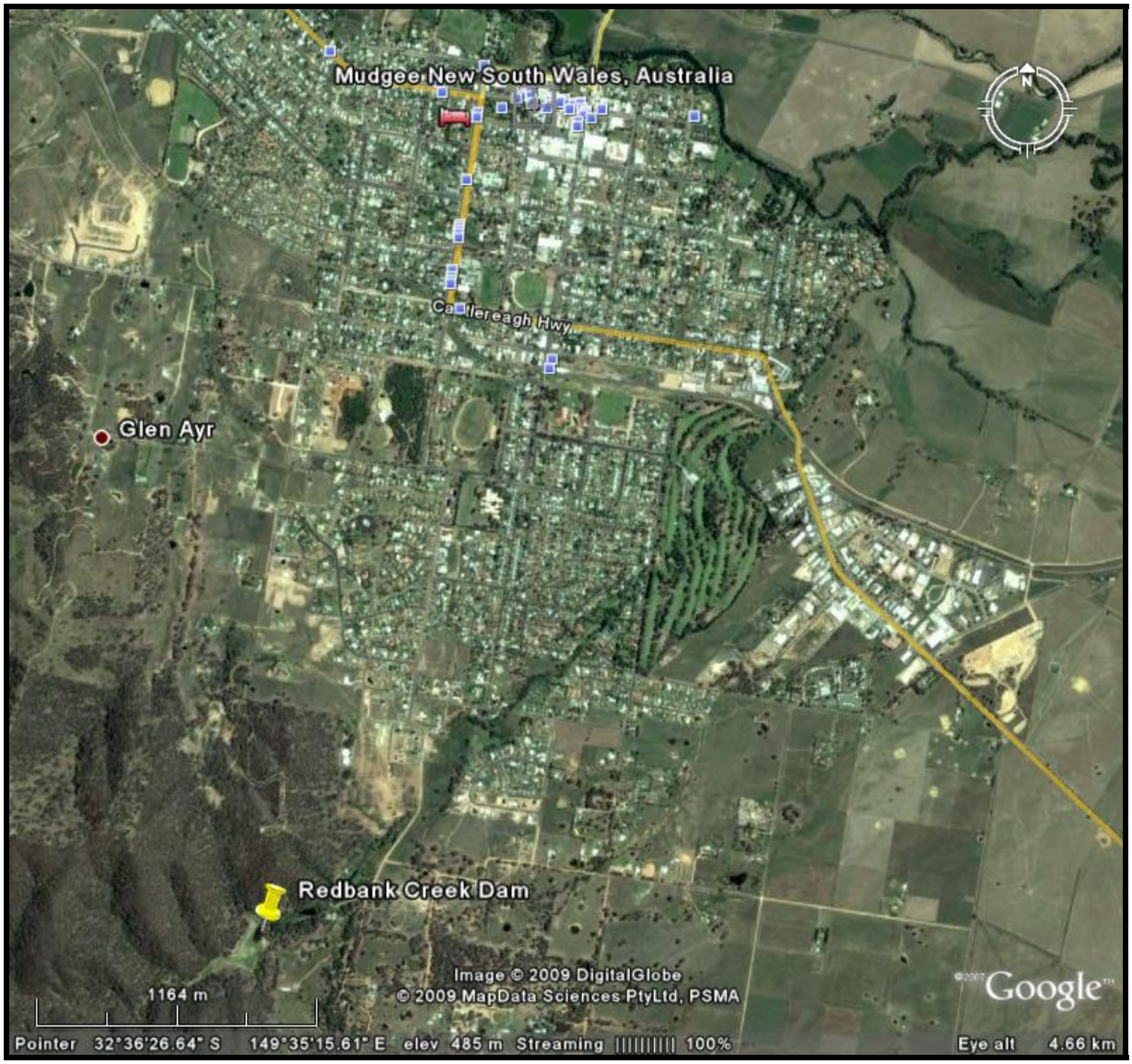


Figure 5-2 Redbank Creek Dam **Locality Map**

SECTION 6 COMMUNICATION & WARNING SYSTEMS

6.1 COMMUNICATIONS SYSTEM FOR REDBANK CREEK DAM

In accordance with the Australian National Committee on Large Dams Guidelines on Dam Safety Management a reliable communications system for the dam is required both in normal and emergency situations.

All information is transferred between the stakeholders via mobile/landline phone systems and internet connections.

There is no telephone link to the dam. Mobile phone communication is only possible from the dam crest at top of the abutments. There is radio telemetry at the dam site.

6.1.1 Alternative Communication System and Power Sources

Severe flooding could most likely cause significant damage to roads, bridges, power lines and other infrastructure. If power supplies or communications have been interrupted, attempts should be made to repair these or make arrangements for temporary or backup systems, including portable generators, two-way radios, mobile telephones etc. Communications will need to be re-established. Note that the "Communications Log" provided at **Appendix G** should be used to record all communications that occur regarding the emergency.

The dam operators at Redbank Creek Dam have hand held two way radios and mobile phones as back up if main power fails. Solar powered radio telemetry to SCADA system with battery backup has also been installed at the dam site.

6.1.2 Radio Frequency and TV Channels

The dissipation of information on the dam emergency will be carried out as per **SES Flow Chart No.1** (Refer to **Figure 2-1**). Local media outlets shall receive flood bulletins from the SES Mudgee Division Headquarters Media Unit. The same media organisations shall receive from this authority other information such as road information for Mudgee and the nearby area.

6.1.3 Emergency Communications Directory

For contact names and phone numbers refer to **Sheet 3 - Emergency Communications Directory** (see end of **Section 3**), or **Table I**, **Table II** and **Table III** in **Section 2** of this document for contacts under alternative emergency circumstances.

A "Communications Log" is included in **Appendix G**. It should be used to record all discussions that take place regarding the emergency. It should include all phone calls; radio and person to person conversations with reference to the current emergency situation. Rule a line to indicate the end of the discussion after every entry.

Note also that after the emergency situation has passed, it should be recorded in the "Operations Log" for the Dam.

6.2 WARNING SYSTEM FOR REDBANK CREEK DAM

No dam instrumentation systems are incorporated in Redbank Creek Dam. However, the dam has a level sensor attached to the dam wall and is connected via radio telemetry equipment to the MWTF. The equipment is housed in a small compound on the southern side of the wall. The telemetry system is powered by a solar panel with battery backup.

The dam level data is monitored by the Mudgee Water treatment facility and a warning system is set up to calculate the rate of fill and would send a warning to the operator if and when the water rises too fast or reaches the alert levels. The on call operations system operates 24 hours a day, 7 days a week. Mid-western Regional Council is responsible for operating and maintaining the system.

Development of a seepage collection system and installation of a seepage measurement weir near the toe of the dam was recommended in the 2006 Audit Inspection Report by DEUS (now known as DECCW).

6.2.1 Instrumentation and Monitoring

An important factor in the effectiveness of the DSEP is the prompt detection and evaluation of information obtained from instrumentation and/or physical inspection and surveillance procedures. Constant monitoring of the Dam for changes will allow remedial action to be enacted quickly and effectively if changes do occur.

Details of the type of instrumentation/monitoring used at Redbank Creek Dam, the locations of these and their normal monitoring frequency are given in **Appendix H**. **Appendix G** provides a "Visual Inspection Report" form that is to be filled in when appropriate during and/or after an emergency. An incident report form too should be filled out in the case of an incident occurring which includes a description of the incident and details of conversation between the reporting Officer and contacted person.

6.2.2 Stream Gauging Stations

Stream gauging stations provide valuable information on the catchment yield and response rate and more accurate estimation of flood magnitude. They are of benefit to any future flood warning system. However, there are no stream gauging stations located in the Redbank Creek Dam area.

SECTION 7 EMERGENCY MANPOWER REQUIREMENTS

7.1 GENERAL

This section details the labour force requirements during an emergency situation at Redbank Creek Dam for:

- Operating the Base Station; communications and coordinating staff and resources
- Inspection of Redbank Creek Dam;
- Collection of surveillance and monitoring data for Redbank Creek Dam.

7.2 EMERGENCY SITUATION MANPOWER RESOURCES

Duty rosters to cover the manpower requirements for manning the base station, inspecting the dam and collecting surveillance and monitoring data during a 'round the clock' emergency operation are required during an emergency situation. Refer to Table 7-1 for this Schedule.

If there are insufficient operational Council personnel to cover the manpower requirements for a 'round the clock' duty roster, a secondment of personnel should be appointed by Council. The seconded personnel appointed, is require to have suitable prior training.

Table 7-1
DSEP DUTY ROSTER

Council Personnel	Time	Duty
Coordinator 1 : MWRC Water & Wastewater Coordinator [redacted]	Operate 3x8 hour shifts over a 24 hour period	Manning Base Station, communications and coordinating staff and resources
Coordinator 2 : To be selected from roster		
Coordinator 3 : To be selected from roster		
Water operator 1 : To be selected from roster [redacted]	Operate 3x8 hour shifts over a 24 hour period	Inspecting Redbank Creek Dam
Water operator 2 : To be selected from roster		
Water operator 3 : To be selected from roster		
Wastewater operator 1 : To be selected from roster [redacted]	Operate 3x8 hour shifts over a 24 hour period	Collection of surveillance and monitoring data from Redbank Creek Dam
Wastewater operator 2 : To be selected from roster		
Wastewater operator 3 : To be selected from roster		

Two additional operational staff will be on-call at all times. Additional staff may be available at the request of on-call staff. Duty operators can call upon additional staff if the need arises and/or contractors if required. Mobile phones contacts will be passed onto the next operator or directed through to a landline where appropriate.

7.3 EMERGENCY SUPPLIES AND RESOURCES

Appendix F contains a recommended list containing the type and quantity of materials that should be stored at the dam site and the suppliers from which they may be obtained. Furthermore, the location of plant/equipment during an emergency condition is specified in this Appendix.

SECTION 8 ORGANISATIONAL RESPONSIBILITIES

Emergency Management of Redbank Creek Dam is conducted in accordance with **Charts 1**, **2**, **3** and **SES Flow Chart No.1** (See **Figure 2-1**).

When the DECCW-OW is notified of an unsafe or potential emergency condition at the dam, they will assess the situation, and if convinced that a dam failure is imminent, will confirm that opinion to Water Supply Manager.

The SES and NSW Police, when notified of an imminent dam failure will initiate appropriate emergency action in accordance with the Mudgee Local Disaster Plan, to safeguard persons in downstream areas.

The DECCW-OW will monitor the situation until the danger is over and will notify their assessment to, or issue advice to the Water Supply Manager, on measures to ameliorate the situation.

The NSW DSC may recommend to the Minister for Climate Change, Environment & Water that a state of emergency be declared at the dam under Section 21 of the Dams Safety Act, 1978. In the event of such a declaration, the DSC may then take charge of actions to protect the safety of the dam. The Executive Engineer, DSC will inform the Minister.

The responsibilities of persons and organisations involved with this emergency management are detailed further in **Table 8-1**.

Table 8-1 -Organisational Responsibilities

Organisation	Responsible Position/(s)	General Responsibilities	Emergency Responsibilities
Mid-Western Regional Council	1. Water Supply Manager 2. Operations Engineer, ***3.*** Mechanical Supervisor ***If the Water Supply Manager is absent, then the next responsible position will carry out his/her duties, including activation of the emergency responses.***	Management of the dam and appurtenant works including the: 1 Production of O&M Manual. 2 Day to day operations to meet the demands of the local community. 3 Collection of dam surveillance & monitoring data. 4 Routine inspections and maintenance of dam and appurtenant works in accordance with the O&M Manual. 5 The routine maintenance work necessary to keep the dam and appurtenant works in a safe operational condition. 6 Provision of information to SES on: i) the downstream flooding due to any emergency; ii) the population at risk due to any emergency. 7 Nomination of the Owner's preferred Consultant. 8 Production of the DSEP. 9 Annual review and distribution of all revisions, amendments, contact details etc. to DSEP.	1 Identify unsafe conditions, due to floods, earthquakes or other, at dam and appurtenant works. 2 Activate emergency *alerts* and advise in order of priority: i) NSW SES HQ; ii) DECCW-OW WUB-Manager Dam Safety; iii) DSC Exec Engineer. 3 Liaise with SES, WUB- MDS, and DSC during emergency. 4 Inspect and collect surveillance & monitoring data in accordance with the O&M Manual or as required by the WUB-MDS, including photos of dam and appurtenant works, under emergency conditions and submit all relevant data to the WUB-MDS. 5 Request WUB-MDS to inspect dam and appurtenant works and provide technical advice if required. 6 React to the advice from the WUB-MDS (ONLY) regarding temporary repairs to the dam and appurtenant works and any additional monitoring requirements. 7 Provide assistance to local emergency response agencies (SES, etc.) if requested. 8 Following an **White**/**Amber**/**Red Alert** flood emergency arrange with the WUB-MDS for a full engineering inspection of the dam and appurtenant works to be carried out. 9 Carry out temporary or permanent repairs recommended by the WIB-MDS to return the dam and appurtenant works to a safe operational condition.

Table 8-1 (continued)

Organisation	Responsible Position/(s)	General Responsibilities	Emergency Responsibilities
Department of Environment Climate Change & Water - Office of Water (DECCW-OW)	Manager Dam Safety (MDS) Water Utility Division (WUD)	1 Oversee the Dam Safety Management programs of Local Water Utility (Owners) dams. 2 Carry out annual inspections of dam and appurtenant works and submit reports to LWU. 3 Review ALL routine inspection reports and surveillance & monitoring data. 4 Review all DSEPs. 5 Test DSEP. (Phone or desk top exercise). 6 Train the Dam Owner's Operational personnel in dam safety inspection techniques. 7 Liaise with the Dams Safety Committee.	1 Liaise with the Dam Owner and DSC. 2 Review/assess all routine and emergency incident inspection reports and surveillance & monitoring data, including any photos to: i) identify any unsafe conditions at the dam and appurtenant; ii) or a potential dam failure; iii) advise the Owner of the identified unsafe or potential failure conditions. 3 Request additional monitoring data. 4 React to all requests from the Owner: i) to inspect the dam and appurtenant works; ii) for advice on preventative measures to ensure the safety of the dam and appurtenant works; iii) for advice on how to mitigate the effects of the flood. 5 Arrange additional technical advice from the Owner's nominated Consultant as required. 6 Advise WUB Director. 7 Following an **White**/**Amber**/**Red Alert** flood emergency arrange with the Owner for a full engineering inspection of the dam and appurtenant works. 8 Advise the Owner on the permanent repairs required to return the dam and appurtenant works to a safe operational condition.
	WUB Director	1 Provide all necessary support to MDS.	Advise Minister.

