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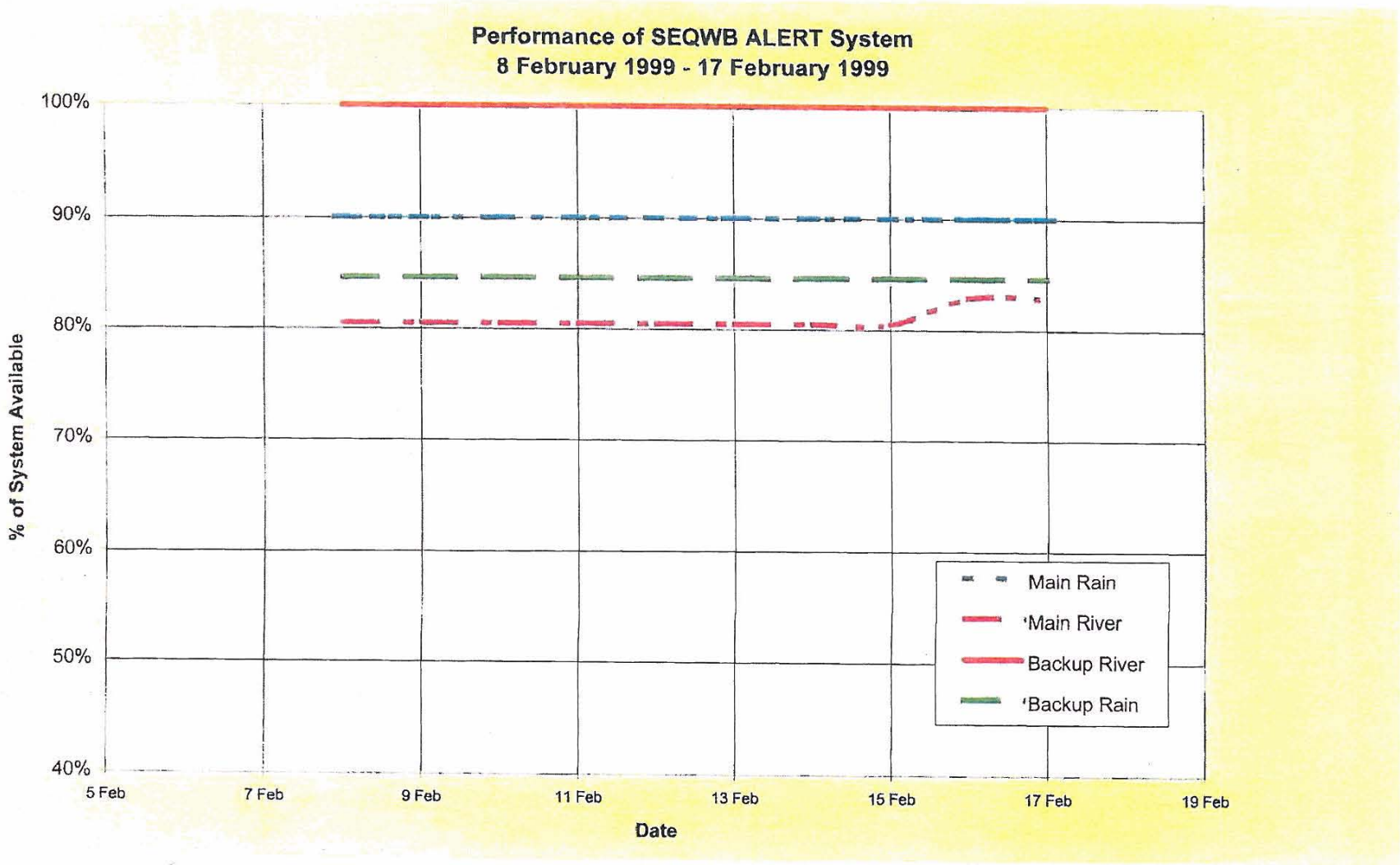

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FIGURE 9.1

It is noted that, of all the 'critical' main network stations that have redundant back-up stations, only the Somerset rainfall stations did not have the primary or the back-up station operational at all times. Of the above sensors, the following deserve special mention:

• #2168	David Trumpy Bridge - River	Not formally part of the SEQWB Network but out of action for extended periods. A mechanism needs to be found to ensure maximum availability for this station.[4]
• #6590 • #6593 • #6594	Somerset Dam headwater & rainfall sensors	The location has experienced radio reception problems in the past and has performed intermittently. A new aerial had been ordered prior to the event, but to date has not been installed. **It is very important this new aerial is installed as soon as possible.**
• #6706	Woodford (A) – River	DNR understand the station is full of sand and gravel. It has been out of action for an extended period.
• 6647 • 6650	Lowood (A) & Lowood (B)	The stations gave different readings during the course of both events. While some of this variation may have been due to superelevation of the flow as it passed around a bend, it needs checking.

Post event, a comparison was made of the total rainfalls occurring at a number of BoM rainfall stations in the catchment. The results of this comparison are summarised in the following Table.

BoM Station	mm	SEQWB ALERT Station	mm	Difference[5]
Amberley	174	#6651	167	- 4.0%
Boonah PO	104	#6252 Kalbar	110	+ 5.8%
Dayboro PO	418	#6711 Baxters Ck	413	- 1.2%
Esk PO	347	#6574 Caboonbah	397	+ 14.4%
Gatton PO	82	#6577 (suspect OOA)	150	+ 83%
Harrisville PO	132	#6571	123	- 6.8%
Jimna	475	#6600 (OOA)	OOA	-
Kilcoy PO	482	#6600	396	- 17.8%
Lake Manchester	193	#6751 Mt Crosby	226	+ 17.8%
Lowood Don St	193	#6649	186	- 3.6%
Moogerah Dam	114	#6623 Tarome	105	- 7.9%
Mt Mee	648	#6690	665	+ 2.6%

[4] Following the February event, it was determined that the BoM was responsible for the operation and maintenance of the David Trumpy Bridge ALERT station. Ian Rocca (BoM) has since provided an up to date calibration for this station and it is recommended that the SEQWB foster this relationship and maintain contact with the BoM for future maintenance.

[5] It is important to note that not all of these stations are adjacent to each other and local variations in rainfall will be sufficient to cause the differences noted. Overall, the differences are considered acceptable.

BoM Station	mm	SEQWB ALERT Station	mm	Difference[5]
Peachester Woodford Rd	890	#6775	749	-15.8%
Somerset Dam BVRT	450	#6593 (OOA) #6574 Caboonbah	413	- 8.2%
Toogoolawah	330	#6604	320	- 3.0%
Crows Nest	325	#6596	285	-12.3%
Long Pocket CSIRO	232	#6730 Jindalee	246	+ 6.0%
Wivenhoe Dam	196	#6639	205	+ 4.6%
Mary Cairncross Park	801	#6716 Bellthorpe West	613	- 23.5%
The Head	197	#6774 Wilsons Peak	217	+ 10.1%

9.2.3 Performance of ALERT Stations during March 1999 Event

Performance data has been extracted for the network and it is summarised in the following Tables.

Sensor Network	No. of Stations	Overall Station Availability
Main Rain	60	88.3%
Main River	41	84.6%
Back-up Rain	13	84.6%
Back-up River	11	92.7%

This data indicates the overall system availability was not quite as good during the March event as it was for the February event.

One heartening aspect was the SEQWB response to a DNR request to fix the Mt Crosby sensor. This station was important to the operation of the drainage phase at the time and it was up and running again in approximately one hour.

