

Emergency Action Plan

WIVENHOE POWER STATION

SPLITYARD CREEK DAM

T - MISC - 149

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1. CONTROLLED COPY DISTRIBUTION SHEET

COPY NUMBER	POSITION	LOCATION
1	Operations Manager	Wivenhoe Power Station
2	Operations Room, Units 1 & 2	Tarong Power Station
3	Operations Room, Units 3 & 4	Tarong Power Station
4	Manager, Asset Strategy	Tarong Energy, 42 Albert St., Bris
5	Director, Dam Safety	Dept. of Environment & Resource Management, WIC, Mineral House, George & Margaret Sts, Brisbane
6	Disaster District Coordinator	Ipswich District Police Headquarters
7	Officer in Charge Police	Lowood
8	SES Controller	Somerset Regional Council
9	Executive Director, State Disaster Coordination Centre, Emergency Management Queensland	Cnr. Park Rd. and Kedron Park Rd, Kedron, Brisbane
10	Regional Director South East Region	32 Tansey Street, Beenleigh
11	Senior Engineer Headworks Assessment Infrastructure Management	Sun Water Asset Solutions, 10/179 Turbot St, Brisbane PO Box 15536 City East Brisbane

2. DOCUMENT CONTROL SHEET

CONTROLLED COPY NUMBER: ____

Document Management: This manual forms part of Tarong Energy's Quality Assurance System. The management, revision and distribution control of this manual shall be controlled in accordance with Tarong Energy's Corporate Business Procedure GOV-PROC-01 — TP3 Management.

AUTHORISATION:

Managed by: _____ Date: _____
(Wivenhoe Power Station Manager)

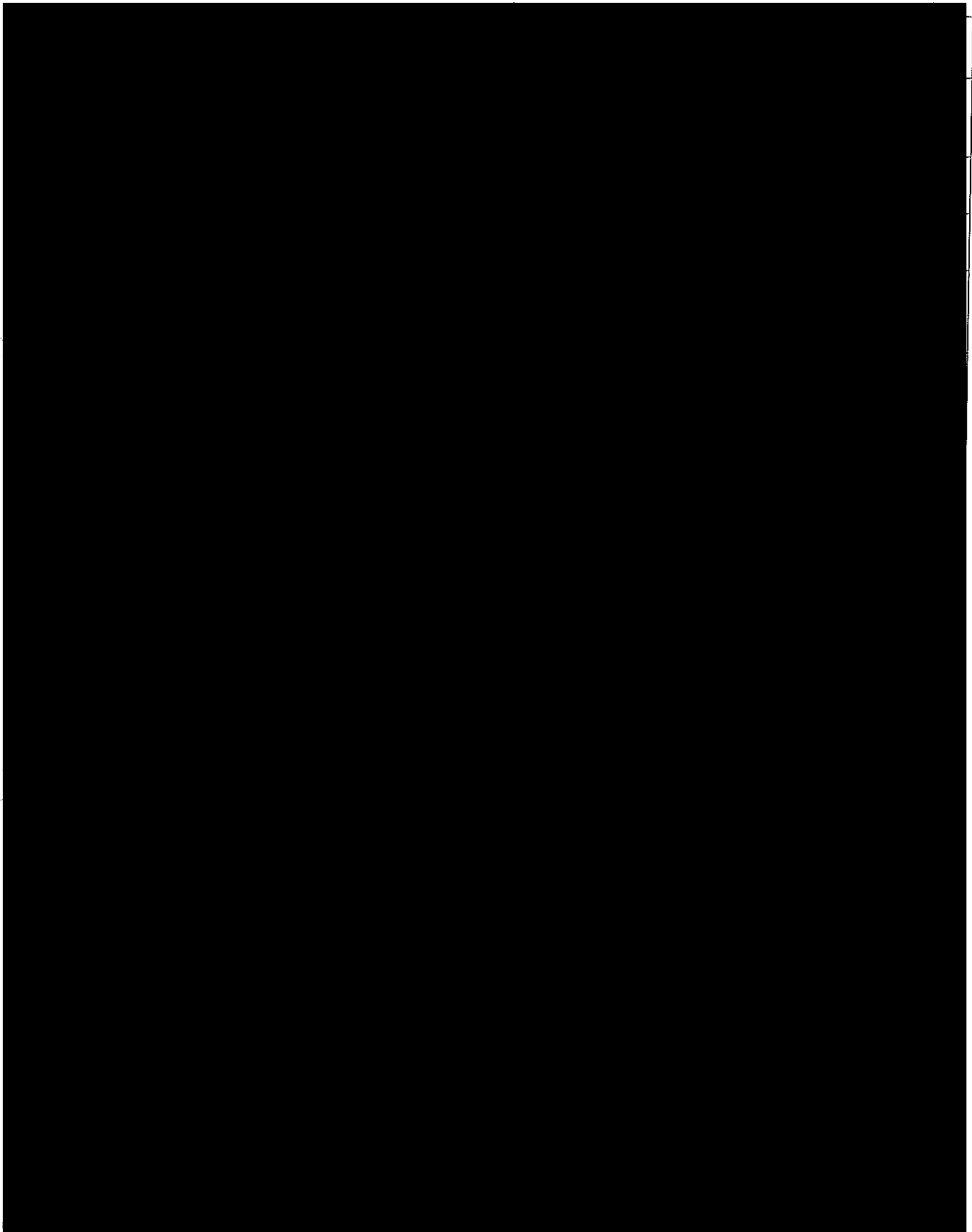
Approved by: _____ Date: _____
(Operations Manager, Tarong Energy)

This Emergency Action Plan was originally prepared by Engineering Services, Sun Water, for Tarong Energy

REVISION STATUS:

Revision Number	Revision Description	Revision Date
1	Initial Issue	19.01.2001
2	Revision Pt1, Pt2, Pt4, Pt6	20.02.2002
3	Notification list revised and formatting	26.03.2003
4	Document completely revised various changes made.	08.04.2008
5	Document revised various changes made.	10.11.2010