State Emergency Service (SES)	SES Local Controller	Preparation and maintenance of the Local Flood Plan; Combat agency for floods (including Dam Failure).	1 Responding to indications of potential dam failure when Dam Failure Warning systems are activated; 2 Controlling warning, evacuation and flood response operations; and 3 Carrying out flood tasks including those relating to evacuation, resupply, rescue, information provision and logistic support.
NSW Dams Safety Committee (DSC)	Executive Engineer	Regulation of dam safety in NSW	1 Liaise with the DECCW-OW WUB-MDS. 2 Inspect dam as required. 3 Advise DSC Chairperson and Minister.
Department of Services, Technology and Administration (DSTA), Dams & Civil	Principal Engineer	Dam investigation & design	1 If requested by the DECCW-OW WUB-MDS. i) inspect dam & appurtenant works; ii) review all inspection and monitoring data; iii) identify unsafe conditions and provide advise on the potential for a dam failure; iv) provide advice on any temporary preventative measures to ensure the safety of the dam. 2 Following an **White**/**Amber**/**Red Alert** flood emergency carry out a full engineering inspection of the structures if requested by the Owner or DECCW-OW WUB-MDS.

REFERENCES

REFERENCES

Australian National Committee on Large Dams
Guidelines on Dam Safety Management
January 1994

Mike 11
Microcomputer Based Modelling System for Rivers and Channels.
Danish Hydraulic Institute, 15 June, 1995.

Pilgrim D H (editor-in-chief)
Australian Rainfall and Runoff - A Guide to Flood Estimation,
Third Edition
Institute of Engineers

United States Bureau of Reclamation
ACER Technical Memorandum No. 3 “Criteria and Guidelines for Evacuating Storage Reservoirs and Sizing Low-Level Outlet Works”, 1982.

DEUS
Redbank Creek Dam, 2006 Audit Inspection Report.

GHD
Mudgee Shire Council, Redbank Creek Dam, Surveillance Report, January 2002, Document # 79223.

Department of Commerce, Hydrology Group
Redbank Creek Dam Flood Study, Report # 06162, September 2006.

GHD
Redbank Creek Dam, Dam Safety Emergency dam, Draft July 2002.

Public Works Department (PWD)
Redbank Creek Dam, Dambreak Study for Mudgee Shire Council, DBS No.2, March 1992.

APPENDIX A

Dam Description/Data

A.1 DAM DESCRIPTION/DATA

Redbank Creek Dam is located on Redbank Creek approximately 2km south-west of Mudgee. The dam was constructed in 1899 by the then Public Works Department (PWD). Redbank Creek Dam was built as a water supply dam to serve the town of Mudgee. However, the dam is no longer actively used for water supply (although it has been used in emergencies). According to Council, its primary use is now for flood retarding and recreational purposes with residential development existing in the flood zone just downstream of the dam.

The axis of the dam runs in the north-south direction with the downstream face of the wall facing to the east.

The dam is currently dewatered by using the 300 outlet pipe (200 diameter valve) because of dam safety concerns.

Details and features of the dam are listed below.

Table A-1
Redbank Creek Dam **Data**

Dam Type	Concrete Arch
Full Supply Level (FSL)	RL 538.16m AHD
Embankment Crest Level	RL 538.92m AHD
Height of Dam	16m
Crest Length (including spillway section)	152m
Freeboard Allowance	0.76m
Type of Spillway	Free Over flow
Spillway Crest Level (Low Sill)	RL 538.16m AHD
Spillway Crest Level (High Sill)	RL 538.46m AHD
Maximum Flood Level	RL 539.47m AHD
Catchment Area	4.5km^2
Storage Capacity at FSL	184ML
Surface Area at FSL	0.034km^2
PMF Inflow	RL 323.6m^3/s
PMF Outflow	RL 326.77m^3/s

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.
Average Recurrence Interval (ARI)	The average or expected value of the period between exceedances of a given magnitude event (e.g. earthquake or flood).
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).
Dam Safety Engineer (DSE)	Department of Water & Energy Dam Safety Engineer
Duty Officer	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.*
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 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.
State Operations Communication Centre (SOCC)	First point of contact for SES in an 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
DSE	Dam Safety Engineer
DCF	Dam Crest Flood
DECCW-OW	Department of Environment Climate Change & Water – Office of Water
DEMC	Police - District Emergency Management Controller, Mudgee
DEMO	District Emergency Management Officer
DEOCON	District Emergency Operations Controller
DFL	Dam Flood Level
D/S	Downstream
DSC	Dam Safety Committee
DSE	Dam Safety Engineer
DSEP	Dam Safety Emergency Plan
DSTA	Department of Services, Technology and Administration
DWE	Department of Water & Energy
FSL	Full Supply Level
IFF	Imminent Failure Flood
IFCC	Incremental Flood Consequence Category
LEMO	Local Emergency Management Officer, Mid-Western Regional Council - SES
LEOCON	Local Emergency Operations Controller, Mudgee - Police
LFP	Local Flood Plan -SES
LWU	Local Water Utility

MDS	Manager Dam Safety
PAR	Population at Risk
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
SOCC	State Operations Communication Centre
UHF	Ultra High Frequency
U/S	Upstream
VHF	Very High Frequency
WUB	Water & Utilities Branch

APPENDIX C

Dambreak Study Summary

C.1 DAMBREAK STUDY SUMMARY

C.1.1 General

The Dambreak Study for Redbank Creek Dam was prepared by the Public Works Department (PWD) in March 1992. The study details results of the dambreak study and the consequences of floodings from dam failure to determine the Consequence categories for Redbank Creek Dam.

BOSS DAMBRK was used to model the study area and carry out hydraulic simulations of dambreak floods for the dam. Five flood cases were considered for the study and include:

- Sunny Day dambreak;
- 0.5PMF with and without dambreak;
- PMF with and without dambreak.

C.1.2 Description of the Dambreak Model

BOSS DAMBRK, a 1989 SI Unit version of a flood forecasting program was used for the 1992 Dambreak Study. The program uses the understanding of dam failures and hydrodynamic theory to predict dam break wave formation and downstream progression due to dambreak floods, reservoir spillway floods and specified flood hydrographs.

The BOSS DAMBRK module simulates the dambreak failure according to the given dam breach of failure parameters, reservoir inflow, reservoir storage characteristics, spillway outflows and downstream tailwater elevations. The Module routes the outflow dambreak flood wave through the downstream valley in order to determine the changes in the hydrograph due to valley storage, frictional resistance, downstream bridges or dams and to determine the resulting water surface elevations and flood wave travel times.

The valley downstream of the dam was specified by a number of cross sections, each defined by a maximum of eight sets of elevations and corresponding top-widths. Eleven cross sections surveyed by Council were used in the modelling. **Table C-1** indicates the cross sections which have been used in the analysis and their locations.

Table C-1
Surveyed Cross Section Locations

Location No.	Distance Downstream (km)	Location/Description
1	0	Dam Crest
2	0.02	D/s toe of dam
3	0.2	Weir
4	0.25	House RHS
5	0.35	House LHS
6	0.5	House LHS
7	0.5	House RHS
8	0.6	X-section
9	1.2	X-section
10	1.7	House RHS
11	2.05	House: 26/262863
12	2.05	House: 30/262863
13	2.05	House: 31/262863
14	2.1	House: 27/262863
15	2.1	House: 28/262863
16	2.1	House: 29/262863
17	2.15	House: 40/262863
18	2.15	House: 39/262863
19	2.25	X-section
20	2.5	House: 3/516480
21	2.5	House: 4/516480
22	2.6	House: 2/514456
23	2.6	House: 1/514456
24	2.6	House: 5/23627
25	2.8	X-section
26	3.4	X-section

C.1.3 Dambreak Flooding Conditions

For the Sunny Day Failure case, 14 dwellings are considered to b at risk of flooding.

For the 0.5PMF case, 9 dwellings are affected without dam failure and 14 with dam failure. 5 dwellings are therefore in the incremental flood hazard zone. A further 4 dwellings are inundated by less than 0.5m in the 0.5PMF case and could also be incrementally affected. Up to 9 dwellings could therefore be incrementally affected in the 0.5PMF + Dambreak case.

For the PMF case, 14 dwellings are affected with and without dam failure. However, 5 dwellings are inundated by less than 0.5m in the PMF without failure case and could be considered incrementally affected in the PMF + dambreak case.

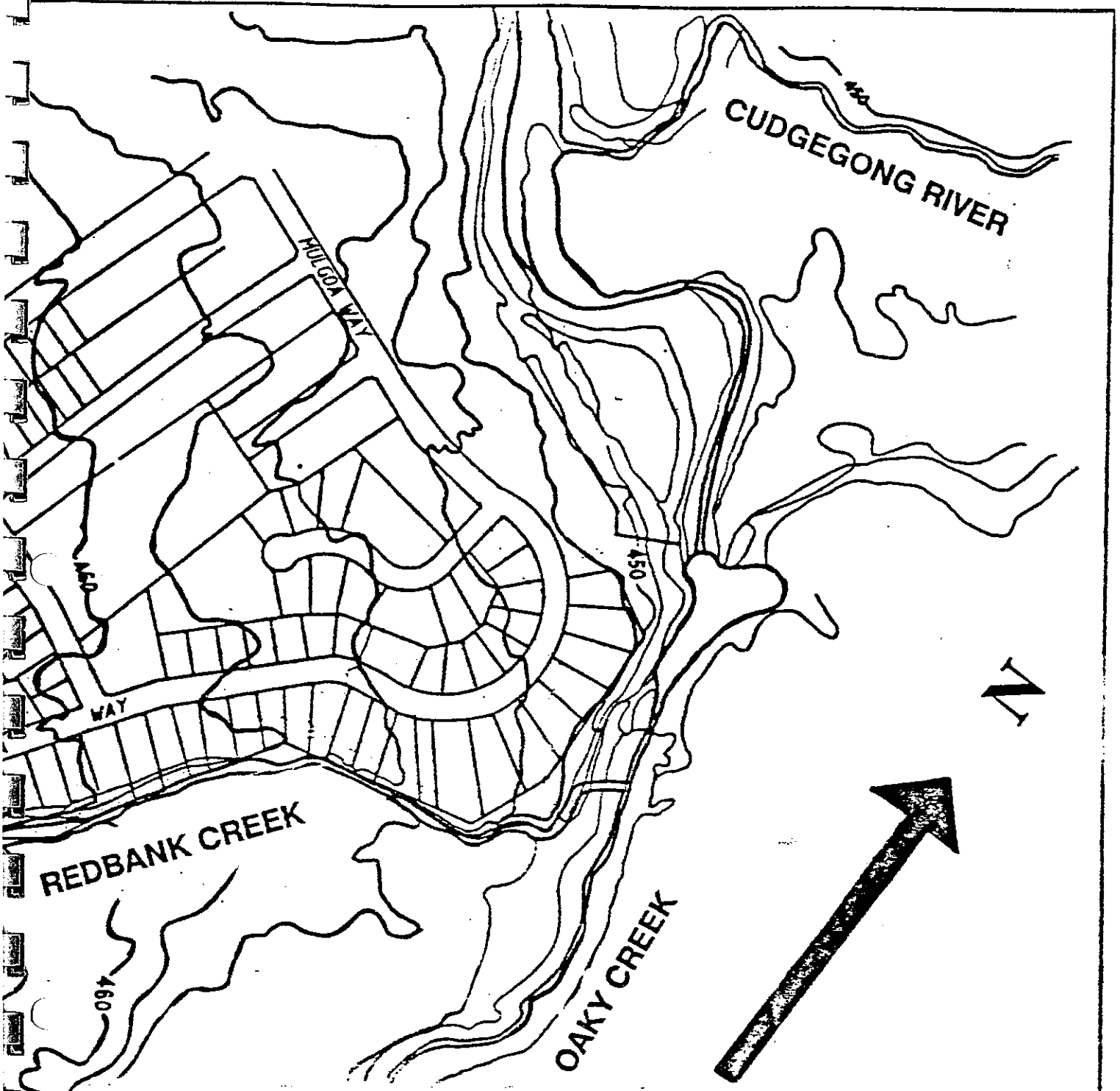
C.1.4 Floodwave Arrival Time

Refer to Section 4 of the main document.

C.1.5 Hazard Rating

More than a few lives are considered to be at risk for the Sunny Day Dambreak, 0.5PMF dambreak and PMF dambreak cases. Therefore the hazard rating for Redbank Creek Dam is therefore assessed as HIGH for all three cases.

Furthermore, even though an economic assessment of damage was not undertaken, it is obvious that damage to houses, road and railway bridges would also occur due to the velocity and depth of the flood wave.