The overall station availability might have been lower but for some preventative maintenance of the ALERT station batteries. During the February 1999 event, when it was thought Cyclone Rona might head down the coast and generate a second flood, DNR requested that SEQWB check the batteries at each station. DNR understand this was carried out and it is probably reflected in the overall availabilities achieved in the second event.

BoM Station	mm	SEQWB ALERT Station	mm	Difference[6]
Amberley	66	#6651	68	+ 3%
		#6653	66	0
Boonah PO	100	#6252 Kalbar	145	+ 45%
Dayboro PO	140	#6711 Baxters Ck	103	- 26%

[6] It is important to note that not all of these stations are adjacent to each other and local variations in rainfall will be sufficient to cause the differences noted. Overall, the differences are considered acceptable.

performance

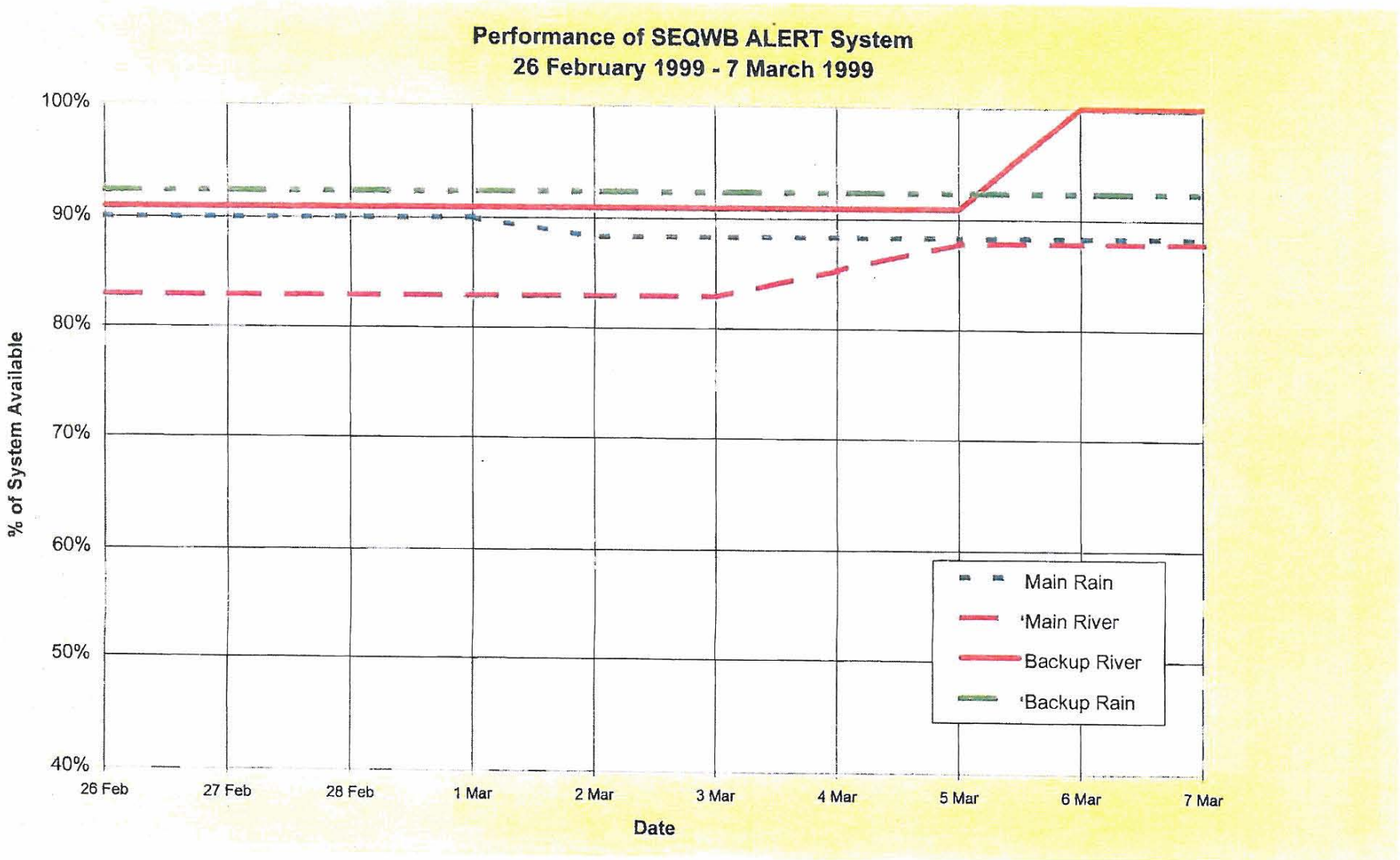

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FIGURE 9.2

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BoM Station	mm	SEQWB ALERT Station	mm	Difference[6]
Esk PO	107	#6574 Caboonbah	96	- 10%
Gatton PO	92	#6577	90	- 2%
Harrisville PO	153	#6571	149	- 3%
Jimna	149	#6608 (OOA)	-	-
Kilcoy PO	125	#6600 (OOA once during period)	86	- 31%
Lowood Don St	91	#6646	76	- 16%
		#6649	68	- 25%
Moogerah Dam	116	#6623 Tarome	110	- 5%
Mt Mee	158	#6690	123	- 22%
		#6701	123	- 22%
Peachester Woodford Rd	275	#6775	197	- 28%
Pechey Forestry	108	#6511 Mt Pechey (A)	95	- 12%
		#6513 Mt Pechey (B)	95	
Somerset Dam BVRT	60	#6593 (OOA)	-	-
		#6574 Caboonbah	96	+ 60%
		#6590 (OOA)	-	-
Tarome	121	#6623	110	- 9%
Toogoolawah PO	97	#6604	93	- 4%
Yarraman PO	60	#6540	37	- 38%
Crows Nest	97	#6596	75	- 23%
Long Pocket CSIRO	81	#6730 Jindalee	153	+ 89%
Wivenhoe Dam	87	#6639	87	0
		#6636	44	- 49%
		#6641	82	- 6%
		#6643	84	- 3%
Mary Cairncross Park	176	#6716 Bellthorpe West	155	- 12%
The Head	147	#6774 Wilsons Peak	116	- 21%

9.2.4 Proposed New Stations

As a result of DNR's experiences during the February and March 1999 events, it is recommended several new ALERT stations be installed. The recommended stations and the reasons for their recommendation are presented below:-

Location	Reason for Inclusion
Linville	To provide greater definition of the rainfall and river heights in the upper Brisbane River catchment. It is also adjacent to the Stanley catchment and would provide valuable rainfall information for the western side of the Somerset Dam catchment. The advantage of this proposed station is that it is already the site of an existing DNR river height station.

Location	Reason for Inclusion
Upstream of Kholo Bridge	To provide information on river heights affecting Kholo Bridge. The bridge is an important river crossing and is some 9 to 10 hours downstream of the dam. River level information is needed to properly manage river levels to keep the bridge open. During the February event, the Flood Operations Engineers had to dispatch a data collector to the site during the 'ramp down' of releases from 1800 m^3/sec to 550 m^3/sec to ensure that the bridge had emerged from the floodwaters as and when predicted. This feedback was necessary to enable any necessary adjustments to the dam discharge to be made as soon as possible to ensure the bridge became trafficable by the next morning.
Upstream of Burtons Bridge	Similar reasoning to Kholo with the bridge becoming trafficable when the flow drops below 250 m^3/sec. Careful management is required to ensure the bridge stays open at this target discharge.
Buaraba Creek	There is currently a 'gap' in the river height network for waters discharging from the Buaraba Creek catchment feeding into Lockyer Creek. This was felt most significantly in the March event when we were trying to keep College's Crossing open. A significant flow was apparently emerging from Buaraba Creek and affecting discharges past O'Reilly's Weir. A station on Buaraba Creek would assist in managing such minor flows and would enable more reliable management of the flows causing inundation of the minor Brisbane River crossings.
Splityard Creek	No mechanism currently exists to determine how much water is being released from the Wivenhoe pumped storage. Data obtained since the start of the February event has indicated that the power station can discharge at about 300 m^3/sec. This discharge capacity is well in excess of the releases made towards the end of most flood events and can cause unanticipated rises in Wivenhoe storage.