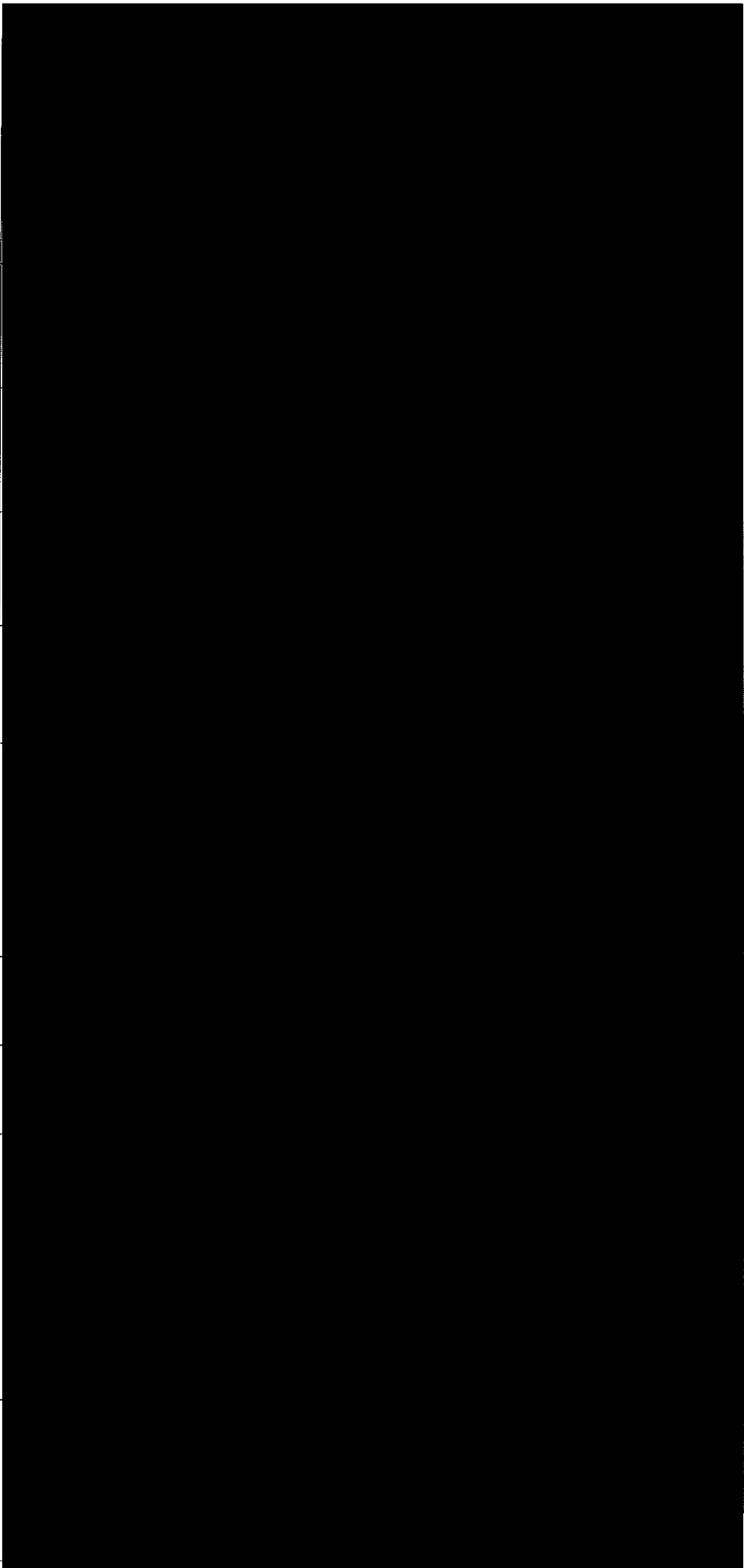
3. TELEPHONE NOTIFICATION LIST





SPLITYARD CREEK - EMERGENCY ACTION PLAN

4. REGISTER - CONTACT LIST FOR EMERGENCIES AND FLOOD INFORMATION - SPLITYARD CREEK DAM





SPLITYARD CREEK - EMERGENCY ACTION PLAN

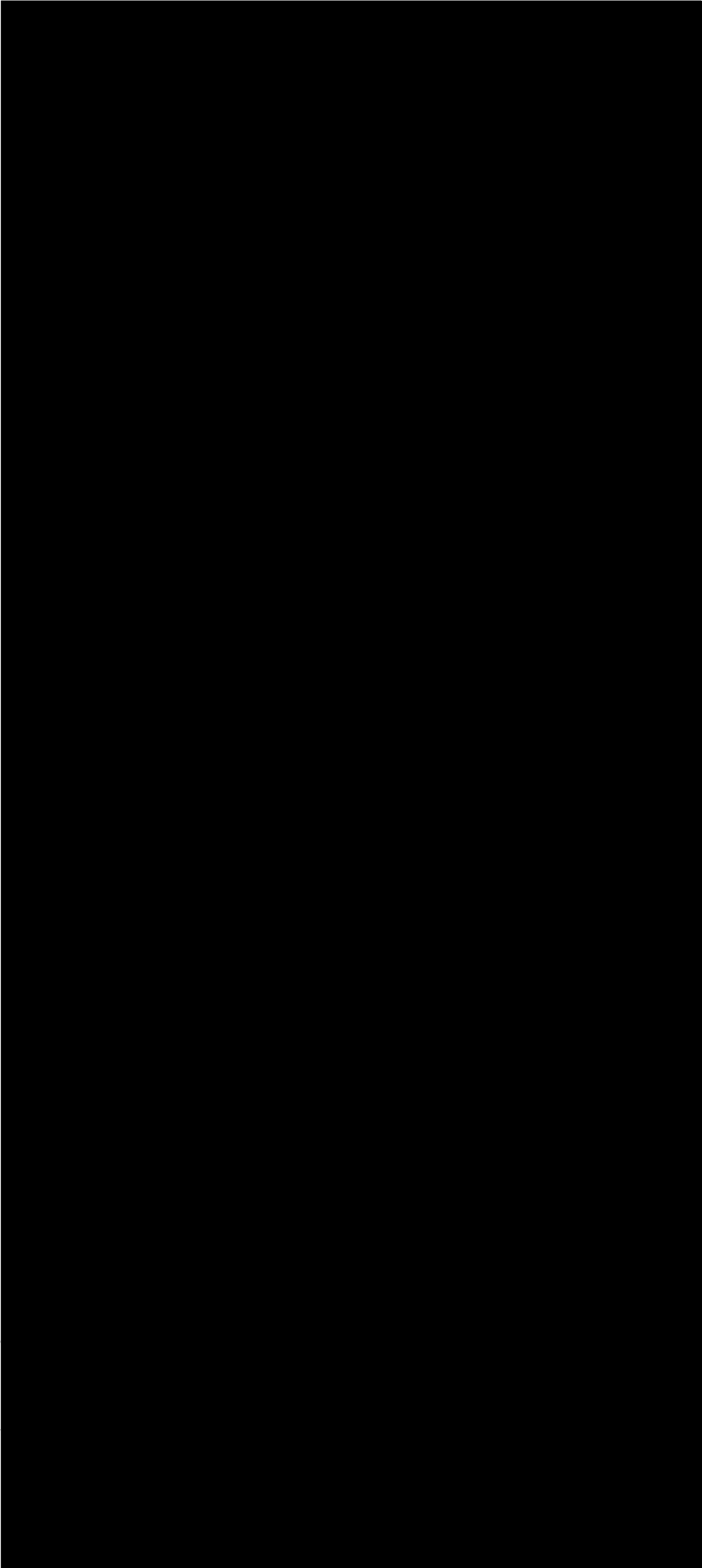
4. REGISTER - CONTACT LIST FOR EMERGENCIES AND FLOOD INFORMATION - SPLITYARD CREEK DAM (cont'd)

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SPLITYARD CREEK - EMERGENCY ACTION PLAN

4. REGISTER - CONTACT LIST FOR EMERGENCIES AND FLOOD INFORMATION - SPLITYARD CREEK DAM (cont'd)





SPLITYARD CREEK - EMERGENCY ACTION PLAN

4. REGISTER - CONTACT LIST FOR EMERGENCIES AND FLOOD INFORMATION - SPLITYARD CREEK DAM (cont'd)

Agency	Position	Working Hrs Priority	Out of Hrs Priority	Name	Work Ph	Fax	Pager	Mobile	After Hrs	Contacted By
Ambulance					000					TEC/FCC
<p>1. Contact with an agency is to be made via position with highest priority. That person contacted is then responsible to forward notification to other relevant persons within the agency</p> <p>2. * = contact person nominated by agency as contact point for amendments</p> <p>3. Updated register to be issued to holders of controlled copies of Emergency Action Plan as well as contact person nominated by agency as contact point for receipt of updated register (indicated by *)</p>										
<p>Notes:</p> <p>FCC Flood Control Centre (for issue of Flood Information only)</p> <p>SEQWater South East Queensland Water Corporation</p> <p>TEC Tarong Energy Corporation</p>										

5. EMERGENCY EVENTS AND ACTIONS**EVENT**

- ☹ DESCRIPTION OF SITUATIONS
- ✓ ACTION

- ☹ Storage at Full Supply Level of EL 166.50 AHD

Earthquake felt in the area - Trigger level - ask SEQWater (refer to section 3 of this EAP)

During normal work hours, the Manager Hydro, Wivenhoe Power Station shall:

- ✓ Immediately inspect the downstream face of the Dam for damage, particularly for **slumps** and **springs**
- ✓ Inspect the Outlet Works Tunnel for water leakage
- ✓ *Record all Actions and Communications on the Log of Events /Actions and Record of Communications Sheets included in Appendix 7 of this EAP*
- ✓ If any **springs** or **water flows** through the Dam are observed, immediately notify in order:
 - The Downstream Landholders (Refer to Appendix 1 of this EAP)
Advise to evacuate as a precautionary measure
 - The Disaster District Coordinator, Ipswich (refer to section 3 of this EAP)
 - The Lowood Police (refer to section 3 of this EAP)
 - SES Controller, Somerset Regional Council (refer to section 4 of this EAP)
 - The Manager, Asset Strategy, Tarong Energy (refer to section 3 of this EAP)
 - The Director, Dam Safety, (Water Supply), (refer to section 3 of this EAP)
 - Department of Water & Resource Management (refer to section 4 of this EAP)
- ✓ Continuously monitor the flow through the Dam, and if any increase in flow is observed, go to the next scenario listed below

5. EMERGENCY EVENTS AND ACTIONS (cont'd)

EVENT

- ☹ DESCRIPTION OF SITUATIONS
- ✓ ACTION

Emergency Situation has developed or is developing (cont'd)

☹ Increasing Leakage through the Embankment

The Manager Hydro (Wivenhoe Power Station), shall:

Record all Communications and Events on the Record Sheets in Appendix 7

- ✓ Report observations immediately to:
 - The Disaster District Coordinator, Ipswich Police (refer to section 3 of this EAP)
 - The Lowood Police (refer to section 3 of this EAP)
 - Residents close downstream of the Dam who are listed in Appendix 1 of this EAP

Advise to evacuate immediately

- The Manager, Asset Strategy Tarong Energy (refer to section 3 of this EAP)
- Director, Dam Safety (Water Supply) (refer to section 3 of this EAP)
- Department of Water & Resource Management (refer to section 4 of this EAP)
- ✓ Monitor the flows continuously and if a rapidly increasing trend is observable, initiate the next action plan for "**Large Increasing Flows**" listed below
- ✓ After the Event, compile an Emergency Event Report and forward unedited copies to the Chief Executive Officer, Tarong Energy, and the Director, Dam Safety, Department of Water & Resources Management

☹ Large Increasing Flows through the Embankment with cloudy water

The Manager Hydro, (Wivenhoe Power Station), shall:

Record all Communications on the Record Sheets in Appendix 7 of this EAP

- ✓ Notify the Disaster District Coordinator Ipswich Police (refer to section 3 of this EAP)
- ✓ Notify the Lowood Police (refer to section 3 of this EAP) and the Counter Disaster Executive Officer, Somerset Regional Council, (refer to section 3 of this EAP), maintain contact, and report the status frequently

5. EMERGENCY EVENTS AND ACTIONS (cont'd)**EVENT**

- ☹ **DESCRIPTION OF SITUATIONS**
- ✓ **ACTION**

Emergency Situation has developed or is developing (cont'd)

- ☹ **Large Increasing Flows through the Embankment with Cloudy Water (cont'd)**
 - ✓ Notify all other contacts in the lists contained in section 4 of this EAP
 - ✓ Monitor the flows continuously and report the progress of the Event to the Disaster District Coordinator, Ipswich Police as frequently as requested (refer to section 3 of this EAP)
 - ✓ After the Event, compile an Emergency Event Report, and forward unedited copies to the Chief Executive Officer, Tarong Energy, and the Director, Dam Safety, (Water Supply) Water Industry Compliance, Department of Water & Resource Management (refer to section 3 of this EAP)

- ☹ **Storage at Full Supply Level of EL166.50 AHD**

Earthquake reported felt in the Area

Outside of normal Working hours, the Shift Coordinator at Tarong Power Station, on becoming aware of a reported earthquake, shall:

- ✓ Contact the Hydro Duty Officer, Wivenhoe Power Station, on the Mobile number and request an immediate inspection be made of the Dam Embankment (refer to section 3 of this EAP)
- ✓ Monitor the Storage level recorder and advise the Manager Hydro if a falling Storage Level trend is noticeable

The Manager Hydro (Wivenhoe Power Station) shall:

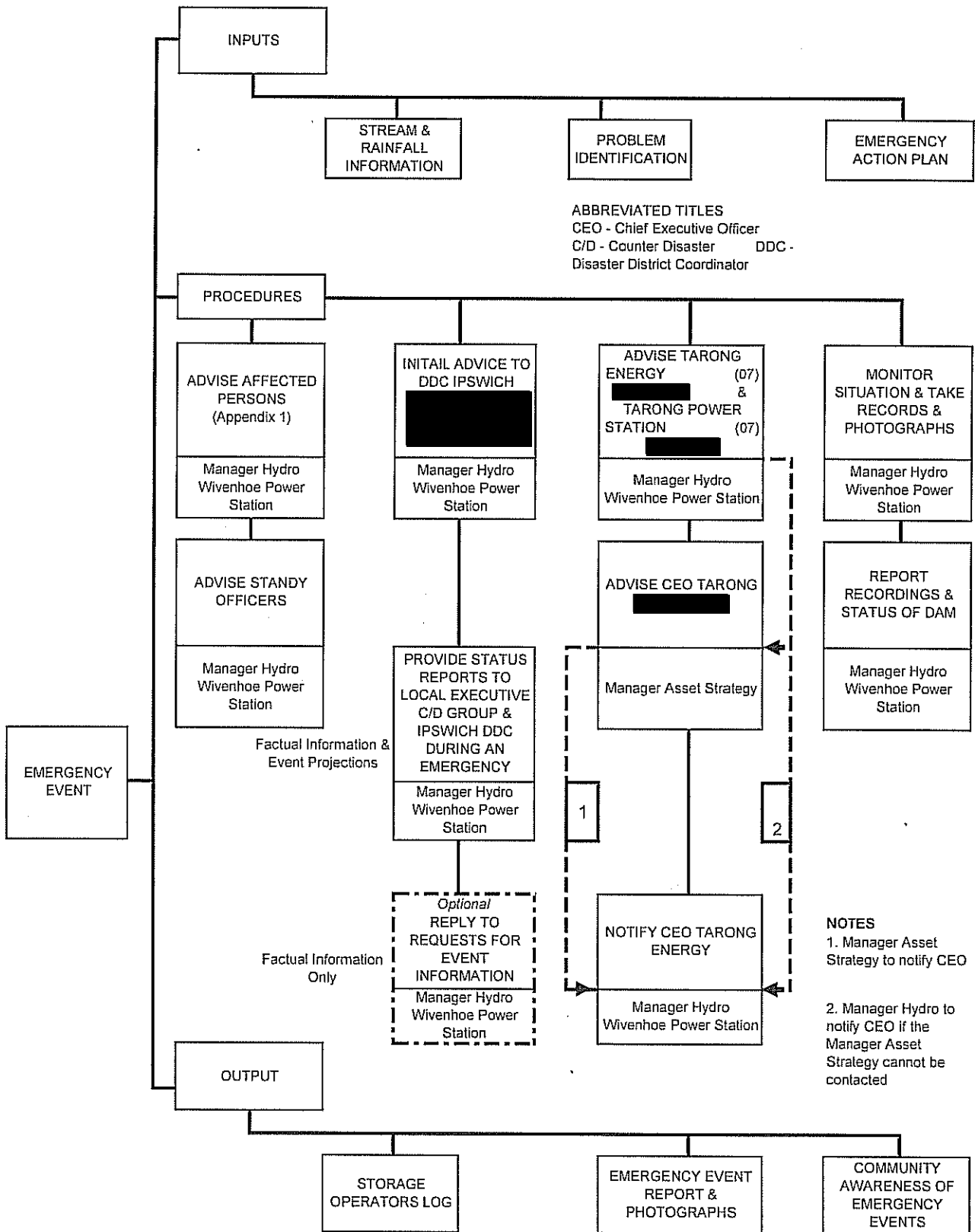
- ✓ Immediately proceed to the Dam and inspect the Embankment and Abutments for springs and deformation, and check for signs of slumps and erosion on the downstream face of the Dam
- ✓ Report any observed damage immediately to:
 - The Disaster District Coordinator, Ipswich Police (refer to section 3 of this EAP)
 - The Counter Disaster Executive Officer, Somerset Regional Council (refer to section 3 of this EAP)
 - The Shift Coordinator, Tarong Power Station Control Room (refer to section 3 of this EAP)
 - The State Counter Disaster Organisation Duty Officer (refer to section 3 of this EAP)

5. EMERGENCY EVENTS AND ACTIONS (cont'd)**EVENT**

- ⊖ DESCRIPTION OF SITUATIONS
- ✓ ACTION

Emergency Situation has developed or is developing (cont'd)

- ⊖ **Storage at Full Supply Level of EL166.50 AHD
Earthquake reported felt in the Area (cont'd)**
 - ✓ On detection of springs, proceed with the Emergency Action Plans for “**Increasing Flows and Leakage**” and / or “**Large Increasing Flows through the Embankment with Cloudy Water**” as set out on the preceding page
 - ✓ After the Event, compile an Emergency Event Report, and forward unedited copies to the Chief Executive Officer, Tarong Energy, and the Director, Dam Safety, Department of Water & Resource Management

6. PROCEDURAL FLOW CHART


7. HYDRAULIC MODEL RESULTS

7.1 Introduction

The results of the hydraulic model simulations are presented in this section of the report. The results are presented for the 'Sunny Day' piping failure of the main earth and rock fill embankment. As the two failure modes considered would result in similar breach shapes and would effectively take the same time to develop, only one downstream flooding scenario has to be reported.

7.2 Peak Flood Levels

The results are presented as a plot of the extent of inundation due to the failure of the dam. This plot is shown as Figure 7 "Drawing A3-216118 Dam Failure Analysis Sunny Day Failure". Table 7.1 "Sunny Day Piping Failure Event Peak Flood Levels" provides a summary of the estimated peak flood levels at key locations for the 'Sunny Day' piping failure event.

Table 7.1 - Sunny Day Piping Failure Event — Peak Flood Levels

Location	Cross-section	Peak Flood Level (m AHD)
Splityard Creek Dam	1	105.93
Switchyard on Pryde Creek	5	79.80
Houses on Pryde Creek	9	59.92
Twin Bridges on Brisbane R.	600m DIS of XS 15	33.82
Fernvale Bridge on Brisbane R	17	33.80
Junction	19	33.77
Savages Crossing on Brisbane R	24	32.78

7.2.1 Splityard Creek Dam

Figure 8 "Sunny Day Failure – Breach Hydrograph" shows the flow profile from a breach in Splityard Creek Dam peaking at 8,500 m³/sec at approximately 1 hour 5 minutes from the failure

7.2.2 Pryde Creek

Figures 9 "Pryde Creek Longitudinal Section – Maximum Flood Level for Sunny Day Failure" and 10 "Brisbane River Longitudinal Section – Maximum Flood Level for Sunny Day Failure" show the longitudinal profiles of the peak flood levels along and the Brisbane River respectively.

Figure 11 "Sunny Day Failure – Stage Hydrographs" shows stage hydrographs at various key locations along Pryde Creek and the Brisbane River. As can be seen from these plots the failure of the dam results in an increase in water level of between 15m immediately downstream of the dam in Pryde Creek to 13m at Savages Crossing on the Brisbane River.

Due to the topography of Pryde Creek, the flood wave is not attenuated greatly until it reaches the junction of the Brisbane River, where it then spreads out and flows upstream and downstream over the flood plain terraces of the Brisbane River.

SPLITYARD CREEK - EMERGENCY ACTION PLAN

7.2.2 Pryde Creek (con't)

The peak flood level estimated at the Fernvale Bridge is approximately equal to the deck level. Whilst the bridge is not expected to be threatened by such an event, it is very likely the northern approaches of the bridge will be inundated, effectively closing the Brisbane Valley Highway for a period of time.

7.3 Time to Peak Flood Levels

The time of start of rise and time to peak for various key locations is summarized in Table 7.3 "Sunny Day Piping Failure Event – Time to Peak Flood Level Splityard Creek Dam". This summary provides an indication of the available response time for each of the sites indicated.

Table 7.3 - Sunny Day Piping Failure Event — Time to Peak Flood Level Splityard Creek Dam

Location	Cross-section	Time to Start of Rise (Hours)	Time to Peak Flood Level (Hours)
Splityard Creek Dam	1	0.05	1.17
Switchyard on Pryde Creek	5	0.10	1.25
Houses on Pryde Creek	9	0.17	1.33
Twin Bridges on Brisbane R.	600m DIS of XS 15	0.83	2.16
Fernvale Bridge on Brisbane R	17	0.75	2.17
Junction	19	0.50	2.18
Savages Crossing on Brisbane R	24	0.75	2.22

The times indicated do not provide sufficient warning times to evacuate the population at risk.

7.4 Peak Flood Flows

Table 7.4 “Sunny Day Failure Event – Peak Flood Flows Splityard Creek Dam” summarizes the estimated peak flood flows at various key locations along Pryde Creek and the Brisbane River.

Table 7.4 - Sunny Day Failure Event - Peak Flood Flows Splityard Creek Dam

Location	Cross-section	Peak Flood Flow (m3/s)
Splityard Creek Dam	1	8473
Switchyard on Pryde Creek	5	8430
Houses on Pryde Creek	9	8355
Twin Bridges on Brisbane R	600m DIS of XS 15	-606
Fernvale Bridge on Brisbane R	17	-1933
Junction	19	7763
Savages Crossing on Brisbane R	24	2665

Note: A negative value indicates flow in opposite direction.

Figure 11a “Sunny Day Failure – Discharge Hydrograph” shows flow hydrographs at various key locations. This comparison highlights the effect the junction area has on the attenuation of the flood wave. The peak flow at Savages Crossing is estimated to be 2,700 m³/s compared to the breach outflow peak of 8,500 m³/s.