LEGEND

CROSS SECTION USED IN MODEL

DWELLING LOCATION (REFER TABLE 4.2)

PUBLIC WORKS DEPARTMENT

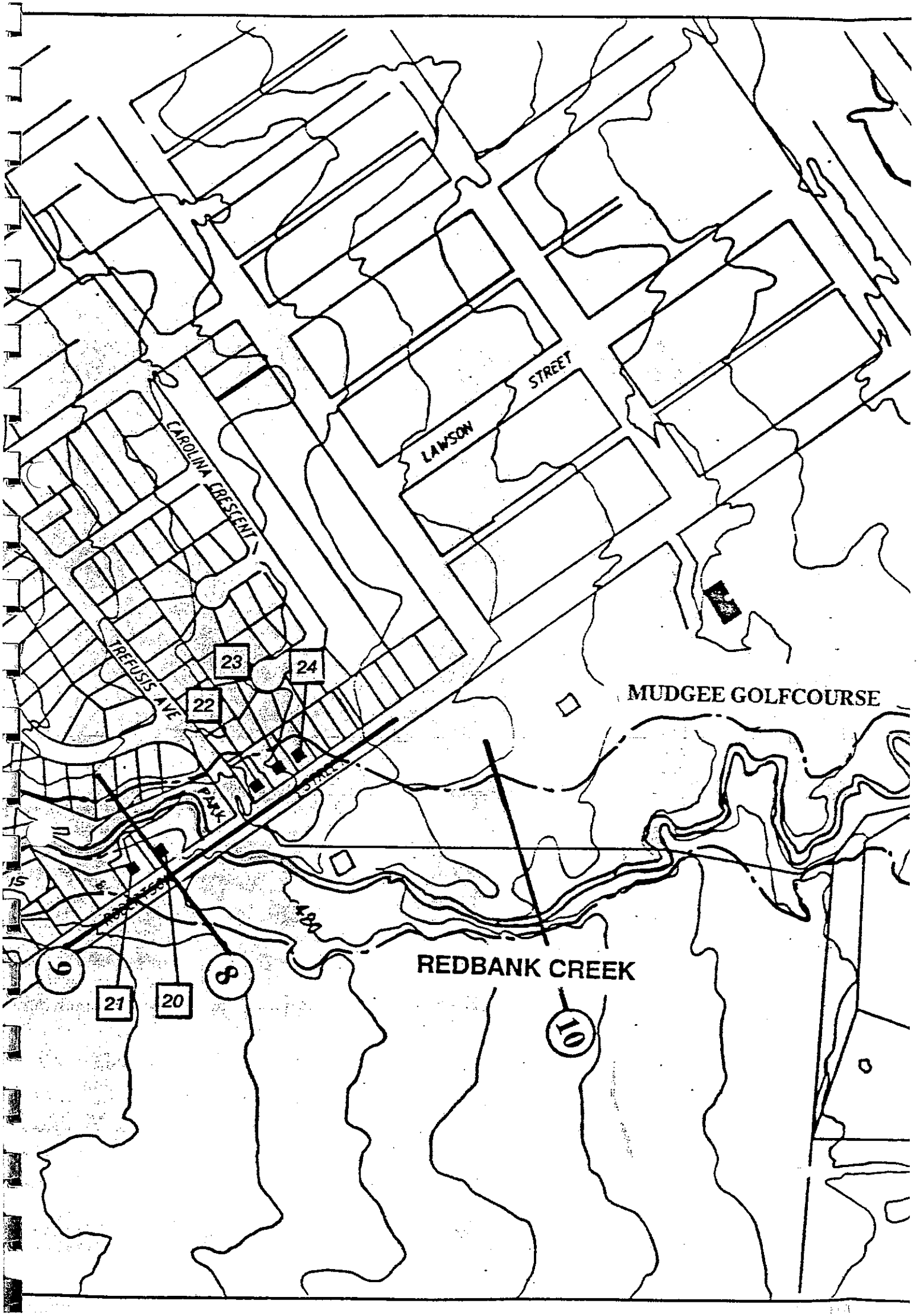
REDBANK CREEK DAMBREAK STUDY

SUNNY DAY FAILURE - TOTAL INUNDATION ENVELOPE

SCALE 1:4 000

EXHIBIT 3

CEDAR
AVE
460
SYDNEY ROAD
MULGOA
WAY
REDBA
460
470
11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CAROLINA CRESCENT
TREFUSIS AVE
23
24
22
PARK
MUDGEE GOLFCOURSE
REDBANK CREEK
9
8
21
20
10

MUDGEE SOUTH

CHURCH STREET

REDBANK ROAD

MOUNTAIN VIEW ROAD

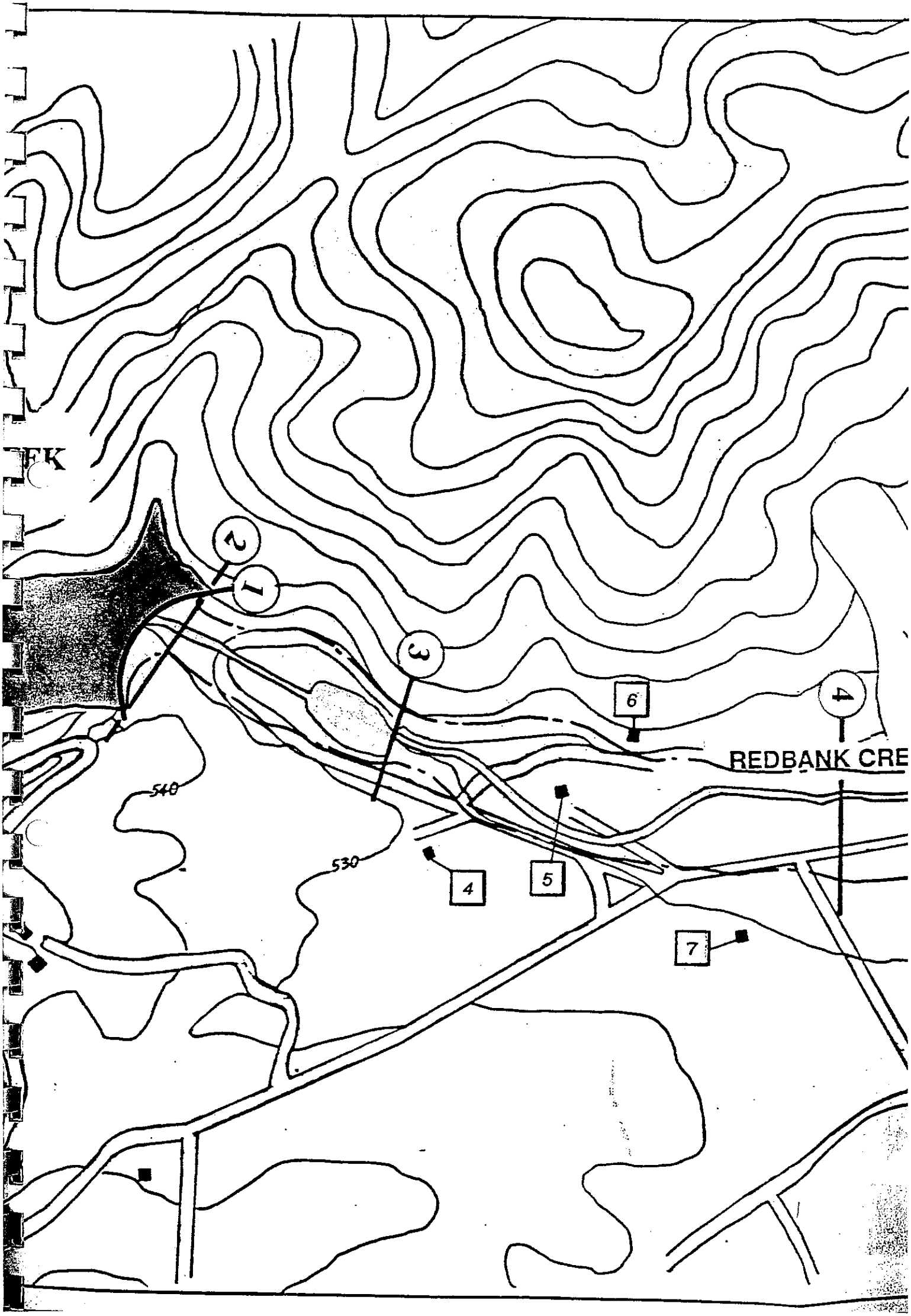
SPRING ROAD

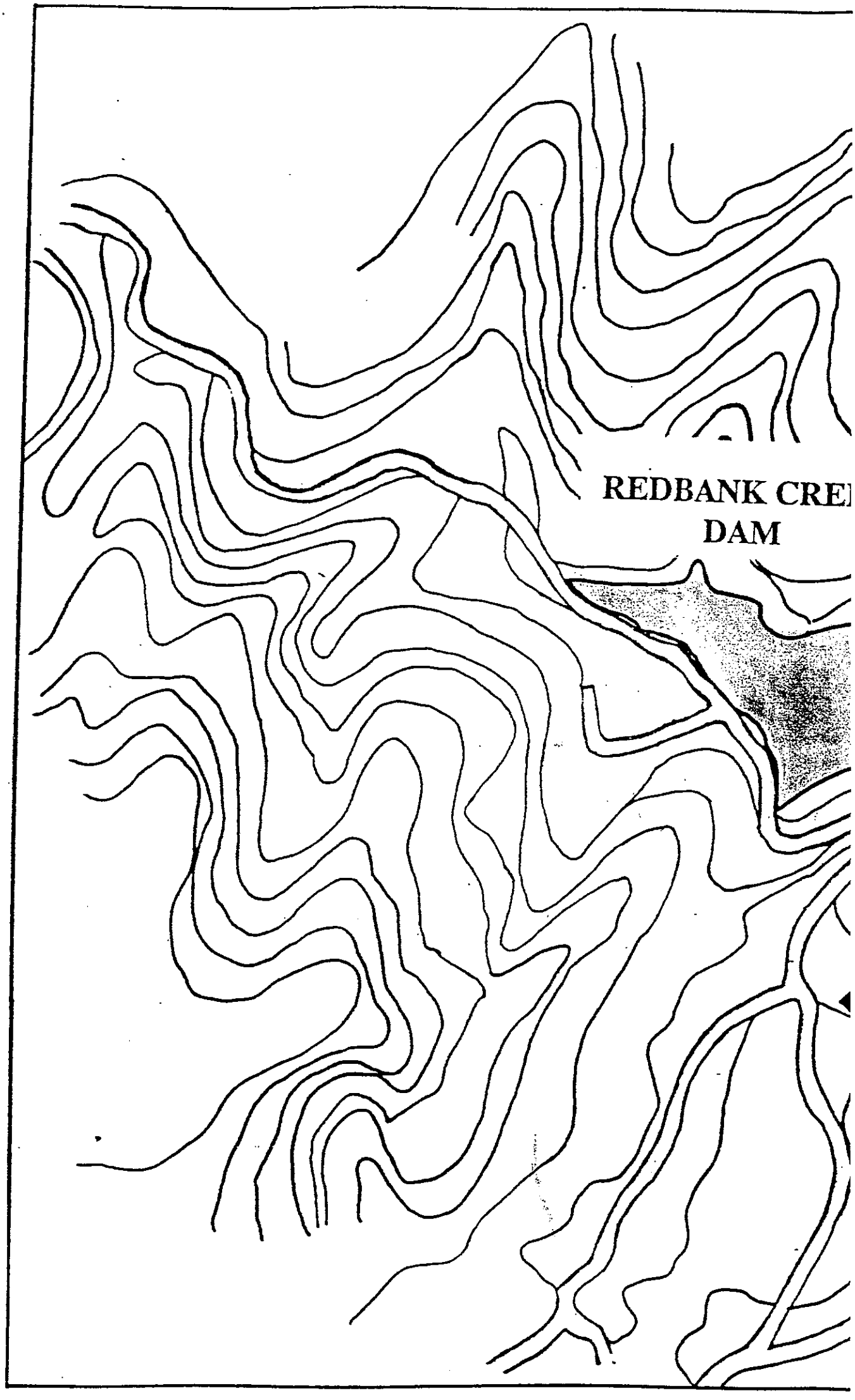
Redbank PARK Creek

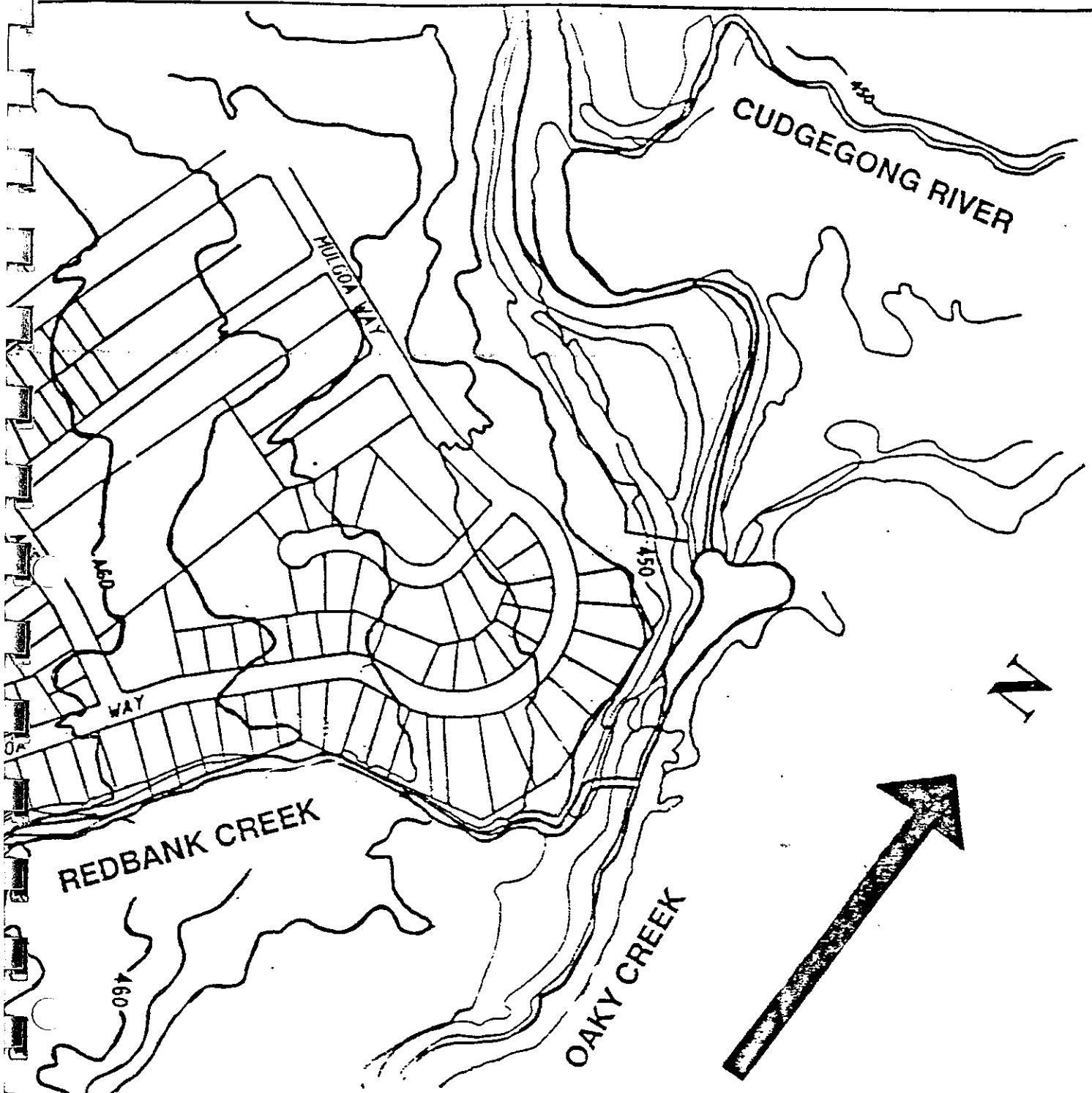
900

500

RESERVOIR
NK CREEK
4
5
500
510
520


FK
2
1
3
6
4
REDBANK CRE
540
530
4
5
7


REDBANK CRE
DAM



LEGEND

CROSS SECTION USED IN MODEL

DWELLING LOCATION (REFER TABLE 4.2)