9.3 The DNR Hydromet Telephone Telemetry System

Prior to the flood event, DNR's SIS software had been installed on a PC resident in the FCC. At the start of the event it was realised that the reliability of the network could be improved by installing SIS on a dedicated PC. A suitable PC was located very early in the event and SIS was duly installed. The system provided backup to the ALERT network and operated successfully for the duration of the event. It especially proved useful when validating the ALERT data for Savages Crossing.

9.4 RAPIC weather radar imagery

The Flood Control Room continued to receive the RAPIC weather radar images from the Bureau of Meteorology for the entire duration of the event. In addition to this dedicated service, the FCC was also able to access radar and satellite imagery on the Internet.

These images proved very useful in understanding development and movement of the storm event.

9.5 BoM weather forecasts and warnings

The Flood Operations Engineers kept in regular contact with the Bureau of Meteorology (BoM). In particular the following contact

(a) Duty Flood Operations Engineers kept abreast of the ongoing BoM weather forecasts;

(b) Duty Engineers spoke to BoM on a regular basis (especially during the February event, the March event was not considered very significant) both to discuss the developing weather and to provide information on the adopted gate operating strategies;

(c) Duty Engineers Allen and Ruffini attended the daily weather briefing given to BoM staff on 12th February. This briefing gave details of the movements predicted for Cyclone Rona by a number of different global weather models. It allowed the Duty Engineers to more clearly understand the developing options for the cyclone and it was a consideration in assessing the required drainage time for the flood storage component of Wivenhoe Dam.

Duty Engineer attendance at such briefings is at the discretion of the BoM staff and relies on their invitation to attend. We appreciated this briefing very much and it provided valuable information for subsequent operations.

9.6 BoM Quantitative Precipitation Forecasts

DNR continued to receive BoM quantitative precipitation forecasts (QPFs) for the duration of the event. While the initial QPFs for the 7th and 8th February proved relatively low, subsequent QPFs (in combination with discussions with the BoM hydrologists) allowed the Duty Engineers to better focus the *FLOODOPS* simulations and produce more reliable results.

9.7 Manually observed storage levels and river heights

During the course of the event, the Dam Supervisors provided regular headwater and rainfall readings to the Duty Engineer. These values were recorded in the detailed FCC event logs. Many of these were not included in the summary logs attached as Appendices A and E for the sake of brevity.

In general these readings agreed well with the ALERT values. However, on several occasions, it proved necessary to recalibrate the ALERT stations on the basis that improved accuracy was required to satisfactorily operate the various outlet structures.

This was especially true at North Pine dam where radial gate movements are made at 15 mm intervals and water levels need to be known accurately for proper operation of the gates.

The manually read levels at Wivenhoe Dam were adequate while the storage levels were significantly above Full Supply Level (FSL). However, variations were noticed closer to FSL which could only be assigned to the accuracy to which the gauge boards could be read. The arrangement is shown in Figure 9.1

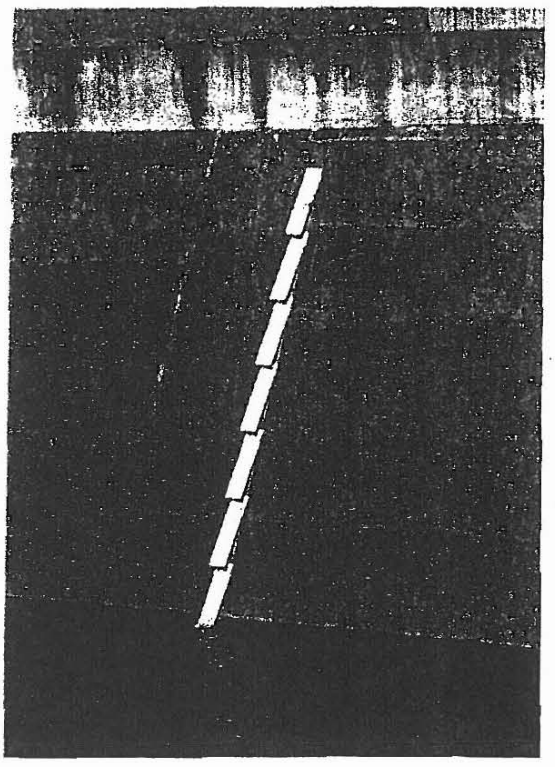

Figure 9.1 Existing Wivenhoe Dam Gauge Boards

It is recommended that a better system be devised for reading Wivenhoe Dam levels to an accuracy consistently better than ± 5mm. This may well require the installation of a float chamber at a point within easy access of the Dam Supervisors. The Duty Engineers understand that anyone reading the current gauge boards cannot get closer than about 15 metres and that the graduations on the boards require significant interpolation.

10. COMMUNICATIONS DURING THE FLOOD EVENTS

10.1 Communications with Dams

- DNR phone communications were lost with Somerset Dam at 2125 hrs on Monday 8th February. The phone lines remained to the SEQWB offices at Somerset Dam and these were used until the DNR phones were restored at 1430 hrs on 11th February.
- All other phones remained serviceable for the duration of both events
- Radio links were successfully tested with all dams at the start of the February event. The radio was only used once when the Somerset Dam operators were away from the phones and it became necessary to get a message to them.

10.2 Communications with those on Register of Contact Persons for Flood Information

Under Section 6 of the Manual of Operational procedures for Wivenhoe and Somerset Dams, the Flood Operations Engineer is required to contact those listed in the 'Register of Contact Persons for Flood Information' whenever all of the following conditions are met:-

- A flood situation is imminent and gate operations are likely and
- The flow is likely to exceed 2000 m^3/sec at Lowood

While this condition was not met in either flood event, the Duty Engineers did speak to a number of authorities on a regular basis. Further details of these communications are provided in the attached Flood Control Centre log sheets. In summary, these authorities included:-

Authority	Occasion in February Event	Occasion in March Event
Police	Advice of prospective bridge closures Dam Supervisors at North Pine Dam contacted local police about closure of downstream crossings.	Advice of prospective closure of Colleges Crossing (see also ICC) Dam Supervisors at North Pine Dam contacted local police about closure of downstream crossings.
Brisbane City Council	To advise of developing situation. Once it was determined that flows would be non-damaging, little further communication took place.	Nil – no effect
Bureau of Meteorology	Numerous occasions over event. Provision of advice on discharges from Wivenhoe; receipt of advice on probable rainfalls; exchange of information on reservoir inflows	Several occasions during event although nowhere near as frequent because of the small nature of the event and the constancy of the discharge.
Pine River Shire Council	Messages that flood releases 'were expected', 'were imminent' and 'were occurring' in accordance with PSC procedure.	Messages that flood releases 'were imminent' and 'were occurring' in accordance with PSC procedure.
Ipswich City Council	To advise of need to close bridges and crossings	To advise of potential need to close Colleges Crossing (on several occasions as the crossing was thought to be close to overtopping although this never eventuated).
Esc Shire Council	To advise of need to close bridges and crossings	To advise of need to close Twin Bridges.
Kilcoy Shire Council	Advising of probable flood levels upstream of Somerset Dam	Nil – no effect

Authority	Occasion in February Event	Occasion in March Event
SEQWB	Advice of mobilisation Advised of operational strategy on a daily basis as per FCC Log Discussions were also had with SEQWB Chairman on possible options for dam operations.	Advice of mobilisation Advised of operational strategy on a daily basis as per FCC Log

11. PERFORMANCE OF RTFM SOFTWARE

11.1 Data Collection System

Overall the data collection system performed well over both flood events. However, some major problems in the *FLOODCOL* data collection system were discovered within 36 hours of the start of the February event.