The estimated dam failure hydrograph is not expected to cause significant property damage further downstream along the Brisbane River as the magnitude is below the known damage value of 3500 m³/s. Several low level crossings will be inundated as a result of the dam failure. These bridges include:

- Burtons Bridge
- Kholo Bridge
- Mt Crosby Weir Bridge
- Colleges Crossing

7.5 Peak Mean Velocity

The peak mean velocity at each of the key locations is summarized in Table 7.5 “Piping Failure Event — Peak Mean Velocity Splityard Creek Dam”. The peak mean velocity together with the depth of flooding provides an indication of the likely consequences of the flooding because it can affect the stability of pedestrians wading through flood-waters and motor vehicles traversing

SPLITYARD CREEK - EMERGENCY ACTION PLAN

flooded roads. The two factors are usually combined to produce hazard graphs, so that emergency service agencies can undertake hazard analyses as part of emergency response plans.

It should be noted however, the peak mean velocity is only an average value for the entire cross-section and if there are large variations in depth across the section then it is likely the mean value will under or over estimate the actual values within the section. The peak mean velocity may not necessarily coincide with the peak flood level and it is often the case that the peak mean velocity occurs on the rising limb of the stage hydrograph.

Table 7.5 - Sunny Day Piping Failure Event — Peak Mean Velocity Splityard Creek Dam

Note: A negative value indicates flow in opposite direction.

Location	Cross-section	Peak Mean Velocity (m/s)
Splityard Creek Dam	1	5.5
Switchyard on Pryde Creek	5	4.7
Houses on Pryde Creek	9	5.8
Twin Bridges on Brisbane R	600m <i>DIS</i> of XS 15	-0.8
Fernvale Bridge on Brisbane R	17	-2.2
Junction	19	6.0
Savages Crossing on Brisbane R	24	1.7

8. SUMMARY AND CONCLUSIONS

The main embankment of Splityard Creek Dam appears to be in good condition and any failure is considered to be remote. Failure of the main embankment due to overtopping is considered highly unlikely due to the available spillway capacity and current extreme flood estimates. The probability of failure due to piping of the embankment has been assessed in accordance with procedures described in Fell and Foster (2000) as being 0.00095% AEP.

The most likely failure mode for Splityard Creek Dam is considered to be a seepage failure of the embankment. Such a failure would be initiated by either earthquake activity causing a transverse crack in the clay core material at the crest of the dam, or deformation of the foundation resulting in the cracking of the outlet conduit and hence piping of the core material around the conduit.

It is estimated that piping failure of the main embankment would result in the removal of approximately 720,000 m³ of material with a breach development time of between 1.5 to 2.0 hours.

Such a breach would have the following dimensions:

Base width of breach b	= 52 m at an elevation of 92.0 m AHD
Breach depth h	= 76 m
Top width of breach B	= 103m at an elevation 168.0 m AHD
Side Slope of Breach	= 1 H:3V

The resultant outflow from the dam would have a peak discharge 8,500 m³/s and it would result in the complete release of the reservoir volume, which is 28 700 ML.

The impacts of the resultant dam break flood on Pryde Creek and the Brisbane River have been assessed as follows:

The Wivenhoe – Somerset Dam Road will be completely inundated by depths of water in excess of 10 m that will be flowing very swiftly (around 5 m/s), effectively preventing the road from being used as a possible evacuation route.

The switchyard located along Pryde Creek is situated above the estimated extent of inundation and therefore should not be affected.

At least six properties located adjacent to Pryde Creek will be inundated by the dam failure flood hydrograph. The time available for warning is only very small, with the initial rise occurring within 10 minutes and peak levels being attained within 80 minutes.

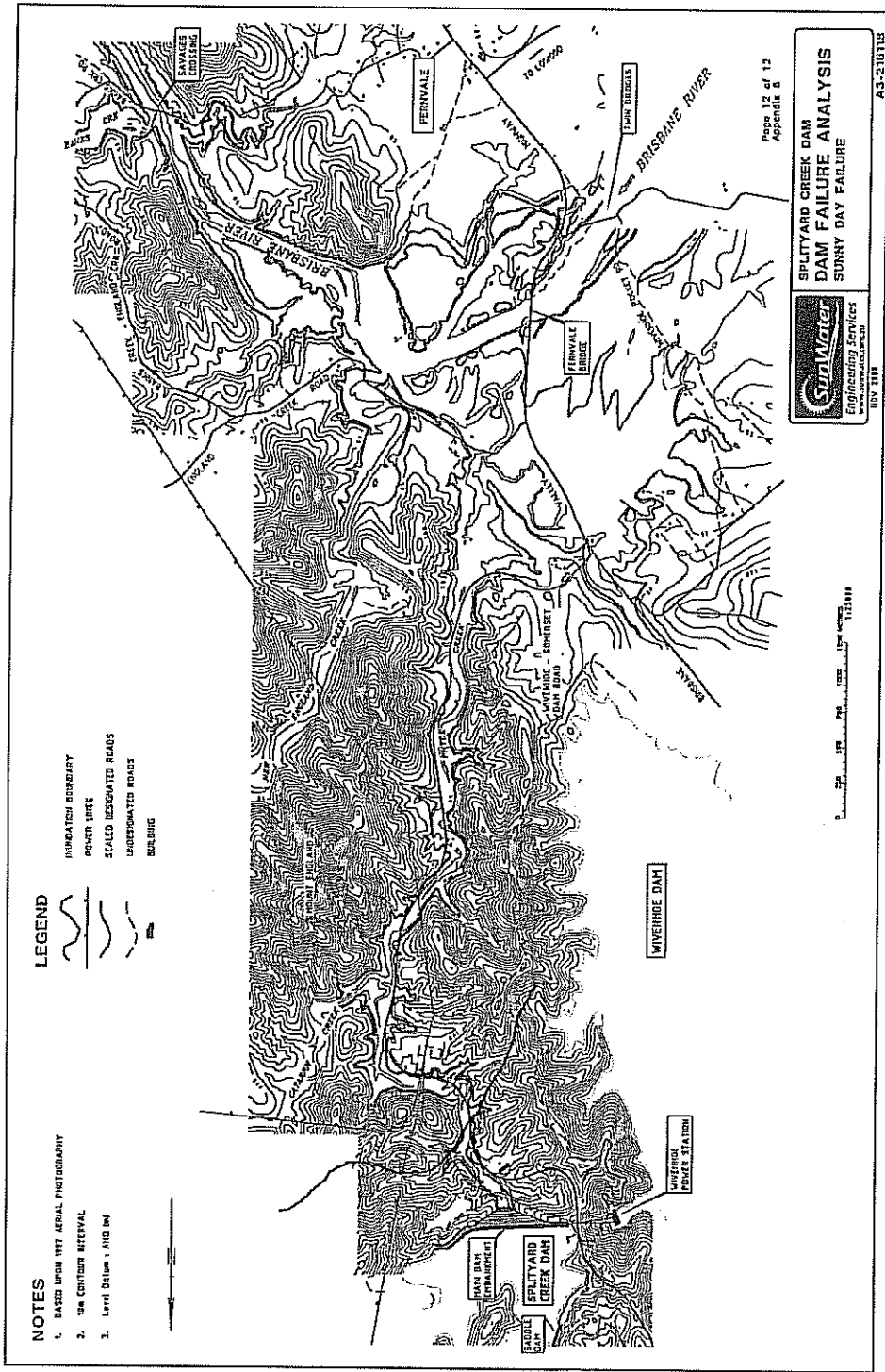
It is likely the Brisbane Valley Highway will be inundated on the northern approach to the Brisbane River. Fernvale Bridge however, should not be overtopped.

Savages Crossing and Twin Bridges will be inundated by floodwaters for a period of at least 12 hours. These crossings should not be subject to damaging velocities so it is unlikely they will be completely destroyed. Low level crossings located on the Brisbane River downstream of Savages Crossing, such as Burtons Bridge, Kholo Bridge and Colleges Crossing will also be overtopped by the floodwaters. Mt Crosby Weir Bridge may also be subject to inundation, although the degree of attenuation of the dam break flood hydrograph may be such that it is spared. The duration of inundation of the low level crossings is expected to be less than one day.



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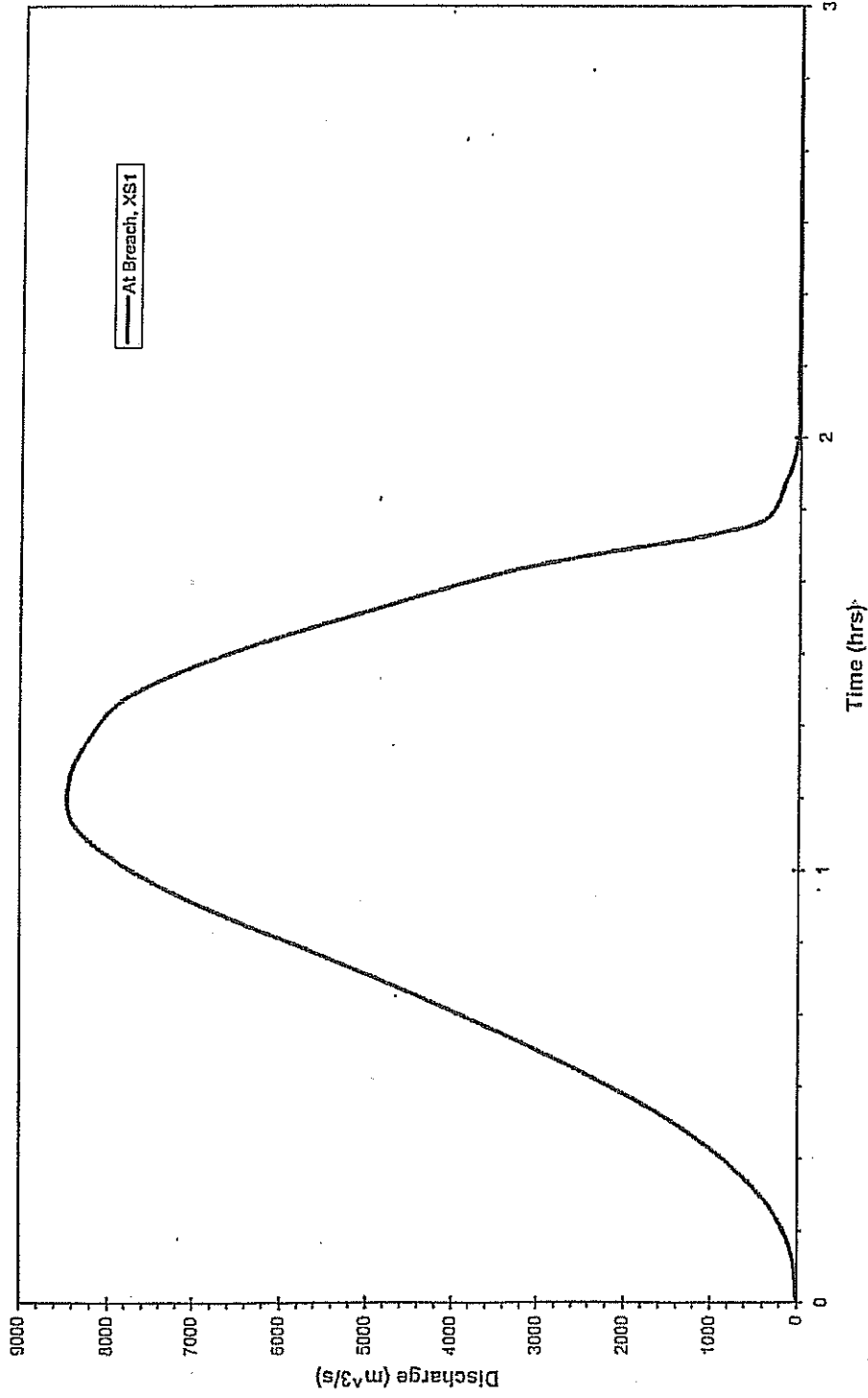
Figure 7 – Drawing A3-216118 Dam Failure Analysis Sunny Day Failure