PUBLIC WORKS DEPARTMENT

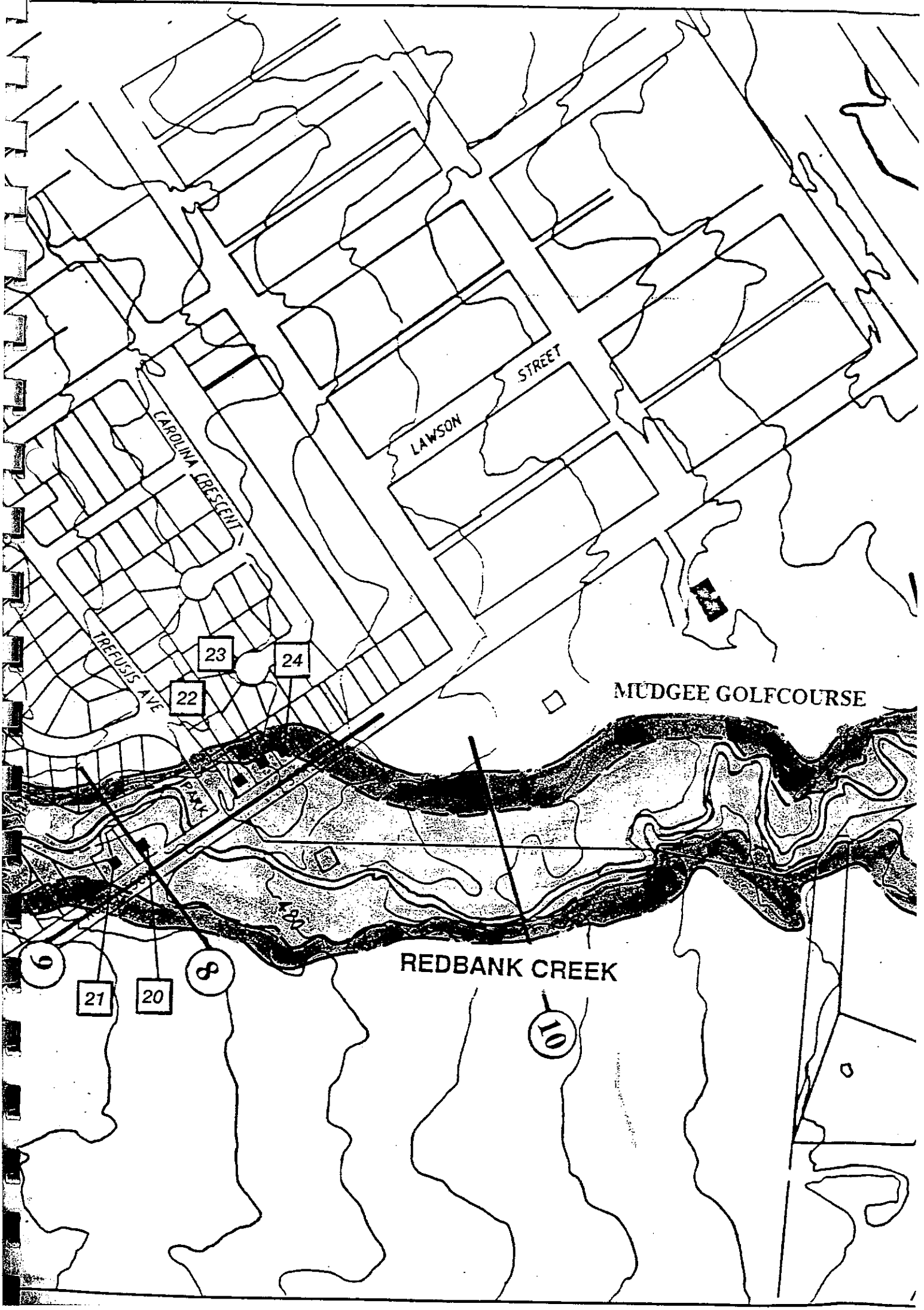
REDBANK CREEK DAMBREAK STUDY

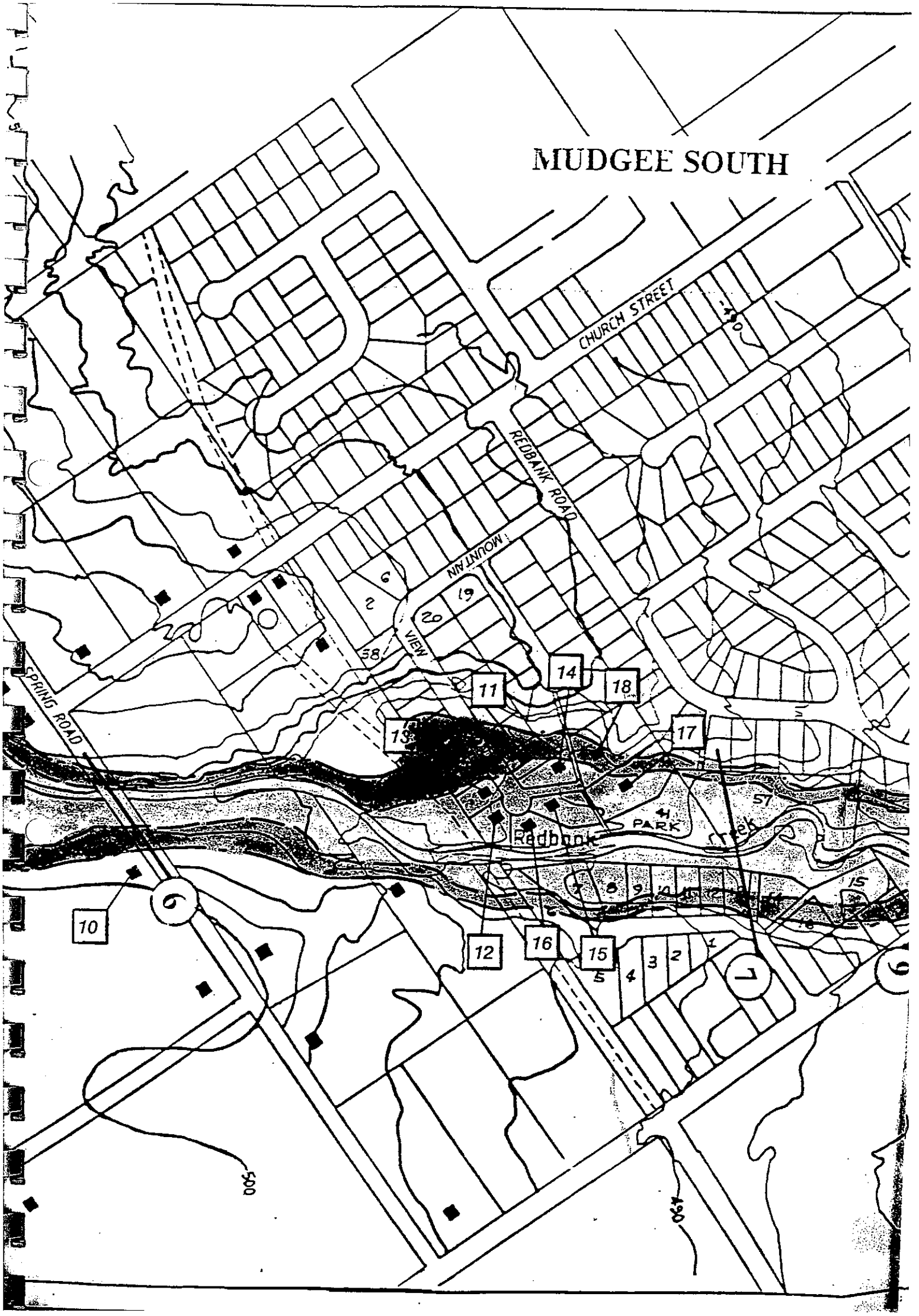
0.5 PMF and 0.5 PMF + DBK - TOTAL INUNDATION ENVELOPE

SCALE 1:4 000

EXHIBIT 5

CEDAR
AVE
460
SYDNEY ROAD
MULGOA
WAY
REDBAN
460
470
11


LAWSON STREET
CAROLINA CRESCENT
TREFUSIS AVE
23
24
22
MUDGEE GOLFCOURSE
PARK
REDBANK CREEK
9
8
21
20
10


MUDGEE SOUTH
CHURCH STREET
REDBANK ROAD
MOUNT AIN
VIEW
SPRING ROAD
Redbank
PARK
Creek
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17
18
500
490

RESERVOIR
CREEK
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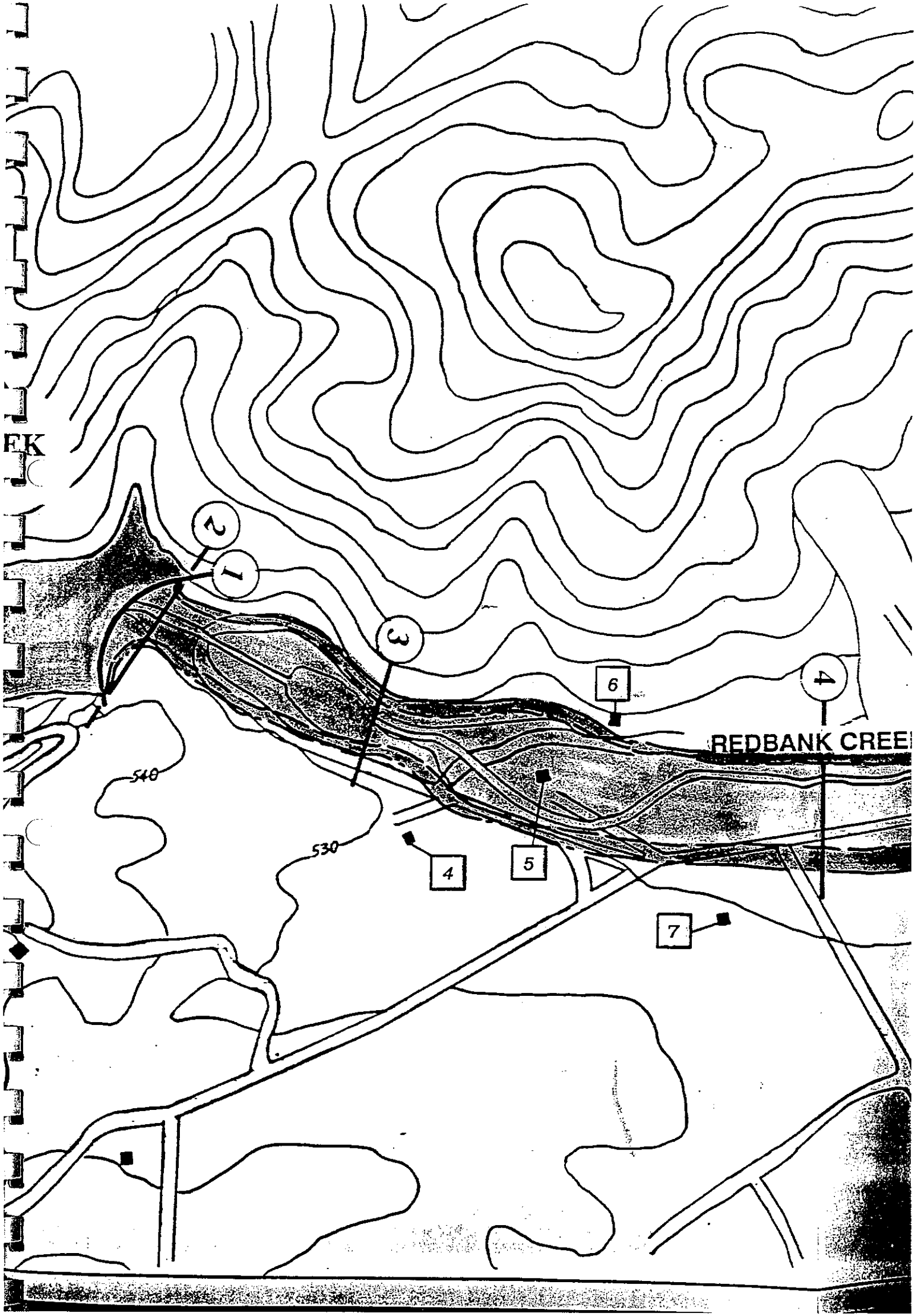
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REDBANK CREE
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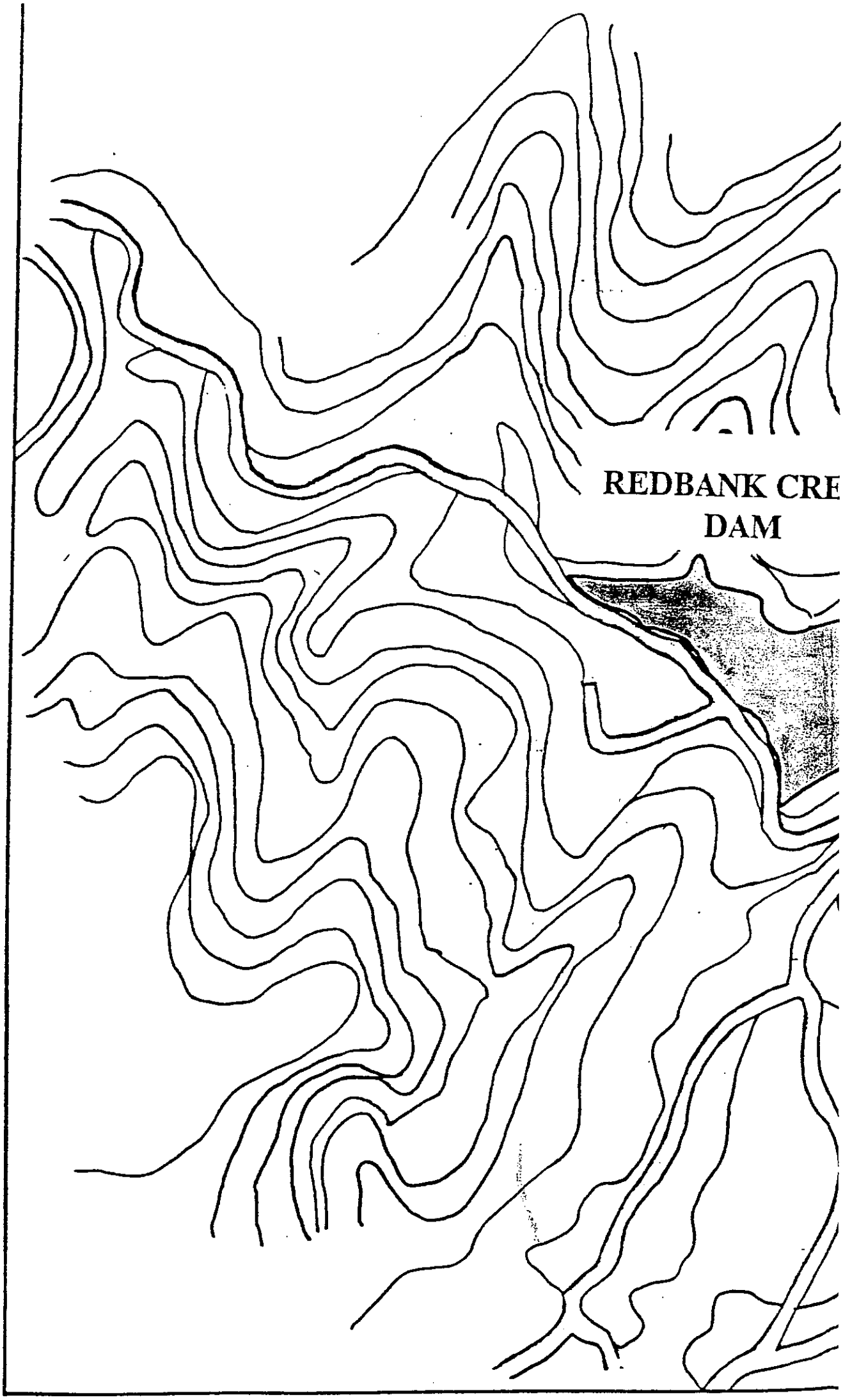
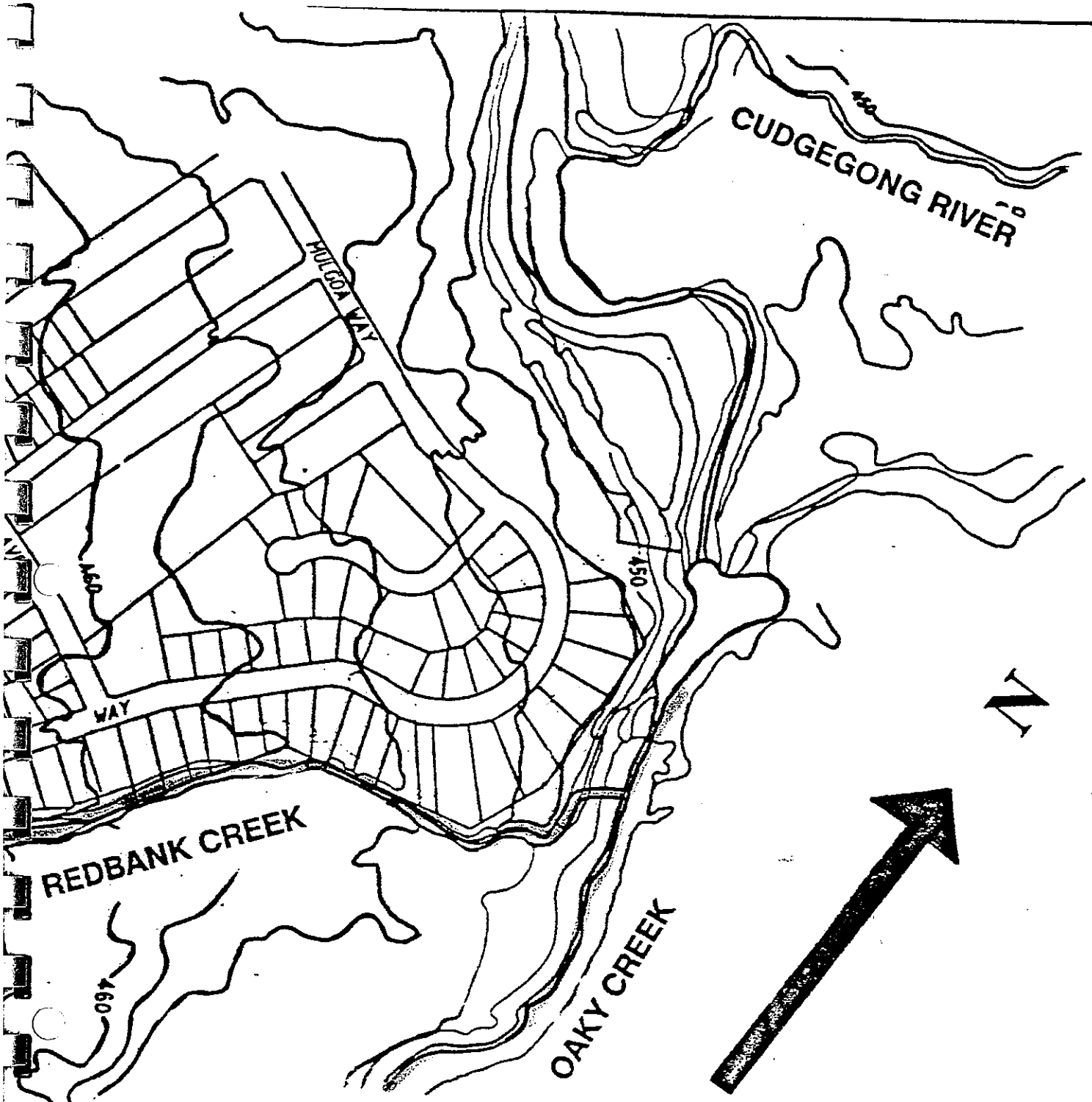