The problem was first noticed at 2015 hrs on the 9th February when it was realised that the HP workstation (Noah) had stopped receiving data from the data collector. The problem was deemed serious and Warren Shallcross (of DNR, SWA) was contacted. Warren came to the FCC and began to investigate the problem.

Warren Shallcross contacted the system developer, Bradley Alderton, by phone in Melbourne and a fix was progressively worked out which could allow the Data Collector to keep operating. The error was eventually tracked back to the corruption of a calibration curve for O'Reilly's Weir. Whenever signals were received for the station it would try to access the discharge calibration and it would hang the collector. Once the problem was isolated, a 'fix' was developed which allowed relatively trouble free subsequent operation.

11.2 Calibration of Hydrologic Models

The calibration of the various hydrologic models generally proved adequate for the purpose to which they were applied. The parameters used in calibrating the hydrological models were the 'initial loss' and 'continuing loss' parameters.

The Duty Engineer utilising the results of the hydrological models needs to be aware of the limitations of the models. These limitations include:-

(a) The hydrological modelling tended to advance the peak forward in time relative to the measured values. This effect is a typical property of the RORB type models used for the hydrological models.

This effect became especially evident during the drainage phase of the smaller March event when releases from Wivenhoe had to be timed to the recession of Lockyer Creek. This was overcome by using the ALERT data directly to determine when discharges in the Lockyer had dropped sufficiently to allow an extra opening of the Wivenhoe gates.

The effect was not so significant in the February event because the discharges from Wivenhoe were much greater than the discharges in Lockyer Creek.

(b) It is noted that the calibrations of the hydrological models were biased towards higher flows and that good calibrations were not expected at the lower flows typical

of the March event. Despite this, the calibrations produced for this event were generally acceptable.

(c) The models do not model the base flows well, at the end of the recessional phase of a flood event. This can be important at the end of a flood event when the Duty Engineer is trying to close off discharges from a dam and maintain it at Full Supply Level. While the inclusion of a Sacramento soil moisture model may overcome this, the Duty Engineers are not sure whether this extra complexity is warranted.

The Duty Engineer, using the models, needs to be aware of the model limitations and modify the dam operations to suit.

11.3 Gate Operational Models

11.3.1 Operational Model for Wivenhoe and Somerset Dams

These dams are considered jointly because Somerset Dam releases are dependent on the storage levels in Wivenhoe which are in turn partially dependent on Somerset dam releases.

For some time it has been known that the existing *FLOODOPS* routines did not properly calculate the required releases from either Somerset of Wivenhoe dams. To cover this problem, a separate Fortran 77 routine, named *WIVOPS,* was developed some time ago to assess the required flood operations at each dam. This routine worked well except that it provided little flexibility for the Duty Engineer to vary the operation to suit local circumstances and practicalities (eg. It often requires rapid opening and closing of the same gate to optimally control releases to keep particular crossings open).

Use of the *WIVOPS* routine is messy as it requires the user to extract inflow hydrographs from the UNIX *FLOODOPS* system and then run *WIVOPS* under MS-DOS.

The long term 'fix' is to integrate two modules into *FLOODOPS* for the operation of these dams. The first is the integration of *WIVOPS* into *FLOODOPS.* This has been flagged for some time and it is hoped that it will be completed within the next several months. The second is a module that can run a 'user edited' version of the gate operations produced by *WIVOPS* through both storages. This option will add greatly to the flexibility of the system as it will allow running of the many 'what ifs' which are considered during the course of the event.

To overcome the inability to run a predetermined set of gate openings through each dam an EXCEL spreadsheet was developed during the first event to perform this task. This spreadsheet allowed comparison of the measured reservoir levels to the theoretical predictions and it produced accurate assessments of drainage times.

11.3.2 Operational Model for North Pine Dam

North Pine Dam is the simplest of the three dams to operate because it relies on simply setting a minimum gate opening corresponding to particular storage elevations. The *FLOODOPS* component of the RTFM performed well for this storage.

An EXCEL spreadsheet was developed during the drainage of North Pine Dam down to EL 39.55 mAHD during the March event to examine the effect of holding the radial gates open longer than would otherwise be necessary for a given level on the build up

phase of the flood. This spreadsheet produced accurate estimates of the recorded drainage times.

It is expected that the integration of 'user edited' gate opening sequences (as discussed in Section 11.3.1) into *FLOODOPS* will make this spreadsheet redundant although it was extremely useful in determining the effect of 'what ifs'.

11.4 Effect of Diversions into Lake Clarendon and Atkinson's Lagoon

It was known that diversions into both Lake Clarendon and Atkinson's were occurring during both events. However, no account was taken of these activities as the diversion rates were small in comparison to the natural flows.

11.5 Review of Rating Curves

Considerable difficulty was experienced (during the drainage phase of both events) at getting flows at one station to correspond with flows at downstream stations. Because of the nature of releases from Wivenhoe, it should be possible to set a number of firm points on the discharge rating curves for the following stations.

- Wivenhoe Tailwater
- Lowood (A) and (B)
- Savages Crossing
- Mt Crosby
- Moggill
- Jindalee

The discharges of interest would be:-

- 150 m^3/sec To maintain College's Crossing open
- 250 m^3/sec To maintain Burton's Crossing open
- 550 m^3/sec To maintain Kholo Bridge open
- 1800 m^3/sec To maintain Mt Crosby Weir bridge open.

Detailed examination of the records would be required as part of such a review.

12. FLOOD MANAGEMENT STRATEGIES FOR FEBRUARY 1999 EVENT FOR WIVENHOE AND SOMERSET DAMS

12.1 Flood Development

Widespread rainfall in all catchments commenced on Sunday 7/02/1999 and late Sunday Somerset dam water level was rising at 80 mm/hr. At 1045 hrs the BoM advised that another150mm was expected in the next 24 hours. At 1645 hrs BoM advised that heavy rain would continue for another 12 hours and a decision to mobilise the Flood Control Centre was made. Soon after BoM issued a flood warning for the Stanley and upper Brisbane Rivers which was closely followed by a similar warning for Lockyer, Bremer and Warrill Creek. On Tuesday at 0745 hrs BoM advised the development of a Low in the Hervey Bay area and the prediction of a 3800 m^3/s inflow into Wivenhoe Dam. At 1624 hrs that day BoM issued a QPF of 20 mm in the next 24 hours in the catchment.

Full inflow and outflow hydrographs for the February event are presented in Appendix D.