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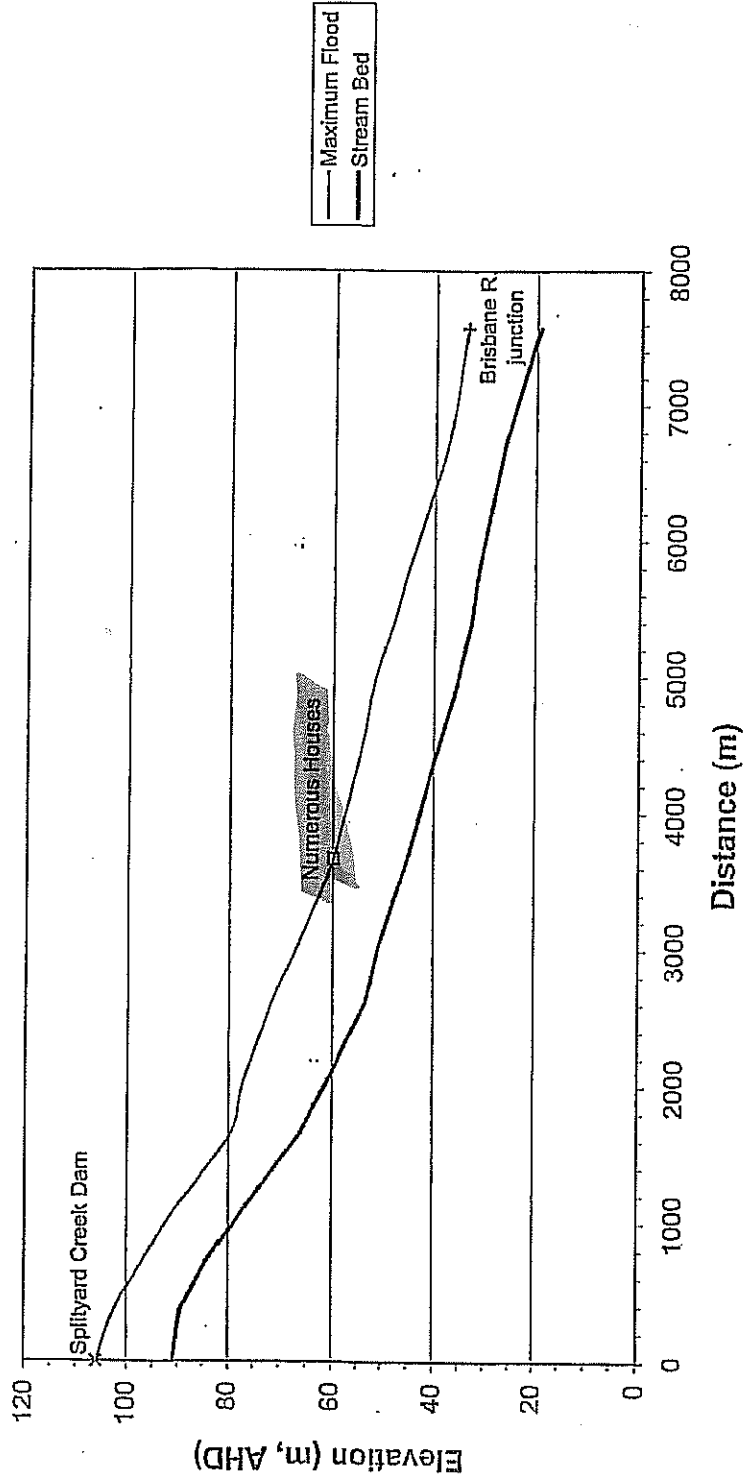
Figure 8 – Sunny Day Failure – Breach Hydrograph





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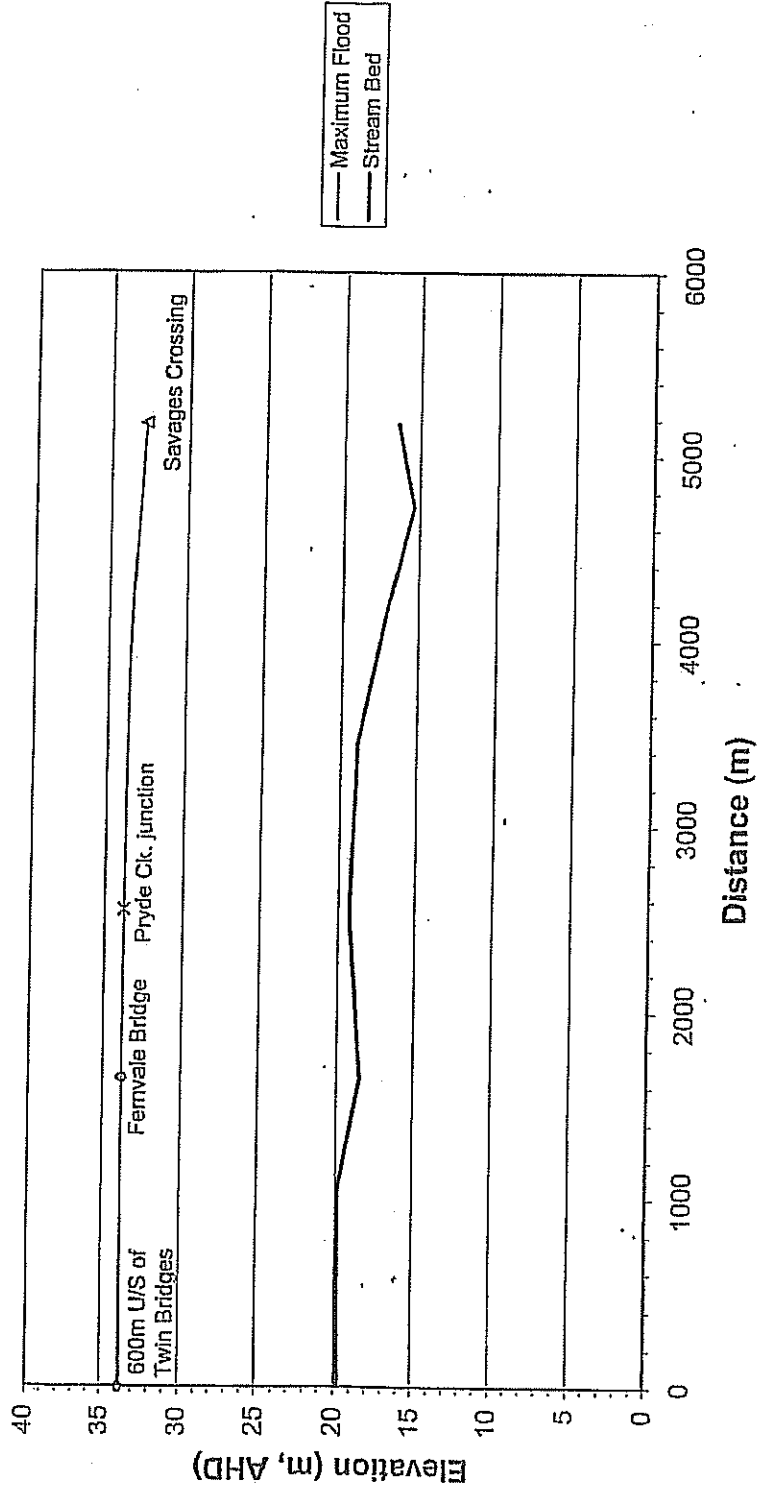
Figure 9 – Pryde Creek Longitudinal Section – Maximum Flood Level for Sunny Day Failure