REDBANK CRE
DAM



PUBLIC WORKS DEPARTMENT

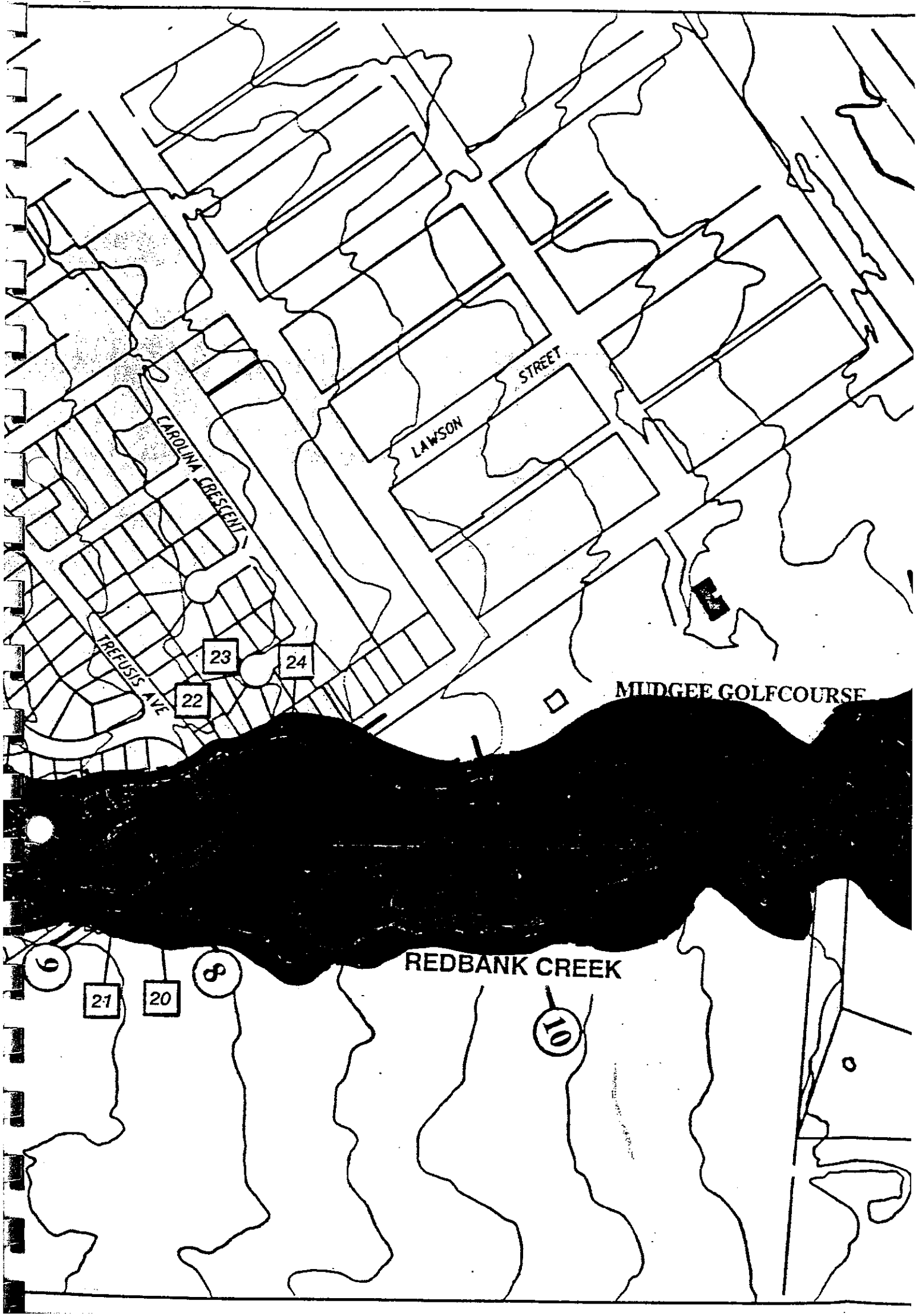
REDBANK CREEK DAMBREAK STUDY

[redacted] and [redacted] TOTAL INUNDATION ENVELOPE

SCALE 1:4 000

EXHIBIT 7

CEDAR
AVE
460
SYDNEY ROAD
MULGOA
WAY
REDBA
460
470
11


LAWSON STREET
CAROLINA CRESCENT
TREFUSIS AVE
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MUDGEE GOLFCOURSE
REDBANK CREEK
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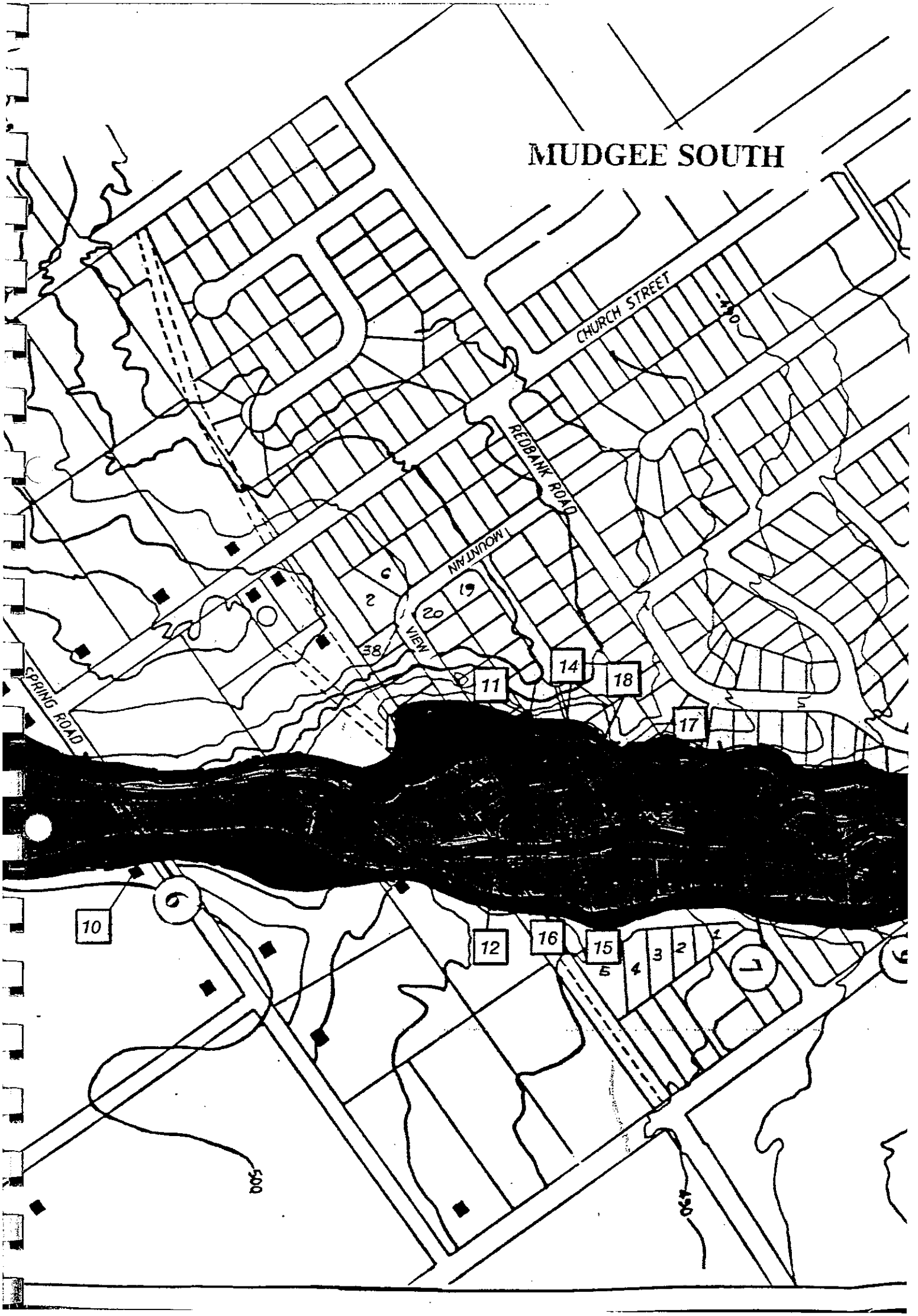
MUDGEE SOUTH
CHURCH STREET
REDBANK ROAD
MOUNT AIN
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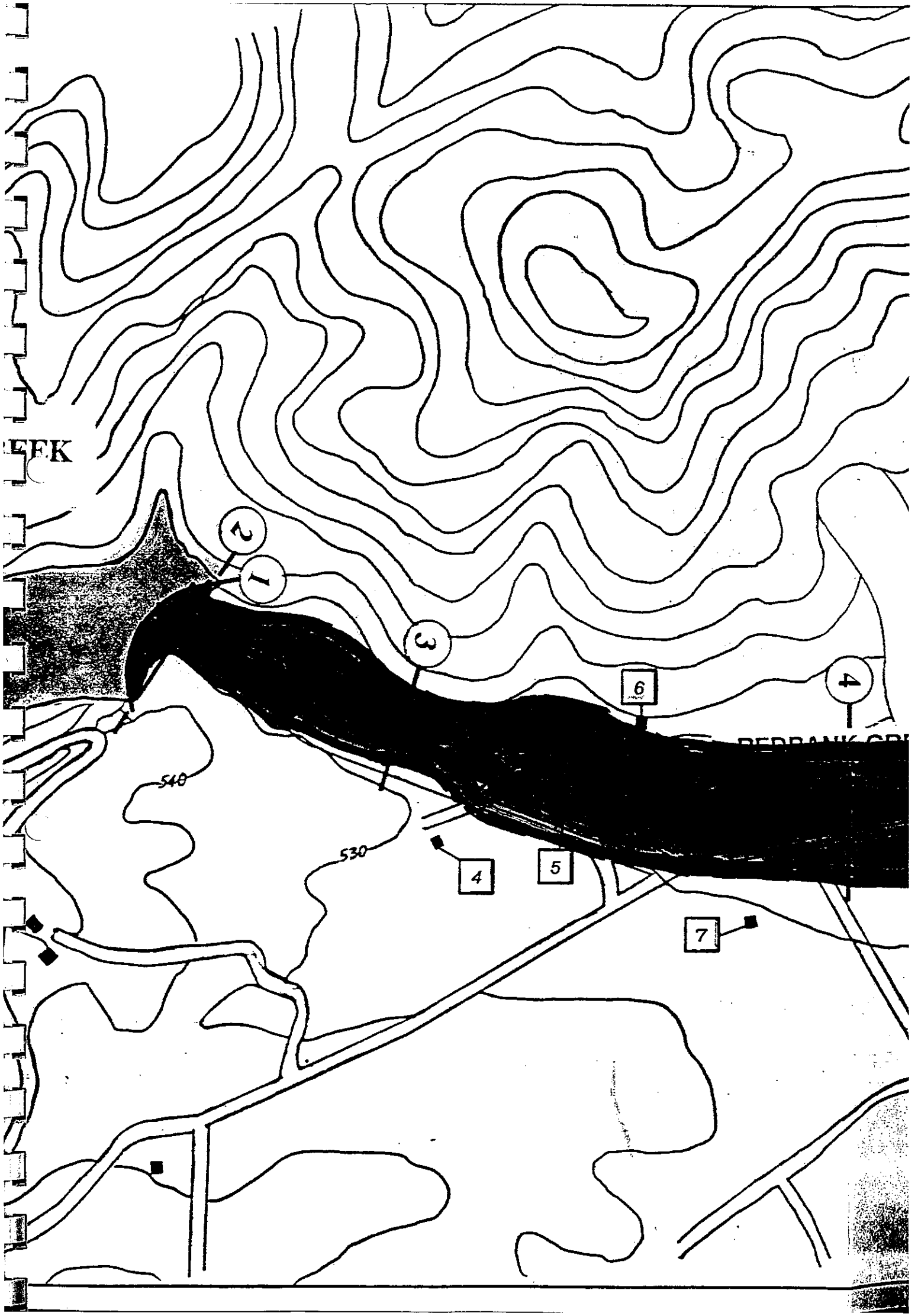
EEK
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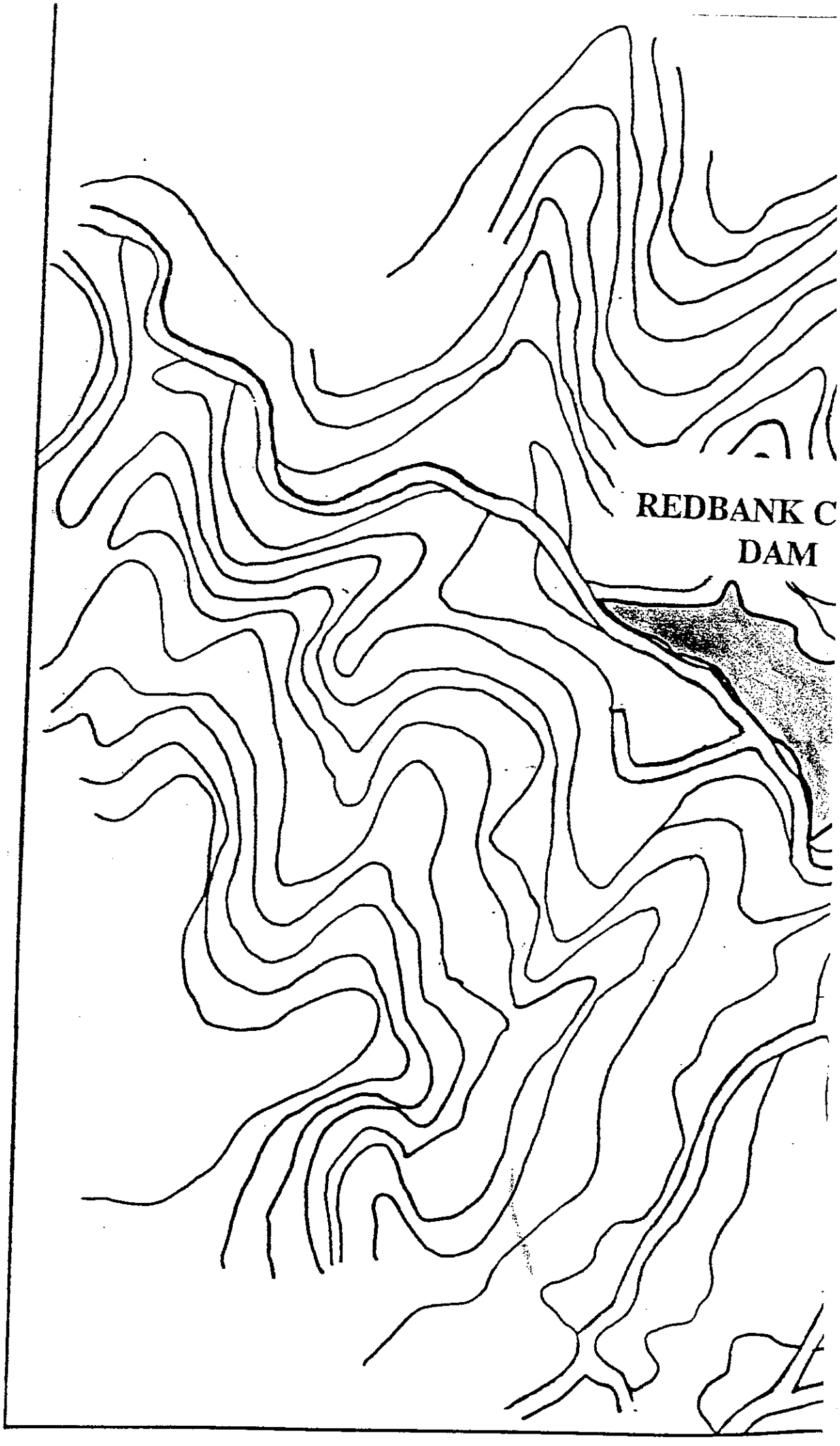
5
7