12.2 General

- Most rain fell in the Somerset catchment and the northern part of the Wivenhoe catchment with relatively minor falls occurring in the Lockyer and Bremer catchments.
- Releases from Wivenhoe under such circumstances are not well covered by the procedures in Manual of Operations. This is because the relatively small discharges in the Bremer (peak 142 m^3/sec) and the Lockyer (peak 950 m^3/sec at O'Reilly's, 375 m^3/sec at Lyon's Bridge) restrict the Wivenhoe discharge to less than that required to discharge the flood storage component in seven days.
- Volume of the flood was assessed relatively accurately early in the event (as early at 1230 hrs on 8/2/99 a peak elevation in Wivenhoe of EL 70.05 was predicted ... (cf actual EL 70.45)
- The option to release floodwaters through Somerset regulators was not available for most of the February event because the regulators were inundated once Wivenhoe exceeded EL 69.30 mAHD. For the smaller March event, this was not a problem as Wivenhoe peaked at EL 67.59 mAHD.
- The interaction curve between Wivenhoe Dam and Somerset Dam reservoir levels is shown in Figure 12.1.

12.3 Discharge Strategy Development for Wivenhoe Dam

Date & Time		Activity
8th February	1200 hrs	Operators mobilised to site and ready for operations
		Event builds up with water levels in dams rising towards Full Supply Level
9th February	0925 hrs	Volume of the event dictates that drainage discharge had to be in excess of these peaks in order to drain in 7 days.
		Runs of FLOODOPS predicts (if no more rain) discharge of 1900 m^3/sec required at Mt Crosby for approximately 24 hrs.
	1010 hrs	Wivenhoe reaches FSL of 67.00 mAHD
	1030 hrs	Request to close Wivenhoe regulator prior to the opening of radial gates
	1037 hrs	Dam Supervisor Wivenhoe advises that a man is stuck at Twin Bridges. SES is attempting to rescue him. Decision taken by SFOE to defer gate opening.
	1140 hrs	Police and Esk Sire Council advised releases of up to 1600 m^3/sec expected over the next three days.
	1217 hrs	Run of FLOODOPS predicts discharge of 1900 m^3/sec required at Mt Crosby for approximately 72 hrs.
	1153 hrs	Wivenhoe Dam Gate 3 was opened 0.5 metres when the water level reached EL 67.25 mAHD in accordance with Procedure 1A.
		Runs of FLOODOPS confirm predictions that a discharge of 1640 m^3/sec will be required by 2050 hrs, which will gradually increase to 1840 m3/sec by 1140 hrs on 12th March as Lockyer flow decreases.