SPLITYARD CREEK - EMERGENCY ACTION PLAN

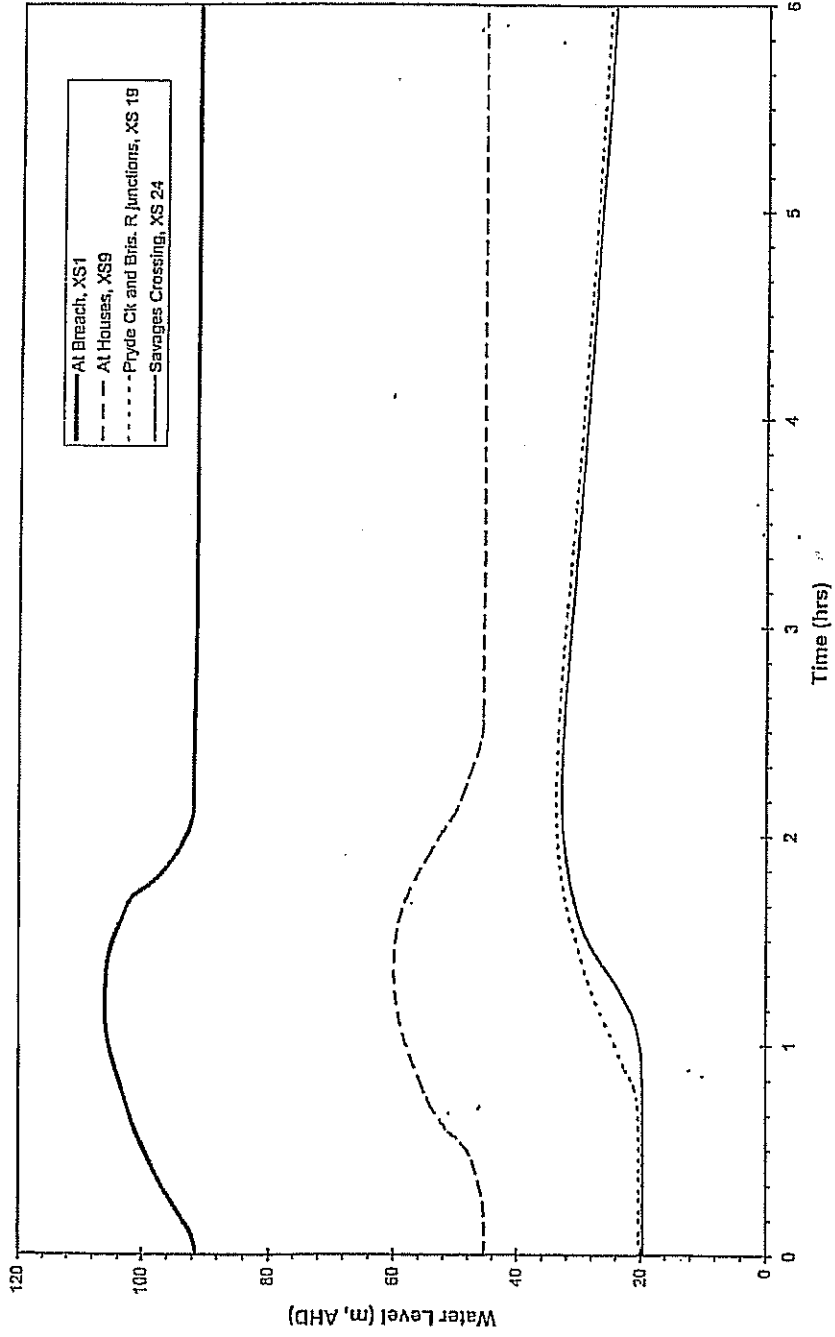
Figure 10 – Brisbane River Longitudinal Section – Maximum Flood Level for Sunny Day Failure





SPLITYARD CREEK - EMERGENCY ACTION PLAN

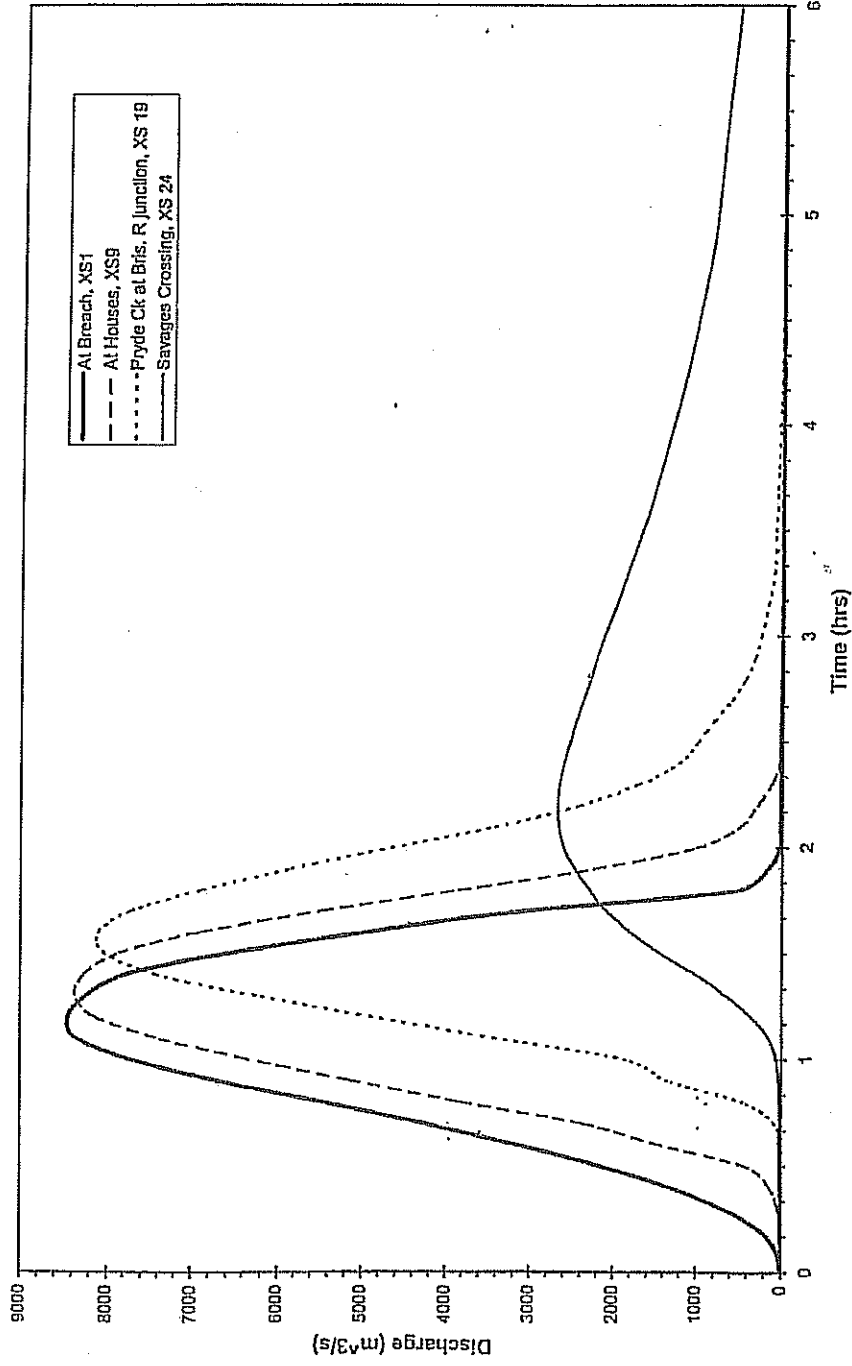
Figure 11 – Sunny Day Failure – Stage Hydrographs





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Figure 11a – Sunny Day Failure – Discharge Hydrograph

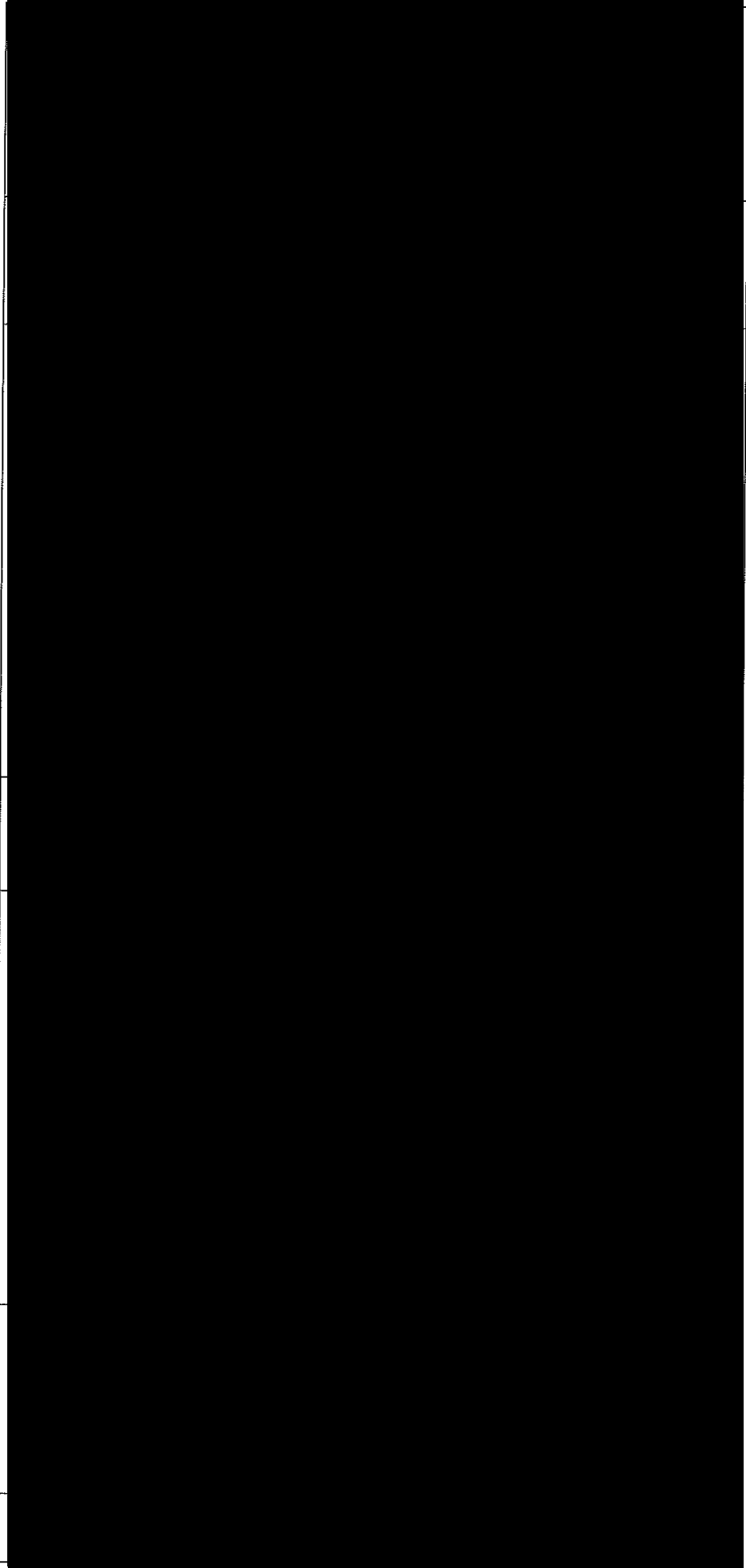


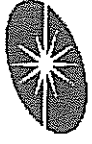


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SPLITYARD CREEK - EMERGENCY ACTION PLAN