REDBANK C
DAM

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 1.5 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 inflow and outflow hydrographs are shown in Figure D-1.

Table D-1
Flood Routing Results

Critical PMP (mm)	Storm Duration (Hrs)	PMF		Storage Level @ RL (m AHD)	Time to Peak (Hrs: mins)
		Inflow (m^3/sec)	Outflow (m^3/sec)		
436	1.5	323	326	539.47	1:18

D.2 STORAGE CAPACITY

Redbank Creek Dam has a storage capacity of 180ML at FSL. The dam storage volume versus height relationship for Redbank Creek Dam is shown at **Figure D-3**.

D.3 SPILLWAY RATING CURVE

The Spillway at Redbank Creek Dam is sharp crested. The spillway is 30 m long at the lower sill. A rating curve for the spillway (up to the Dam Crest level) is shown at **Figure D-2**.

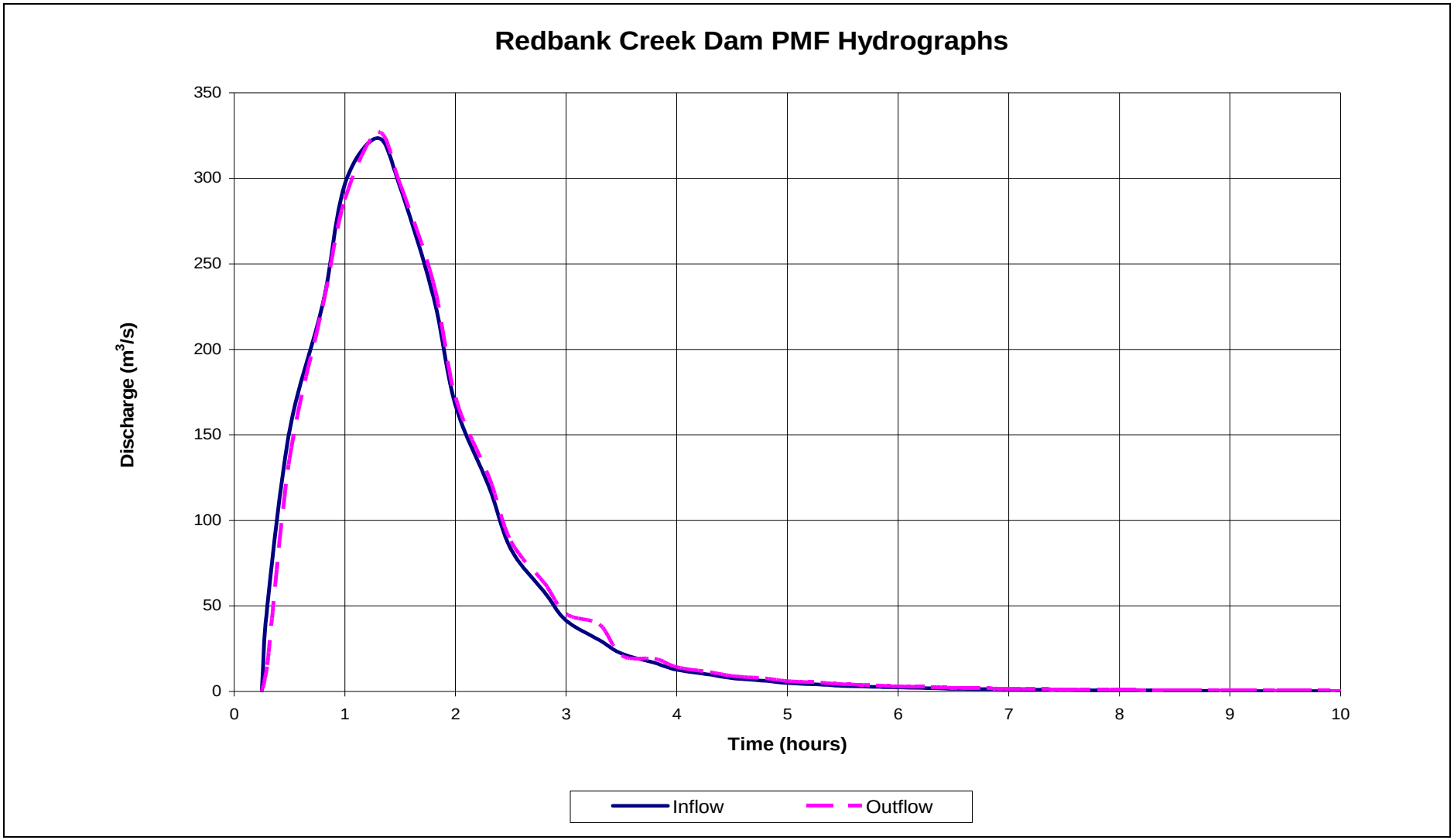


Figure D-1 Redbank Creek Dam**, Inflow/Outflow Hydrograph**

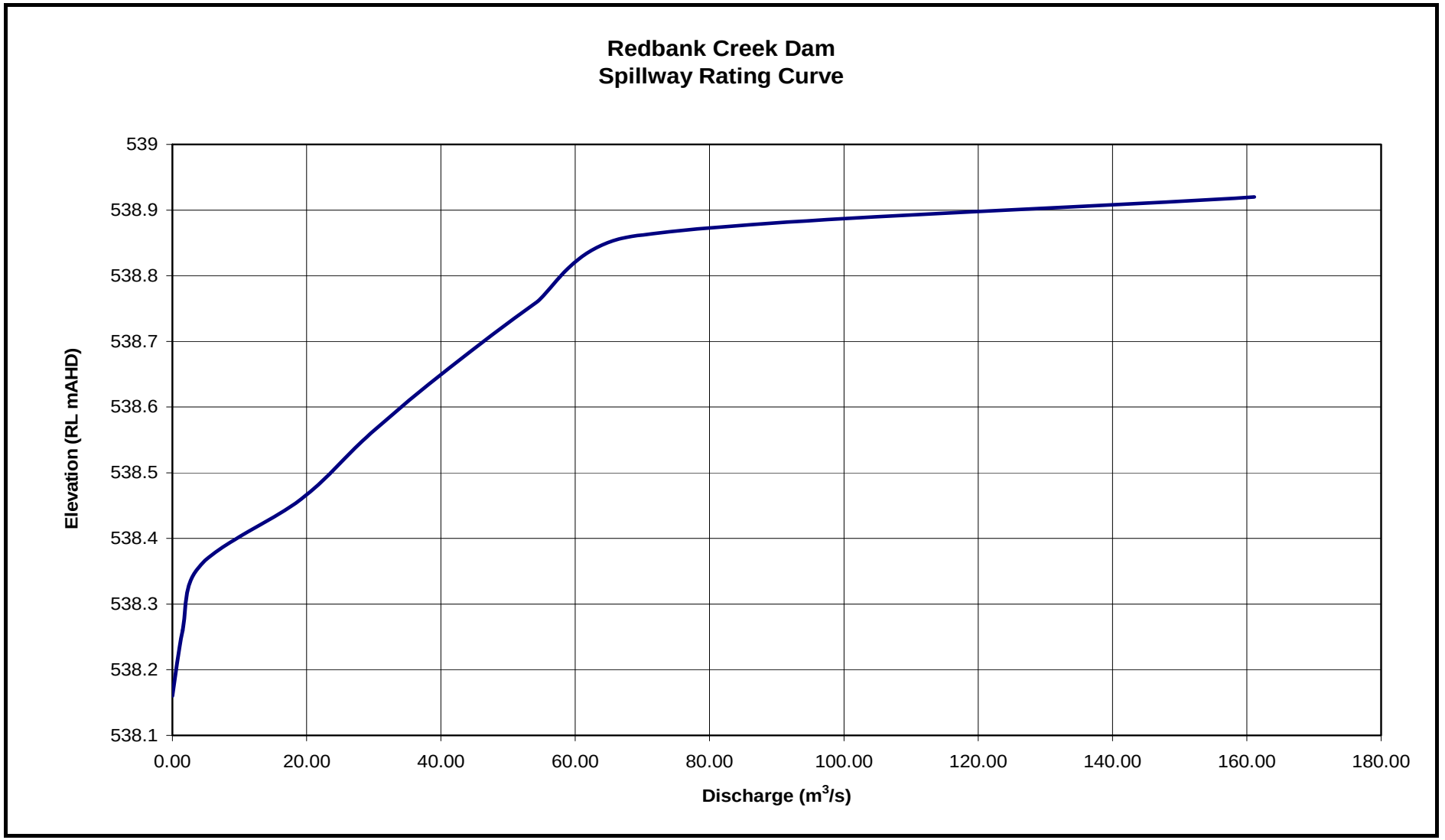


Figure D-2 Redbank Creek Dam **Spillway Rating Curve**

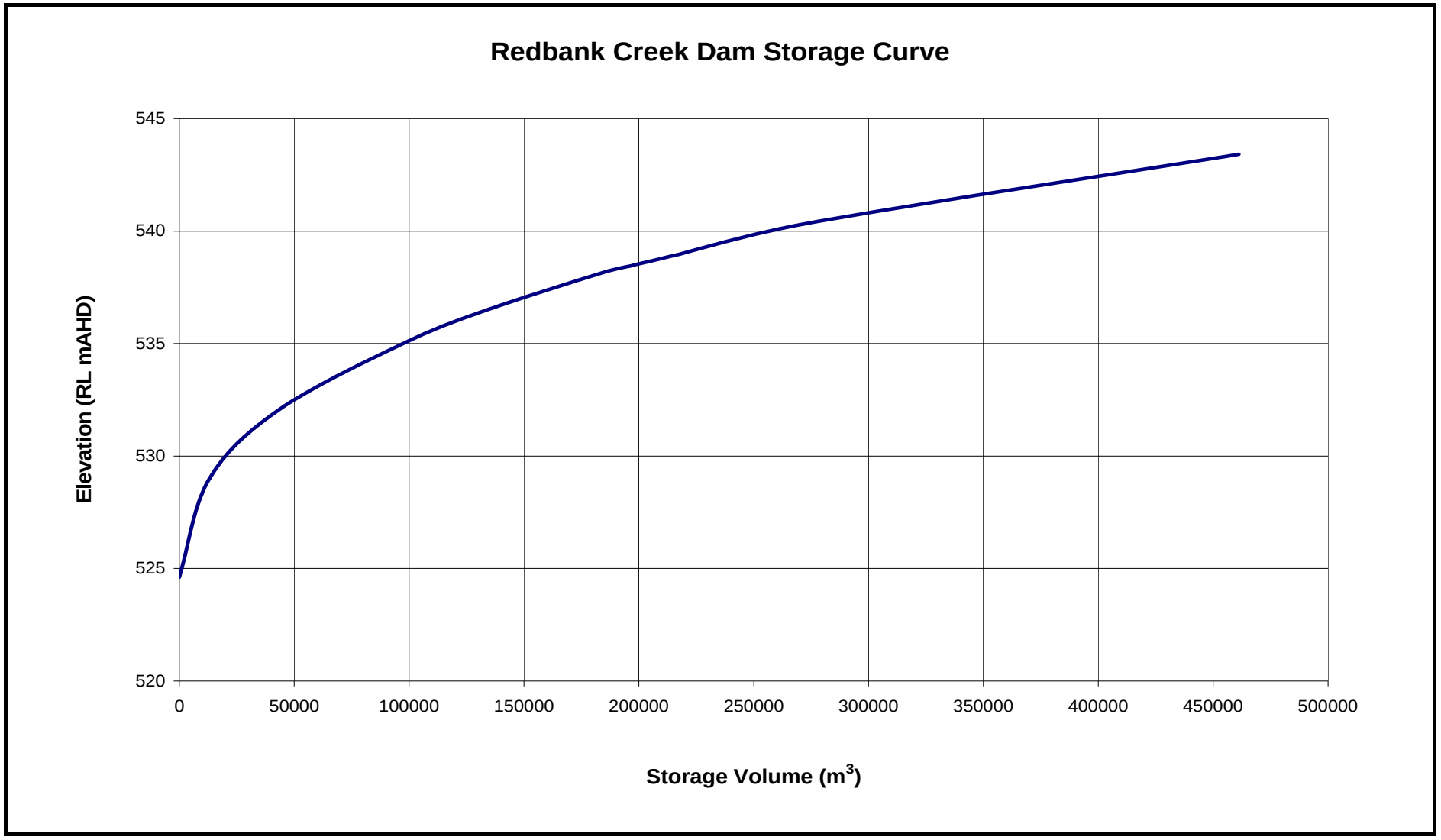


Figure D-3 Redbank Creek Dam **Storage Capacity Curve**

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 Water Supply Manager, to lower the Redbank 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 Redbank Creek Dam consists of a low level scour and a low level water supply outlet. The maximum discharge via the 200mm diameter outlet valve would be up to 50ML per day at normal FSL. It should be noted that this flow may not be safely passed via the valve. A safer limit would be of the order of 25ML/day.

Prior to and during emergency lowering of the storage level, the Water Supply Manager shall keep the DECCW MDS 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 Redbank 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 Redbank 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 Redbank Creek Dam; and

2. Flooding impacts downstream.

E.1.2 **Maximum Possible Releases from** Redbank Creek Dam

The storage level of the dam at the time of any emergency will govern the rate of release at the time of the drawdown. Redbank Creek has two possible mechanisms which can be operated simultaneously. They are:

1. The 200 mm diameter outlet valve and 300 diameter conduit

2. The 600 diameter scour valve

The water supply (outlet system) consists of a 300mm diameter conduit embedded through the dam at RL 525.82 with a valve of approximately 200mm diameter located on the downstream. The upstream is connected to a trunnion swinging arm and screen intake. The trunnion arm and intake have previously been connected to a winch on the dam crest but this winch has now been removed and the trunnion is submerged in the reservoir.

The 200mm valve is no longer connected to the downstream conduit to the town water supply. This valve discharges into the gap left between the downstream conduit and the valve. The valve is currently kept open to keep the reservoir drawn down to a minimum level.

The scour is located at RL 524.26 and consists of a 600mm diameter pipe embedded through the dam with a 600 diameter gate valve at the downstream face. The scour discharges into free space, no stilling basin or other protection works is provided. The scour valve is currently in an unserviceable condition but should be assessed for operation in an emergency condition.

E.1.3 Flooding Impacts Downstream of Redbank Creek Dam

Refer to **Section 4** of main document.

E.1.4 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.1.5** of this document.

Table E-1, below, indicates the number of days required to dewater Redbank Creek Dam from the relevant level assuming there are no inflows into the storage and outlet systems are functioning. Note this could cause minor flooding downstream depending on downstream tributary inflows.

Table E-1
Emergency Dewatering

Storage Level (m AHD)	Dewatering Time, No Inflow (No. of hrs)
538.16	103
536.61	76
535.11	43
532.11	21
529.01	0

Data Source: GHD Redbank Creek Dam DSEP, Draft, July 2002

E.1.5 Emergency Valve Operation

The 200mm diameter outlet valve and the 600mm diameter scour valve are manually operated only. The scour valve has not been operated during recent times and maybe unserviceable. It is recommended that this valve only be operated as a last resort in an emergency situation. The outlet valve is chained and padlocked to prevent unauthorised operation.

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 Redbank 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 Redbank Creek Dam Operations and Maintenance Manual.

c. Contact the DECCW-OW WUB-MDS, for advice.

2. The following assessments should be made by the Water Supply Manager 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 the MDS 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 MDS. The MDS 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 **Table F-1**. The contractor will determine actual suppliers used.

Table F-1
Potential Material and Equipment Suppliers

Organisation	Person/Title	Business Address	Communication Links	After Hours
Material Suppliers				
Furneys Plumbing and Building Supplies			[redacted]	
Mitre 10 Hardware			[redacted]	[redacted]
Bunnings Warehouse			[redacted]	
Equipment Suppliers				
Adrian Ingram Cartage	[redacted]	42 School Lane Mudgee NSW 2850	[redacted]	[redacted]
Andrew Turner Excavations	[redacted]	202 Mortimer Street Mudgee NSW 2850	[redacted]	[redacted]
Countrynet Transport	[redacted]	3 Burrundulla Road Mudge NSW 2850	[redacted]	[redacted]
M.M& R Faucett	[redacted]	36 Cox Street Mudgee NSW 2850	[redacted]	[redacted]
Max Phillips Plant Hire	[redacted]	'Hillview' Edgell Lane	[redacted]	[redacted]

F.2 PLANT/EQUIPMENT LOCATION DURING AN EMERGENCY

In the case of an emergency requiring the implementation of any of the alert levels, plant and equipment required must be moved into the most suitable location above the flood affected area near the dam wall. Plant may include but not limited to bulldozer, crane, excavator and repair material.

F.3 MATERIALS TO BE STORED AT THE SITE

The materials to be stored on the site for an emergency situation are listed in **Table F-2**.

Table F-2
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 **Table F-1**.

APPENDIX G

Standard Forms

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

DATE	TIME	FROM	TO	DISCUSSION	ACTION

Signed: _____ Date: _____ Position: _____

SHEET G-2, Mid-Western Regional Council Redbank Creek Dam
Visual Inspection Report

NAME OF DAM: _____ INSPECTION DATE: _____

CONCRETE/MASONRY DAMS
1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTIGATE	REPAIR
UPSTREAM FACE	84	SURFACE CONDITIONS				
	85	CONDITION OF JOINTS				