Interaction Diagram

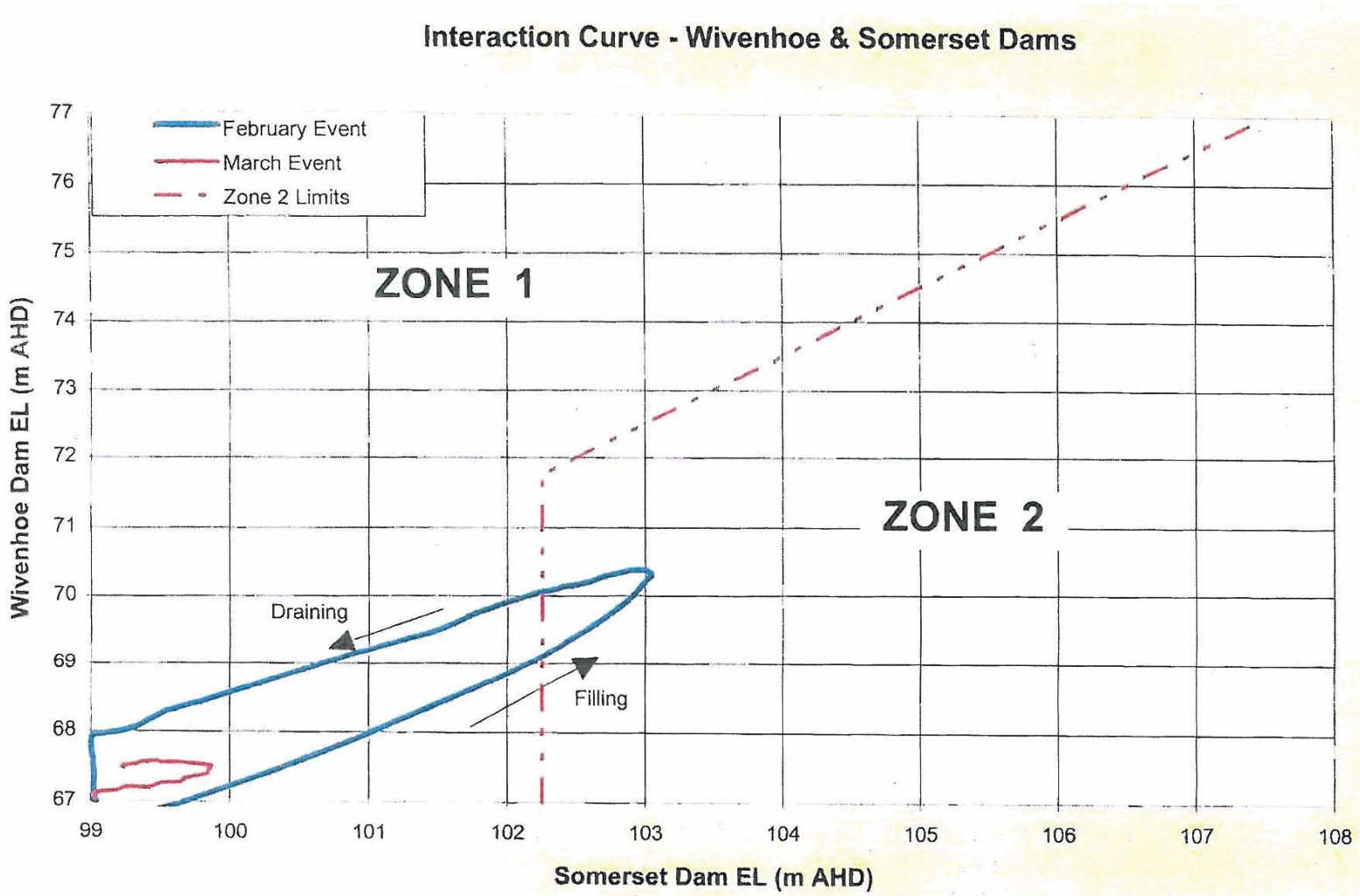

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Figure 12.1

Date & Time		Activity
9th February (continued)	1511 hrs	Wivenhoe reaches EL 68.25 mAHD; Dam Supervisor given direction to open Gate 3 to 4m in 10 minute intervals. (Procedure 1E); Discharge approx 400 m^3/sec.
	1535 hrs	Police advised of need to close Kholo Bridge ... They agreed to check if it already been closed
	1548 hrs	Esk Shire Council confirm Burtons Bridge closed
	1600 hrs	Wivenhoe complete opening of Gate 3 to 4.0 m; Discharge 400 m^3/sec
	1630 hrs	Gates 2 & 4 opened to 0.5m and Gate 3 to 4.0 m. Wivenhoe EL 68.5m (Procedure 2 – overriding requirement to restrict discharge to peak of Lockyer/Bremer because of need to drain in excess of 1800 m^3/sec. – Aim to keep Mt Crosby open) Total discharge 507 m^3/sec.
	1700 hrs	Gate 3 was opened to 4.5m, Gates 2 & 4 to 1.0m. Wivenhoe EL 68.62m (Procedure 2). Total discharge 660 m^3/sec.
	1900 hrs	Gate 3 open to 4.5m, Gates 2 & 4 at 3.0, Gates 1 & 5 at 0.5 m Wivenhoe EL 69.0 m (Procedure 2). Total discharge 1217 m^3/sec.
	1950 hrs	Gate 3 open to 4.5m, Gates 2 & 4 at 3.5 m, Gates 1 & 5 at 1.0m;. Wivenhoe EL 69.1m, Discharge 1410 m^3/sec.
	2320 hrs	Run 'peter9' indicates releases from Somerset necessary which will necessitate releases from Wivenhoe in excess of 2000 m^3/sec and a combined Lowood flow of 2400 m^3/sec. Decision taken (after discussions with John Mulheron (SEQWB) and after consideration of advice from BoM that no significant rain was forecast) to hold releases from Somerset and Wivenhoe as is until the morning and then review decision.
	2400 hrs	Gate 3 closed to 4.0 m to avoid the peak of the Lockyer and keep Mt Crosby open; Discharge 1414 m^3/sec.
10th February	0250 hrs	Gate 2 closed to 3.0 m to reduce Lowood flow and keep Mt Crosby open; Discharge 1362 m^3/sec.
	1033 hrs	Gate 4 closed to 3.0 m to reduce Lowood flow and keep Mt Crosby open; Discharge 1327 m^3/sec.
	1615 hrs	Wivenhoe peaks on ALERT (#6638) at 70.38 mAHD; Site measurements indicate peak of 70.43 m at 1850 hrs
	1830 hrs	Gates 1 & 5 opened to 1.5 m to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge 1445 m^3/sec.
	1848 hrs to 2050 hrs	Gate 3 opened to 4.5 m and Gates 2 and 4 progressively opened to 3.5 m to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge at 2050 hrs 1600 m^3/sec.
11th February	0210 hrs	FLOODOPS runs predict need to hold release for Mt Crosby criterion until about 0000 hrs 14th February when it can be ramped down to 550 m^3/sec. Precise timing of 'ramp down' depends on rate of reduction of gate openings.
	0450 hrs	Gate 3 opened to 5.0 m to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge 1649 m^3/sec.

Date & Time		Activity
11th February (continued)	1115 hrs	After some experimentation, Gate 1 opened to 1.5 m (in preference to opening Gate 2 to 4.0m) to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge 1694 m^3/sec.
Period to 12th February:1935 hrs		Wivenhoe gates progressively opened to Gate 1 & 5 at 2.5 m, Gates 2 & 4 at 3.5 m and Gate 3 at 5.0 m. Discharge 1784 m^3/sec. These gate openings were then held until ramp down to 550 m^3/sec
14th February commencing at 1100 hrs until 15th February at 1100 hrs		Ramp down to 550 m^3/sec to bring Kholo bridge out of water. A one hour interval between gate closures was adopted instead of the 20 minute minimum interval set in the Manual so as to minimise bank instabilities. With only one minor problem associated with an hydraulic motor oil leak, gate closures went according to plan with final gate openings of Gates 2 at 0.5 m, Gate 4 at 1.0 m and Gate 3 at 4.0 metres. Discharge 546 m^3/sec.
15th February	1350 hrs	Ray Fitzsimon began observations of Kholo Bridge to monitor it's emergence from the flood waters. At 2040 hrs, the water level had dropped to the point where sideboards of bridge were keeping water out.
16th February	2100 hrs	Discussed options for bringing Burton's Bridge out of floodwaters with John Mulheron (SEQWB). If current release was maintained final closure would be on 18th. If discharge reduced, it would take until 23rd to drain. After some discussion convinced JM to keep status quo at least until following morning.
17th February	2330 hrs	Began closure of gates to bring Burton's Bridge out of water using 30 minute closure intervals. Completed at 0130 hrs on 18th. Designed to bring Burton's out of water by morning.
18th February	1900 hrs	Began final closure of Wivenhoe at 30 minute intervals. Closure completed by 2130 hrs
19th February	1230 hrs	Event declared over and FCC demobilised. Ongoing monitoring of lake levels by Duty Engineer remotely using FLOODPC.

12.4 Performance of Wivenhoe Radial Gates

(a) As discussed in Section 18.1, some 'experimentation' was necessary into the required gate openings for the side gates (Nos. 1 & 5) during the course of the event. It was found that the side gates had to be opened earlier than indicated in the Manual of Flood Operations to limit the impact of the spillway flow jet on the sidewall of the spillway plunge pool. This variation was done in conjunction with the Dam Supervisors who provided feedback on gate operations. This action was confirmed by a visit to the dam by the Duty Engineers on Friday 12th February.

(b) Significant vortices were noticed on the upstream side of the radial gates. A photo is shown as Figure 12.2. These vortices were evident in the original model testing and are not considered to present any problems for gate operations. Flow patterns of this type will always be present for gate arrangements such as this where the gates are relatively recessed downstream of the pier noses. These vortices should not cause significant gate vibrations. Indeed, as the gate openings become larger and the gate starts to lose control of the flow the turbulence could be expected to be more significant.

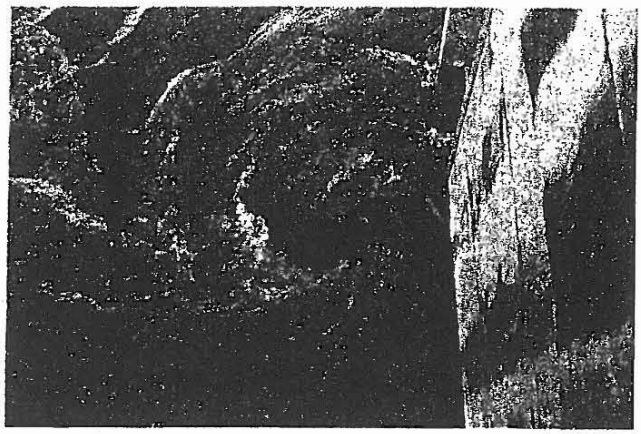

Figure 12.2 Vortex formation upstream of the Wivenhoe Radial Gates

12.5 Inundation of Brisbane River Crossings

A significant amount of time and effort was successfully input into ensuring access across the Brisbane River was maximised. The location of these crossings is shown in Figure 12.5. As indicated above, the lower level crossings were inundated early in the event and the principal control criteria soon became limiting the discharge at Mt Crosby Weir to less than 1900 m^3/sec. In the event, the flood control team was able to keep the flow lapping the underside of the weir bridge for approximately four days. The situation is show in Figures 12.3 and 12.4, which were taken at approximately 1400 hrs on Friday 12th February.