APPENDIX 1 - DOWNSTREAM LAND HOLDERS AFFECTED BY SUNNY DAY FAILURE OF SPLITYARD CREEK DAM





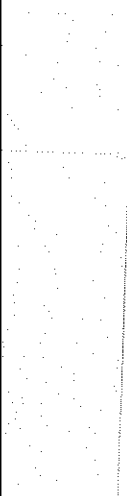
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SPLITYARD CREEK - EMERGENCY ACTION PLAN

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APPENDIX 1 - DOWNSTREAM LAND HOLDERS AFFECTED BY SUNNY DAY FAILURE OF SPLITYARD CREEK DAM (cont'd)

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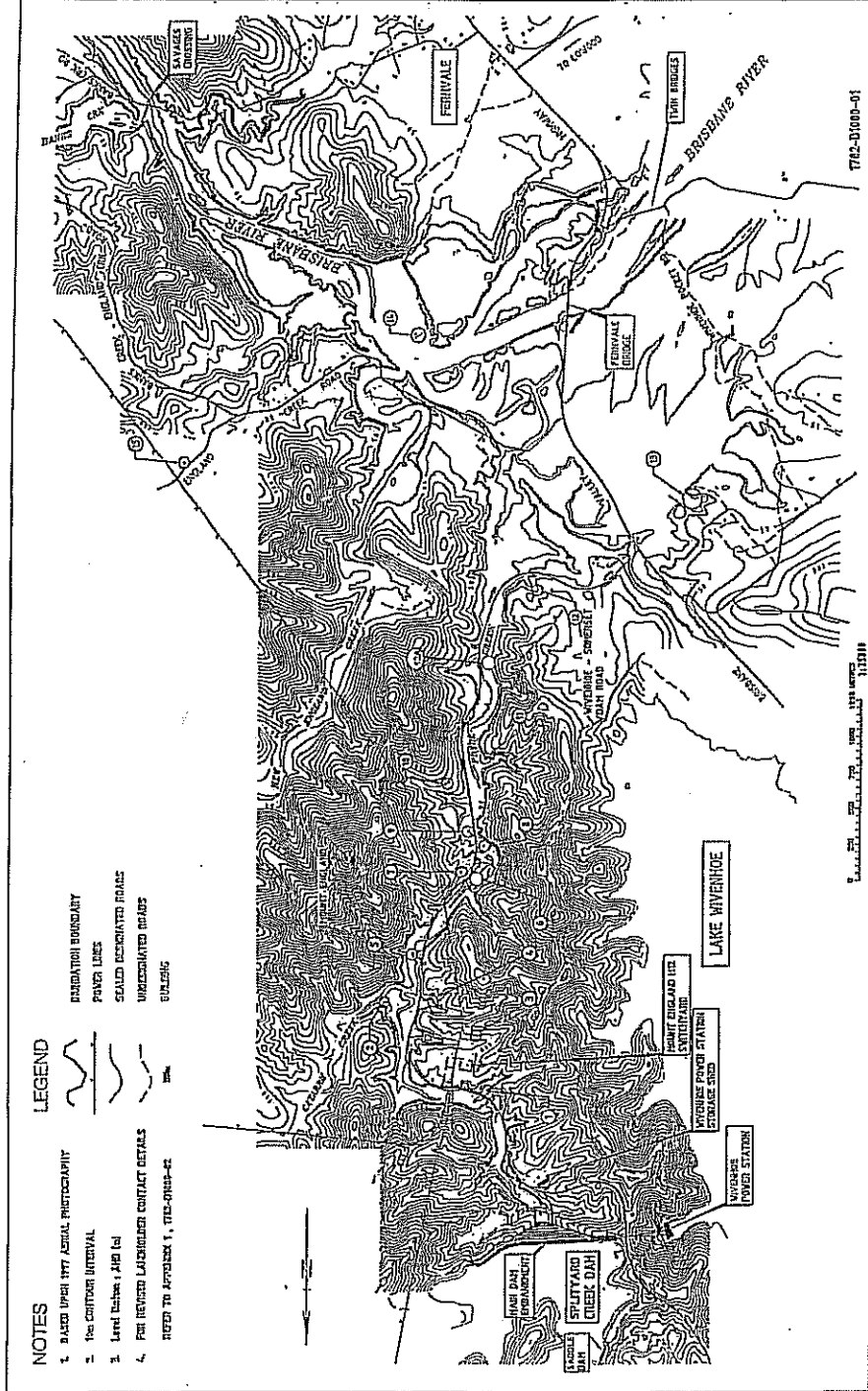




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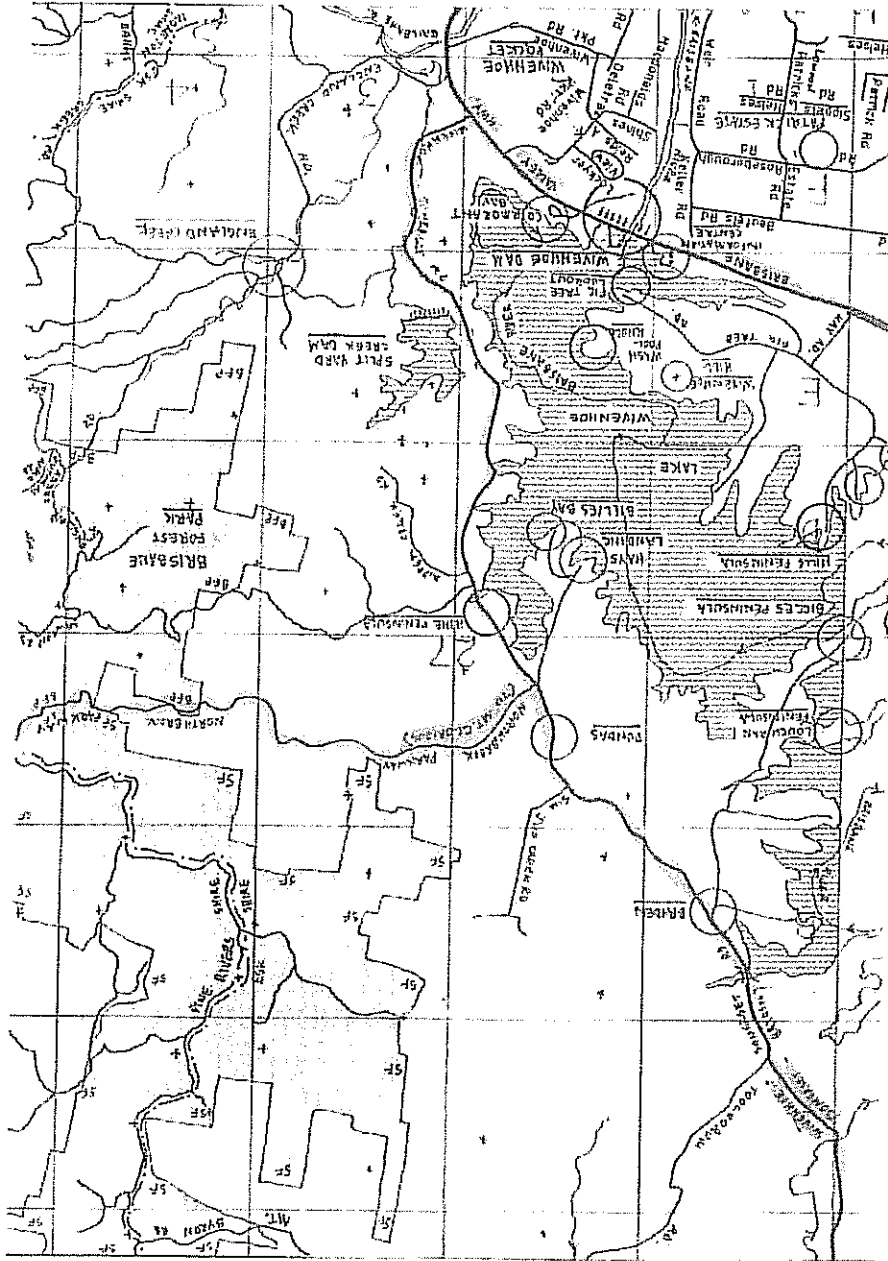
SPLITYARD CREEK - EMERGENCY ACTION PLAN

APPENDIX 2 - Drawing 1782-D1000-1 "Splityard Creek Dam Inundation Land Ownership Details"