	86	UNUSUAL MOVEMENT				
	87	ABUTMENT-DAM CONTACTS				
	88					
	89					
	90	SURFACE CONDITIONS				
DOWNSTREAM FACE	91	CONDITION OF JOINTS				
	92	UNUSUAL MOVEMENT				
	93	ABUTMENT-DAM CONTACTS				
	94	DRAINS				
	95	LEAKAGE				
	96					
	97					
CREST	98	SURFACE CONDITIONS				
	99	HORIZONTAL ALIGNMENT				
		VERTICAL ALIGNMENT				
		CONDITION OF JOINTS				
		UNUSUAL MOVEMENTS				

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

NAME OF DAM: _____ INSPECTION DATE: _____

SPILLWAYS
1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTI-GATE	REPAIR
ERODIBLE CHANNEL	51	SLIDE, SLOUGH, SCARP				
	52	EROSION				
	53	VEGETATION CONDITION				
	54	DEBRIS				
	55					
	56					
NON-ERODIBLE CHANNEL	57	SIDEWALLS				
	58	CHANNEL FLOOR				
	59	UNUSUAL MOVEMENT				
	60	APPROACH AREA				
	61	WEIR OR CONTROL				
	62	DISCHARGE AREA				
	63					
	64					
DROP INLET	65	INTAKE STRUCTURE				
	66	TRASHRACK				
	67	STILLING BASIN				
	68					
	69					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

NAME OF DAM: _____ INSPECTION DATE: _____

DOWNSTREAM AREA AND MISC.

1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTIGATE	REPAIR
DOWNSTREAM AREA	36	ABUTMENT LEAKAGE				
	37	FOUNDATION SEEPAGE				
	38	SLIDE, SLOUGH, SCARP				
	39	DRAINAGE SYSTEM				
	40					
	41					
	42	DOWNSTREAM HAZARD DESCRIPTION				
	43	DATE OF LAST UPDATE OF EMERGENCY ACTION PLAN				
MISCELLANEOUS	44	RESERVOIR SLOPES				
	45	ACCESS ROADS				
	46	SECURITY DEVICES				
	47					
	48					
	49					
	50					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

DAM: _____ INSPECTION DATE: _____

OUTLET WORKS
1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTIGATE	REPAIR
OUTLET WORKS	70	INTAKE STRUCTURE				
	71	TRASHRACK				
	72	STILLING BASIN				
	73	PRIMARY CLOSURE				
	74	SECONDARY CLOSURE				
	75	CONTROL MECHANISM				
	76	OUTLET PIPE				
	77	OUTLET TOWER				
	78	EROSION ALONG DAM TOE				
	79	SEEPAGE				
	80	UNUSUAL MOVEMENT				
	81					
	82					
	83					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

G.1 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 Water Supply Manager.

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 Water Supply Manager 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 Water Supply Manager.

Complete details on Sheet G-5.

THREAT TO WATER SUPPLY
SHEET G-4

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 Water Supply Manager.

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 H

Routine Inspections

H.1 GENERAL

Preparation of an Operations and Maintenance List for Redbank Creek Dam in accordance with the ANCOLD Guidelines and Dam Safety Committee's requirements was recommended in the 2006 Audit Inspection Report and previous surveillance reports.

H.2 REDBANK CREEK DAM **INSTRUMENTATION AND ROUTINE MONITORING**

There is no dam instrumentation monitoring systems installed at Redbank Creek Dam. Council is however, in the process of installing an automatic storage level recorder at the dam with telemetry.

The 2006 Audit Inspection Report has recommended the development of a seepage collection system and installation of a seepage measurement weir near the toe of the dam.

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 according to the following minimum schedule (in accordance with the Australian National Committee on Large Dams Guidelines on Dam Safety Management – ANCOLD 1994).

H.2.1 Seepage Readings

Council should take readings at least twice a week and record these together with rainfall and storage levels. Seepage readings (L/s) should be recorded in a table with storage RL (mAHD) and rainfall (mm) values for each day of the reading on **Sheet G-2** "Visual Inspection Report" Sheet. At the end of each month, values from the table should be plotted on a graph and submitted directly to the DECCW-OW WUD Manager Dam Safety. 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 Mid-Western Regional Council Water Supply Manager is to contact the SES at Mudgee Regional Headquarters. Mid-Western Regional Council should then contact the MDS 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.

H.2.2 Rainfall and Storage

Rainfall records as well as storage water level records should also be entered in the format of **Sheet G-2** "Visual Inspection Report" Sheet and should be summarised annually.

H.2.3 Survey Readings

Surveys of the dam should be carried out every 2 years and "control "surveys should be carried out every 5 years. Results of future surveys should be submitted to MDS for review.

H.2.4 Routine Visual Inspections

Mid-Western Regional Council operation and maintenance staff currently visit Redbank Creek Dam twice a week, carrying out a brief inspection of the dam. This frequency is in accordance to with ANCOLD Guidelines for a High C hazard dam. No formal inspection sheets exist for the dam to record results of Councils routine inspections.

The Water Supply Manager should review and sign off reports of standard routine inspections. The inspection form should be stored in a secure place for reference and review by MDS engineers at future audits.

The operator should carry out the following tasks:

- Fill out inspection pro-forma at every routine inspection, at least twice a week.
- At each inspection, collect and record monitoring data such as rainfall, reservoir levels, seepage and turbidity
- Sign off and date each inspection form and submit a monthly summary with attached routine inspection forms to the Water Supply Manager for review and signature.
- Report any "other than normal observations" immediately to the Water Supply Manager for resolution/advice.

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.	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 Water Supply Manager should carry out the following tasks:

- Review and sign off the monthly summary sheet
- Review all monitoring data and prepare plots of the data on Microsoft EXCEL Spreadsheet every month
- Submit plots of readings on Microsoft EXCEL spreadsheet together with the raw data to DECCW on monthly intervals
- Attend all future DECCW Annual Audit Inspections on the dam

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 H.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 I-1**, of this document. If any of the observations discussed under **Table I-1** are evident then the relevant emergency alert is to be initiated by the Water Supply Manager.

H.2.5 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 Mid-Western Regional Council Water Supply Manager. A copy of the report is to be submitted at the same time to the DECCW-OW WUB-MDS, 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**).