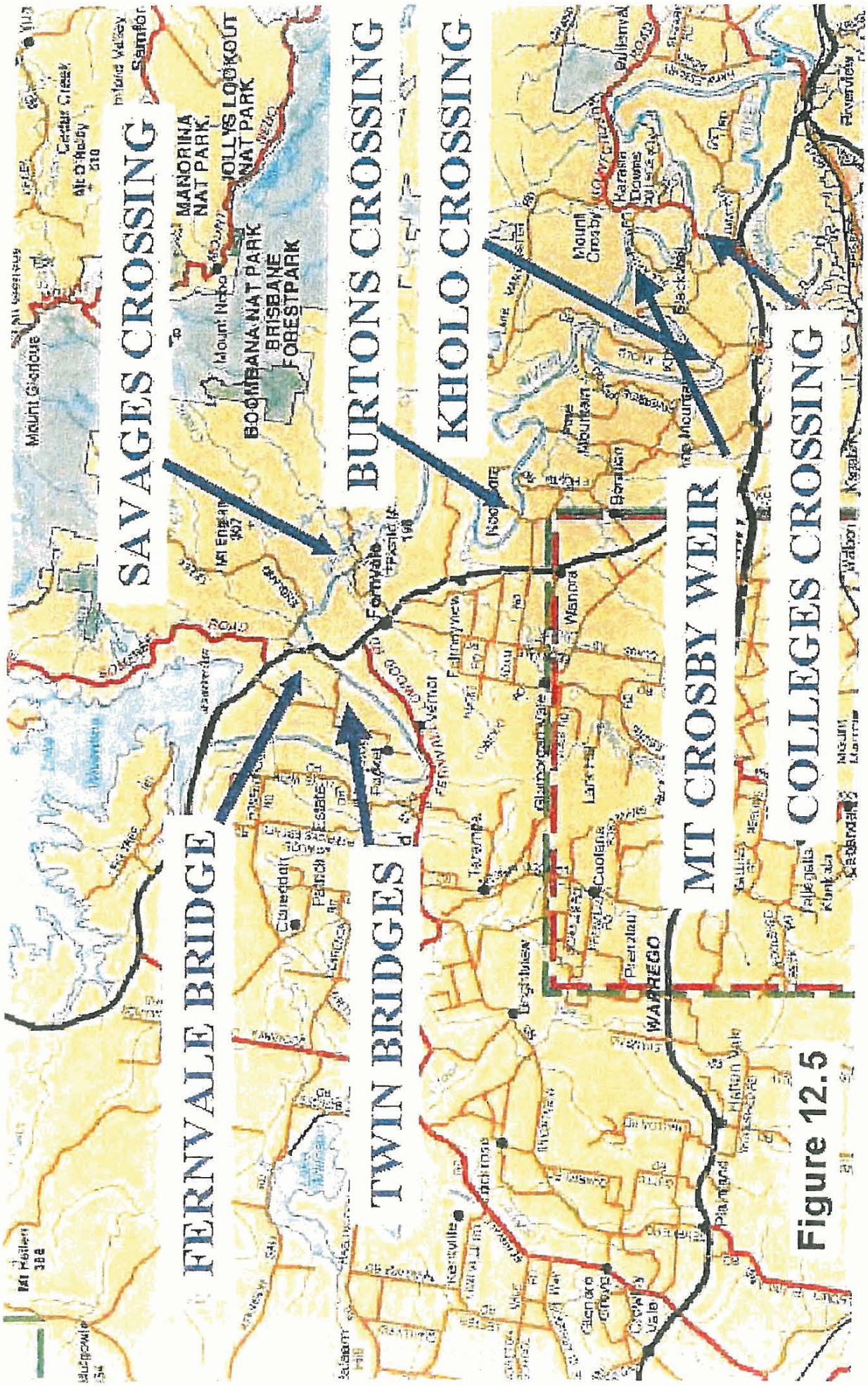
SAVAGES CROSSING
BURTONS CROSSING
KHOLO CROSSING
FERNVALE BRIDGE
TWIN BRIDGES
MT CROSBY WEIR
COLLEGES CROSSING
MANORINA NAT PARK
JOLLYS LOOKOUT NAT PARK
BOOMBANA NAT PARK
BRISBANE FORESTPARK
WARREGO

Figure 12.5

Figure 12.3 & 12.4 Mt Crosby Weir Bridge – 1400 hrs Friday 12th February

Fernvale Bridge, with an immunity of approximately 2000 m^3/sec remained opened at all times during the event with a small clearance between the underside of the bridge beams and the flow. This clearance was less than 200 mm at times.

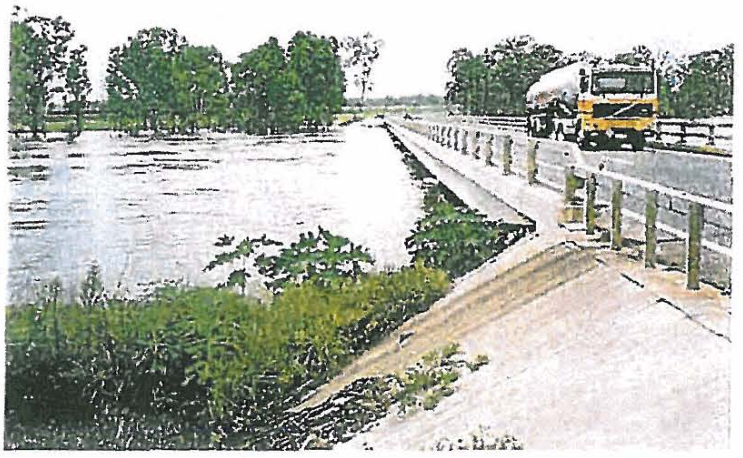

Figure 12.6 Fernvale Bridge 1430 hrs Friday 12th February

As soon as it was reasonably practicable, the flow was reduced to 550 m3/sec to bring the Kholo Bridge out of water. Figure 12.7 shows Kholo Bridge on 16th February.

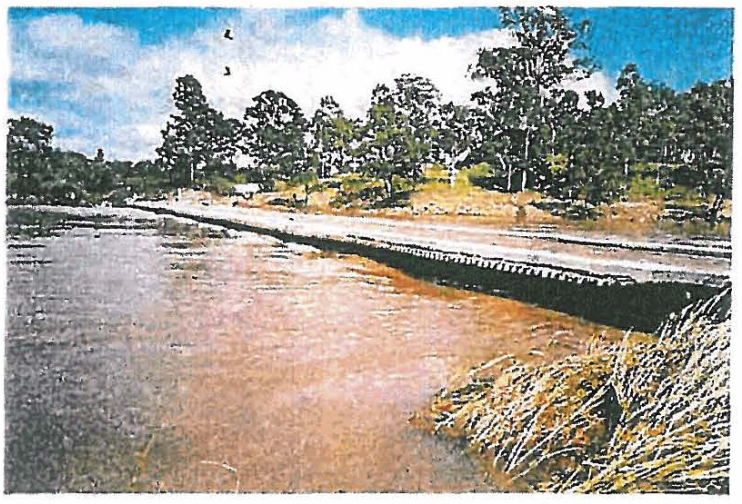

Figure 12.7 Kholo Bridge Tuesday 16th February

12.6 Discharge Strategy Development for Somerset Dam

Date & Time		Activity
8th February	1300 hrs	Operators mobilised to site and ready for operations
9th February	0925 hrs	Completed raising of radial gates to allow unrestricted flow over the ogee crests in accordance with the Manual of Flood Operations for Wivenhoe and Somerset Dams.
	1553 hrs	Headwater reached EL 100.45 mAHD and discharge began over the fixed crest.

Date & Time		Activity
9th February (continued)		No further action was taken until the storage reached EL 102.25 mAHD (the minimum for releases into Wivenhoe if it has not peaked). This level was achieved at approximately 2000 hrs on 9th March.
	2235 hrs	Sluice L is opened to limit the rate of rise in Somerset and to head towards (EL 107.5, EL 77) on the Wivenhoe/Somerset Dam interaction curve. This release was in accordance with DNR Procedure FLX41101.
	2340 hrs	FLOODOPS run indicates initial opening of another sluice followed by the progressive closure of the Somerset crest gate to control the rate of rise of Somerset relative to Wivenhoe. Decision taken to hold releases unchanged ... The effect will be storage neutral on Wivenhoe by mid-day (following day); it will avoid numerous gate operations and will be more acceptable to affected persons upstream in Kilcoy. ... Situation discussed and strategy agreed with John Mulheron (SEQWB)
10th February	1200 hrs	Wivenhoe peaks at EL 70.38 mAHD (ALERT)
11th February	1055 hrs	Sluice M opened to replace reductions in Upper Brisbane inflows into Wivenhoe Dam.
	1240 hrs	Discussed situation with John Mulheron (SEQWB) who advised DE that D'Aguilar Highway bridge was inundated by Somerset headwaters above EL 102.035 mAHD.
12th February	2028 hrs	Sluice K opened to increase rate of draining of Somerset Dam.
13th February	0908 hrs	Somerset regulators now above water. Tailwater EL 69.3mAHD
14th February	1320 hrs	Testing of regulators to see if they are operational following inundation by Wivenhoe floodwaters.
	1425 hrs	Sluice K closed as part of closedown sequence.
	1700 hrs	Sluice M closed and one regulator opened as part of closedown sequence.
15th February	1700 hrs	Sluice L closed when lake level dropped to EL 99.025 mAHD as part of planned closure sequence.
	2010 hrs	Somerset reaches FSL of EL 99.00 mAHD. Regulator '12' closed and shift work stopped.
18th February	0945 hrs	Closure of crest gates
		Ongoing monitoring of ALERT lake levels from FCC with twice daily reports of lake level to FCC.