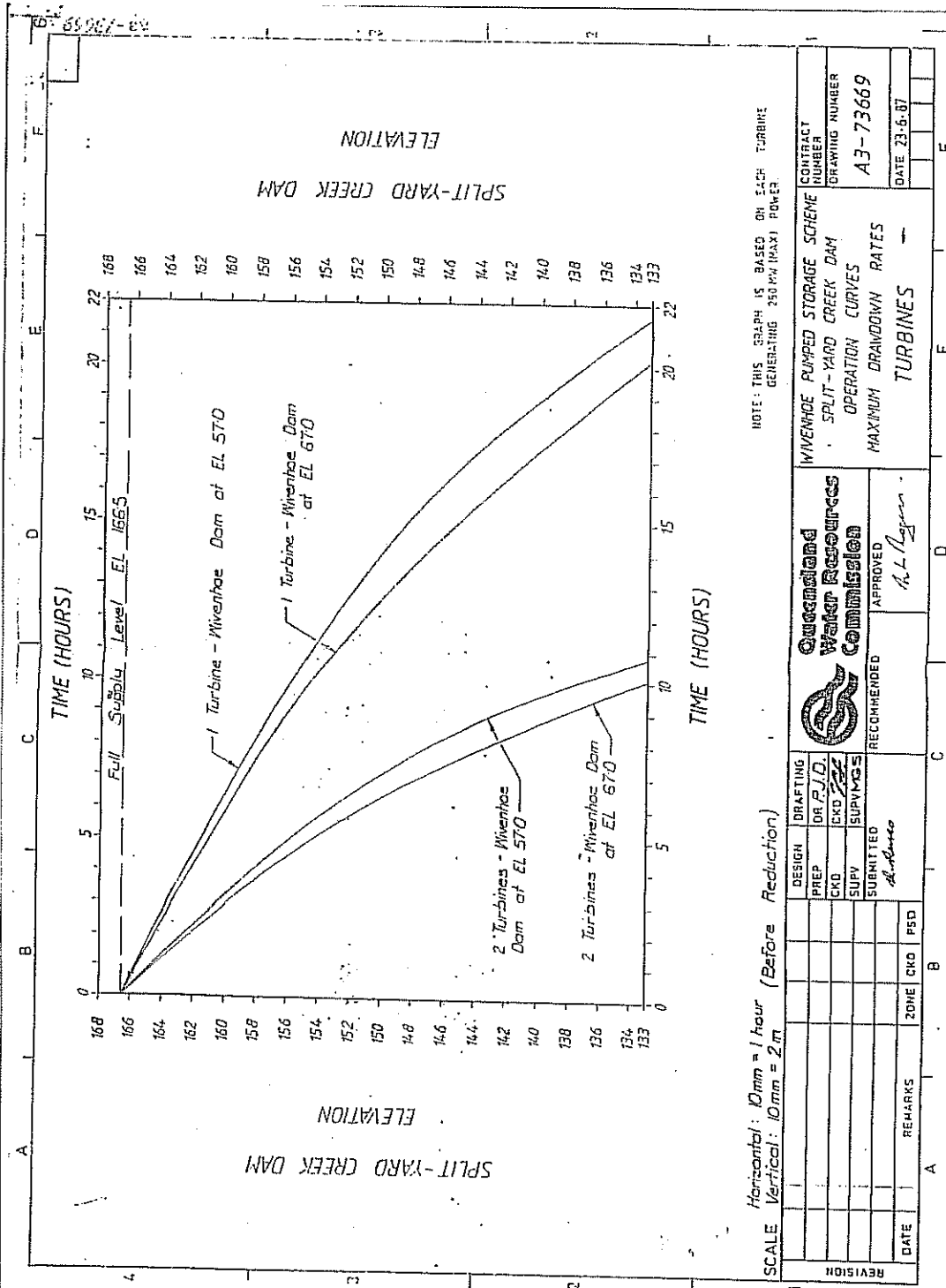
APPENDIX 3 – Alternative Routes to Splityard Creek Dam





SPLIT-YARD CREEK - EMERGENCY ACTION PLAN

APPENDIX 4 - Operational Curves for Maximum Drawdown Rates for Splityard Creek Dam



Horizontal: 10mm = 1 hour (Before Reduction)
 Vertical: 10mm = 2m

REVISION

DATE	REMARKS	ZONE	CNO	PSD

DESIGN: PREP, CKD, SUPV, SUBMITTED, DRAFTING, DR, P, J, D, CKD, SUPVMS

RECOMMENDED: *Alfonso*

APPROVED: *R.L. Rogers*

Queensland Water Resources Commission

WIVENHOE PUMPED STORAGE SCHEME
 SPLIT-YARD CREEK DAM
 OPERATION CURVES
 MAXIMUM DRAWDOWN RATES
 TURBINES

CONTRACT NUMBER: A3-73669
 DRAWING NUMBER: A3-73669
 DATE: 23-6-07

APPENDIX 5 – Flooding Event Definitions**FLOODING EVENT DEFINITIONS**

- **“DCF”** or

“Dam Crest Flood”

The flood Event which when routed through the Reservoir results in a still water level in the Reservoir, excluding wave effects, which for an Embankment Dam is the lowest point of the Embankment Crest.

- **“PMF”** or

“Probable Maximum Flood”

The flood resulting from the Probable Maximum Precipitation, and where applicable, snow melt, coupled with the worst flood producing catchments conditions that can be realistically expected in the prevailing meteorological conditions.

- **“PMP”** or

“Probable Maximum Precipitation”

The theoretical greatest depth of precipitation for a given duration that is physically possible over a particular drainage system.

- **“SDF”** or

“Sunny Day Failure”

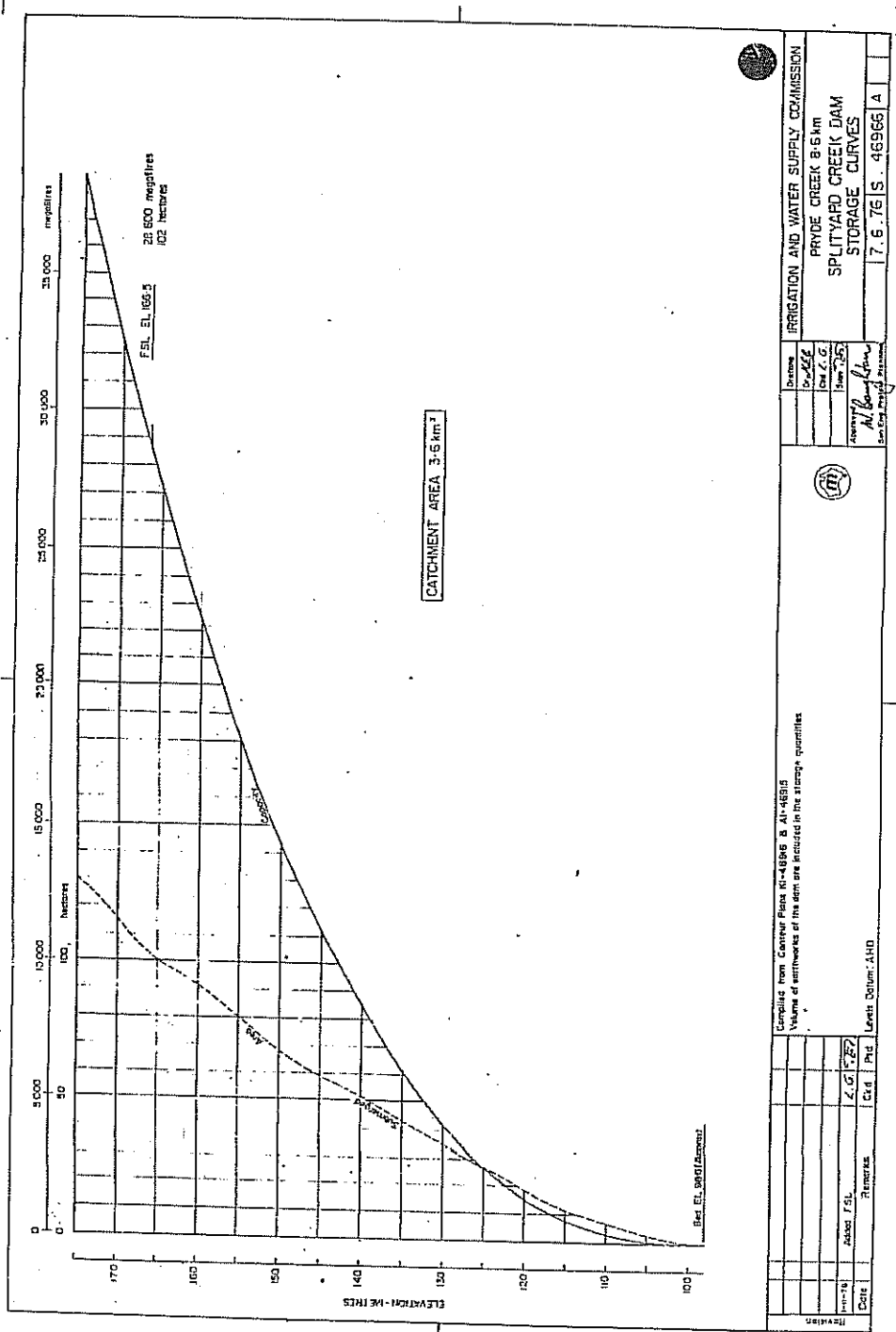
Unexpected failure of a Dam not associated with flooding, but maybe initiated by natural disaster.

- **“AHD”** or “Australian Height Datum”

Height referenced to a standardized datum level in Australia.



SPLITYARD CREEK - EMERGENCY ACTION PLAN
 APPENDIX 6 - Splyard Reservoir Storage Curves



Compile from Center Plans K-4886 & A1-16816 Volumes of earthworks of the dam are included in the storage quantities		IRRIGATION AND WATER SUPPLY COMMISSION PRYDE CREEK 8.6 km SPLITYARD CREEK DAM STORAGE CURVES 7.6.76 S. 46966 A	
Date	11-16	Author	FSL
Drawn	4.15.82	Checked	11/16
Scale	1:1000	Level	Bottom: AHD
Remarks			



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APPENDIX 7 – Splityard Creek Dam Emergency Event Record of Actions, Events and Communications

Date	Time	Contact Person	Phone No.	Action Taken / Event Recorded / Message Sent or Received	Call Sent By / Received By