H.3 EARTH TREMOR/EARTHQUAKE EMERGENCY PROCEDURES

H.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 Mudgee area. Refer to the attached description of the Modified Mercalli Scale in **Table H-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)

H.3.2 If the Tremor is LESS than MM4

Carry out a full inspection in accordance with the Redbank 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 and piezometers levels. Note any pronounced changes in the rate of flow and colour of seepage water - both increases or decreases from the normally recorded values.

If the inspection finds some changes due to the tremor, notify the DECCW-OW WUB-MDS immediately. If there is no effect from the tremor, notify them of its occurrence at the next convenient opportunity.

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

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

Table H-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 Mudgee 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 Redbank 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 Redbank 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 WUB-MDS. If no changes are found notify them at the conclusion of inspection. 7. Notify Mudgee 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 cracks • Seepage through joints and cracks • Seepage through abutments • Major cracks in concrete structures • Major movement of outlet works	Activate Emergency Response **Red Alert** Procedure.
3 (operator*)	Visible damage has occurred but is not	1. Activate **White Alert**. 2. Quickly observe nature, location and extent of damage -

Step No. (personnel)	Description	Action
	serious enough to cause immediate failure of the concrete arch dam.	document and photographs relevant items such as depth and openness of cracks, reservoir level, mechanical function, etc. 3. Report all information to the relevant Mid-Western Regional 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 WUB – MDS. 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. Report all findings to the WUB-MDS.
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;

Step No. (personnel)	Description	Action
		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; 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 DECCW-OW WUB-MDS.

Table H-2
Modified Mercalli Intensity Scale

Average Peak Velocity (cm/s)	Value Description (MM)	Intensity	Average Peak Acceleration (g = 9.8 m/s^2)	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 H-2 continued

Average Peak Velocity (cm/s)	Value Description (MM)	Intensity	Average Peak Acceleration (g = 9.8 m/s^2)	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.		

H.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

H.4.1 Hydraulic Deficiencies

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

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

H.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.

H.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 I

Dam Failure Indicators

I.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 I-1** below.

Table I-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 J

Emergency Remedial Measures

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

J.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

J.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.

J.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.

J.1.3 Modifying Operational Procedures

For abutment and reservoir rim slope instability problems, it maybe 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.

J.1.4 Buttressing 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.

J.1.5 Other Actions

In the event of a rapidly deteriorating structural deficiency which is likely to threaten the security of Redbank Creek Dam (as per **Section 2** Notification Flow Charts and **Section 3** Actions, Responsibilities & Communications Directories), Redbank 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 K

Notification Procedures

K.1 NOTIFICATION PROCEDURES FOR FLOODING CONDITIONS

K.1.1 Flood Response

If a storage level of RL 538.16, RL 538.66m or RL 539.1 mAHD is reached then preparations for either a **White**, **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 Redbank Creek Dam Staff, keeping the Water Supply Manager, the DECCW-OW WUB-MDS and the 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.

K.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 538.16 mAHD (at FSL). The emergency situation should be reported to the member of Mid-Western Regional Council Staff first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Mid-Western Regional Council Staff should contact the following in the order listed:

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

2. WUB-MDS or DSE. The MDS or DSE is to arrange inspections and make plans, in consultation with Mid-Western Regional Council, for remedial action as necessary.

Additionally, Mid-Western Regional Council Staff should:

- Monitor the condition of the dam.

- Maintain contact with SES, DECCW and DSC.

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

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

A member of Mid-Western Regional 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 538.66 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 538.66 mAHD (greater than 0.5m above the FSL). The emergency situation should be reported to the member of Mid-Western Regional Council Staff first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Mid-Western Regional Council Staff should contact the following in the order listed:

1. NSW SES State Headquarters, SOCC (or if unavailable contact NSW Police Duty Officer). The SES/Police shall activate procedures as per **SES Flow Chart No.1**.

2. DECCW-OW WUB-MDS or DSE:

    - Arranges inspections and make plans, in consultation with Mid-Western Regional Council, for remedial action as necessary.

    - Informs WUB Director.

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

This member of Mid-Western Regional Council Staff should also:

- Monitor the condition of the dam.

- Maintain contact with SES, DECCW-OC and DSC.

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

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

A member of Mid-Western Regional 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 539.1 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 539.1 mAHD (greater than 0.94m above the FSL). The emergency situation should be reported to the member of Mid-Western Regional Council Staff first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Mid-Western Regional Council Staff should contact the following in the order listed:

1. NSW SES State Headquarters SOCC (or if unavailable contact NSW Police Duty Officer). The SES/Police shall activate procedures as per **SES Flow Chart No.1**.

2. DECCW-OW WUB-MDS or DSE:

    - Arranges inspections and make plans, in consultation with Mid-Western Regional Council, for remedial action as necessary.

    - Informs the WUB Director who will inform the DECCW Director General/Minister for Water.

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

The WUB-MDS or DSE should contact the following in the order listed:

1. WUB Director who will contact the DECCW Director General and Minister for Water.

2. DSTA, Dams & Civil Unit for technical support.

The DSC Executive Engineer should contact the DSC Chairperson and the Minister of Climate Change, Environment & Water.

A member of Mid-Western Regional Council Staff should also:

- Monitor the condition of the dam.

- Maintain contact with SES, DECCW-OW and DSC.

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

A member of Mid-Western Regional Council Staff should continue to monitor the depth of flow over the spillway *hourly*, 24 hours a day.

The member of Mid-Western Regional Council Staff will regularly advise the Mudgee SES Region of developments, following the initial alarm. Mid-Western Regional 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 SES or the Police Media Liaison Unit.

K.2 EARTHQUAKE CONDITIONS

K.2.1 Earthquake Response

If a tremor is felt or if notified by the *Environmental System & Services* (previously the Seismology Research Centre) that a tremor has been detected in the area by the Centre's instruments, the earthquake should be reported to the member of Mid-Western Regional 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 Mid-Western Regional 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 H-1.**

K.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

Mid-Western Regional 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, Mid-Western Regional Council staff should contact WUB-MDS and together discuss/review the results of the inspection made. If no change is detected, MDS should again be notified for recording purposes. A follow-up inspection within the next 24 hours is to be carried out by Mid-Western Regional 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 H-1**, "Post Earthquake Response Procedures" and Mercalli Intensity Scale (Refer to **Appendix H** or **Table 3-1** for Scale), the relevant member of Mid-Western Regional 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 Mid-Western Regional Council Staff that is first available as listed in **Section 8 - Organisational Responsibilities**.

This member of Mid-Western Regional Council Staff should:

- Monitor the condition of the dam for 24 hours after last "after shock".
- Contact with the WUB-MDS or DSE and advise of any problem or unusual incident that poses a potential risk to the dam.

The MDS or DSE will assess the situation and in conjunction with the Water Supply Manager will arrange any necessary inspections and works at the dam. The MDS or DSE will inform the DSTA, Dams & Civil Unit for technical support, as required.

A member of Mid-Western Regional 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 Mid-Western Regional Council finds that the situation is more dangerous than was initially assessed, and it presents a risk of imminent dam failure, the Water Supply Manager 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 Mid-Western Regional Council Staff should contact the following in the order listed:

1. NSW SES State Headquarters, SOCC (or if unavailable contact NSW Police Duty Officer). The SES/Police shall activate procedures as per **SES Flow Chart No.1**.

2. WUB-MDS or DSE. The MDS is to arrange inspections and make plans, in consultation with Mid-Western Regional Council, for remedial action as necessary.

3. DSC Executive Engineer.

After contacting the SES and MDS, Mid-Western Regional Council Staff should continuously inspect the site for at least 24 hours, at *3 hourly* intervals.

The WUB-MDS should contact the following in the order listed:

1. WUB Director, who will contact the DECCW Director General and Minister for Water.

2. DSTA, Dams and Civil Section for technical support.

The DSC Executive Engineer should contact the DSC Chairperson and the Minister of Climate Change, Environment & Water.

The member of Mid-Western Regional Council Staff will regularly advise the SES of developments, following the initial alarm. Mid-Western Regional 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 SES or the Police Media Liaison Unit.

K.3 OTHER THAN FLOOD OR EARTHQUAKE CONDITIONS

K.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 G.1**.

K.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:

- Mid-Western Regional Council Staff must **immediately** inform Mudgee Police or NSW Police (DOI) of threat.

- Carry out **immediate** inspection of the dam **ONLY** when "all clear" received from NSW Police. The relevant member of Mid-Western Regional 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 Mid-Western Regional Council Staff inspects the Dam and considers there is NO damage to structure, the Staff member must then contact the WUB MDS or DSE.

White Alert

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

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

Red Alert

The member of Mid-Western Regional Council Staff should contact the following in the order listed:

1. NSW SES State Headquarters, SOCC (or if unavailable contact NSW Police Duty Officer). The SES/Police shall activate procedures as per **SES Flow Chart No.1**.

2. WUB-MDS or DSE. The MDS is to arrange inspections and make plans, in consultation with Mid-Western Regional Council, for remedial action as necessary.

3. DSC Executive Engineer.

The WUB-MDS should contact the following in the order listed:

1. WUD Director who will contact the DECCW Director General and Minister for Water.

2. DSTA, Dams & Civil Unit for technical support.

The DSC Executive Engineer should contact the DSC Chairperson and the Minister of Climate Change, Environment & Water.

The member of Mid-Western Regional Council Staff will regularly advise the Mudgee SES Region of developments, following the initial alarm. Mid-Western Regional 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 SES or the Police Media Liaison Unit.

APPENDIX L

Training, Review and Document Control

L.1 TRAINING, REVIEW AND DOCUMENT CONTROL

L.1.1 Document Control

This Emergency Plan is registered as a controlled document with the Department of Services, Technology and Administration, Dams & Civil Unit, the Master Manual is with Mid-Western Regional Council, Mudgee. The details are:

Document Author: Department of Services, Technology and Administration, Dams & Civil Unit

Document ID No.: DC09096

Document Title: Dam Safety Emergency Plan for Redbank Creek Dam

Document Approver: Water Supply Manager, Mid-Western Regional Council

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

The responsible officer for the document is the Water Supply Manager, Mid-Western Regional 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 Redbank 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.

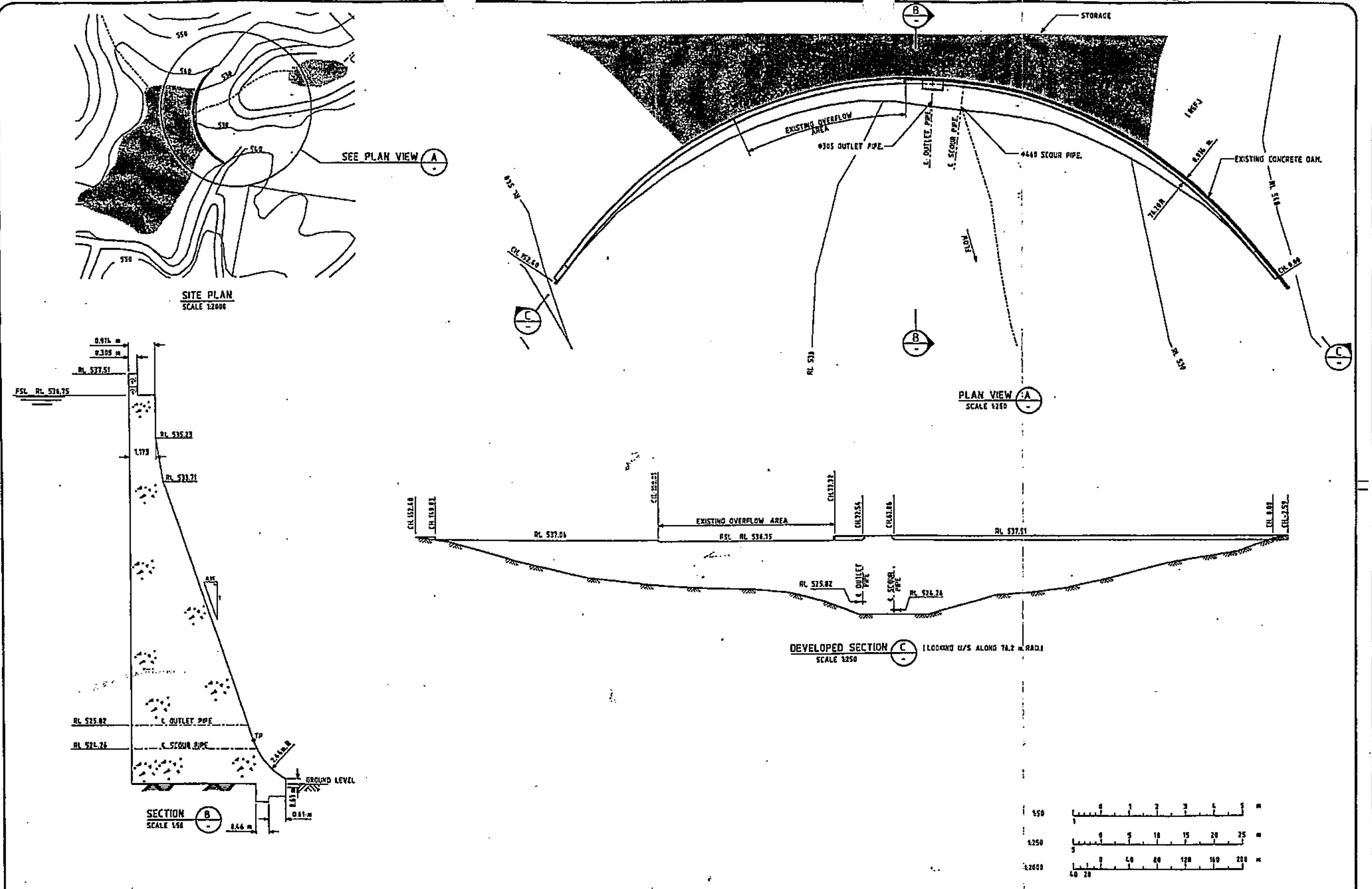
L.1.2 Training

Council have in the past organised relevant personnel involved in the operations and maintenance of the dam to attend training in Dam Safety Surveillance.

As recommended in the 2006 Audit Inspection report for Redbank Creek Dam by DWE, **ALL** council engineers and personnel involved in the day to day operation, maintenance and monitoring 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 M

DRAWINGS



	DETAILS OF AMENDMENTS	APPROVED DATE

DPWS Dams Projects
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PREPARED / TRACED / EXAMINED — SURVEYOR

DESIGNED: S.M.COOPER, S.E.DAMS & CIVIL
DRAWN: P.KEAYTER, P.E.DAMS & CIVIL
CHECKED

Director-General
Department of Public Works and Services, N.S.W.

REDBANK CREEK DAM

EXISTING DAM LAYOUT

FILE
DRAWING NO. 97-C73E-00

j:/13w_dams/pcad/redbank/redbnk00. Jul. 29, 1997 12:15:39