13. FLOOD MANAGEMENT STRATEGIES FOR MARCH 1999 EVENT FOR WIVENHOE AND SOMERSET DAMS

13.1 General

The flood developed slowly at Somerset with a number of storms that deposited a catchment average of just over 100 mm over several days. The main components of this rainfall occurred over a 16 hour period from about 0900 hrs on the 28th February and a 6 hour period from 0300 hrs on the 1st March.

Little flow occurred at any time in the catchment above Wivenhoe Dam.

Because of the minor magnitude of the March inflows it was decided to control the Somerset Dam level using the regulators and to pass this flow almost directly through Wivenhoe. Releases from Wivenhoe were initially discharged through it's regulators until flows from the Lockyer Creek catchment inundated the Twin Bridges crossing. Once the Lockyer inundated Twin Bridges, it was decided to increase the Wivenhoe discharge to reduce the drainage time. The strategy was to keep the combined discharge from the Lockyer and Wivenhoe less than 175 m^3/sec.

Because the peak outflow from Lockyer Creek was approximately 135 m^3/sec, the discharge from Wivenhoe was initially held at 50 m^3/sec until 2030 hours on the 4th March when it was reduced to 30 m^3/sec to ensure that the peak of the Lockyer would not inundate College's Crossing. Releases were then progressively increased to 170 m^3/sec so as to drain the flood storage as quickly as reasonably possible while having the minimum effect on downstream communities.

Final closure of the Wivenhoe radial gates was achieved at 1800 hrs on 15th March with discharge control being transferred to the regulators. Final closure of the Wivenhoe regulators was ultimately achieved on 18th March.

13.2 Discharge Operations

The following tabulation summarises the principal decisions taken in operating Somerset and Wivenhoe dams during the development of the flood.

Date and Time		Item
28th February	2050	Initial runs of hydrological models indicate a maximum inflow of approximately 80 m3/sec and a reservoir rise of 0.2 metres.
1st March	0630	Initial mobilisation (primarily as a result of inflows into North Pine Dam although minor inflows had occurred in the preceding days which had increased the storage level to EL 99.10 prior to mobilisation)
	1200	Direction to Somerset Dam operators that radial gates be opened.
	1239	Confirmation received that Somerset Dam radial gates were open
	1300	DE John Ruffini discussed the emerging situation with Garry Grant (SEQWB) and advised that a regulator would be opened at Somerset and two regulators would be opened at Wivenhoe. The aim would be to drain it steadily through Wivenhoe while keeping Twin Bridges crossing open.
	1400	Direction to Somerset Dam to open two regulators 50% Total discharge 69 m^3/sec
	1418	Direction to Wivenhoe to open two regulators 50%; Total discharge 30 m^3/sec
	1422	Confirmation of opening of Somerset regulators
	2015	Dam Supervisor; Wivenhoe told to stand down for night and return to duty in the morning
	2145	Scenarios run on basis of 0 mm and 50 mm continuing rain over next 48 hours. Both cases indicated within operational range of regulators

Date and Time		Item
	2210	Dam Supervisor, Somerset told to stand down for night and to return to duty in the morning
2nd March	0600	Somerset Dam EL 99.35 mAHD; Wivenhoe Dam EL 67.17 mAHD
	1135	Review of gate operations – Twin Bridges still 43 cm below top of culvert. Decision taken to upgrade Wivenhoe discharge to 50 m^3/sec. Wivenhoe Dam Supervisor directed to open regulators to 50 m^3/sec.
2nd March (continued)	1630	Dam Supervisor, Wivenhoe told to stand down for night following a final reading at 1700 hrs.
3rd March	0900	Discussions between David Gill, Garry Grant & John Mulheron (SEQWB) and Peter Allen, John Ruffini and Don Cock (DNR) re: Somerset/Wivenhoe Dam operations. It was concluded that the slow drainage of Wivenhoe using the Twin Bridges criterion (55 m^3/sec at Lowood) was the preferred option despite the fact that it would take until 17th March to drain. (refer: Fax to SEQWB 3rd March 0730 hours).
	2145	Runoff occurring in Lockyer Creek following afternoon rainfall. Flow has inundated Twin Bridges.
	2315	Inspection of Savages Crossing bridge by Dam Supervisor, Wivenhoe – Inspection indicates bridge is unserviceable and it is not relevant to consider it in determining revised discharge criterion for Wivenhoe.
4th March	0815	Previous day's rainfall has resulted in inflow into Wivenhoe Dam – extending probable drainage time if current strategy remains in place.
	1000	David Gill (SEQWB) advised we would be releasing on the back of the Lockyer Creek flow with the aim of keeping College's Crossing open.
	1530	Esk SC, Ipswich City C, Police, BoM advised of proposed release strategy for Wivenhoe
	1710	Wivenhoe regulators closed, Gate 3 opened in preparation for larger future releases.
	2030	Wivenhoe Gate 3 discharge reduced to 30 m^3/sec to avoid Lockyer peak and keep flow at Lowood to less than 175 m^3/sec.
	2400	Somerset Dam peaks at EL 99.87 m
5th March	0108	Wivenhoe discharge increased to 50 m^3/sec
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
	1500	Wivenhoe discharge increased to 100 m^3/sec
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
6th March	2010	Wivenhoe discharge increased to 150 m^3/sec

Date and Time		Item
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
8th March	2000	Wivenhoe discharge increased to 170 m^3/sec
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
9th March	0935	Wivenhoe discharge reduced to 150 m^3/sec (... due to suspected rise in discharge from Lockyer Creek.) Subsequent information proved this incorrect and the discharge was again raised to 170 m^3/sec at 2040 hours.
10th March	0915	SEQWB advised DG DNR had approved the holding of Somerset at EL 99.3 mAHD with ongoing releases using Somerset hydro operating 24 hours/day
10th March (continued)	1050	Somerset regulators closed with Somerset level 99.23 m
	1200	Installed temporary benchmark at Colleges Crossing to gauge rise and fall more effectively.
	PM	Problems experienced with O'Reilly's Weir gauge requiring several visits by Wivenhoe operators to confirm flows.
Ongoing		Continued monitoring of levels at Colleges Crossing
14th March	0930	Somerset crest gates closed, continued 24 hour releases through Somerset hydro station
15th March	1200	Closure of Wivenhoe gate to a discharge of 100 m^3/sec
	1800	Final closure of Wivenhoe gates with transfer of discharge to regulators – Regulators opened to 50 m^3/sec
16th March	1300	Reduction of regulator flow to 30 m^3/sec
18th March	0900	Final closure of Wivenhoe regulators with Wivenhoe at EL 66.94 mAHD and Somerset at EL 99.17 mAHD. (FSL deficit in Wivenhoe equivalent to FSL surplus in Somerset)

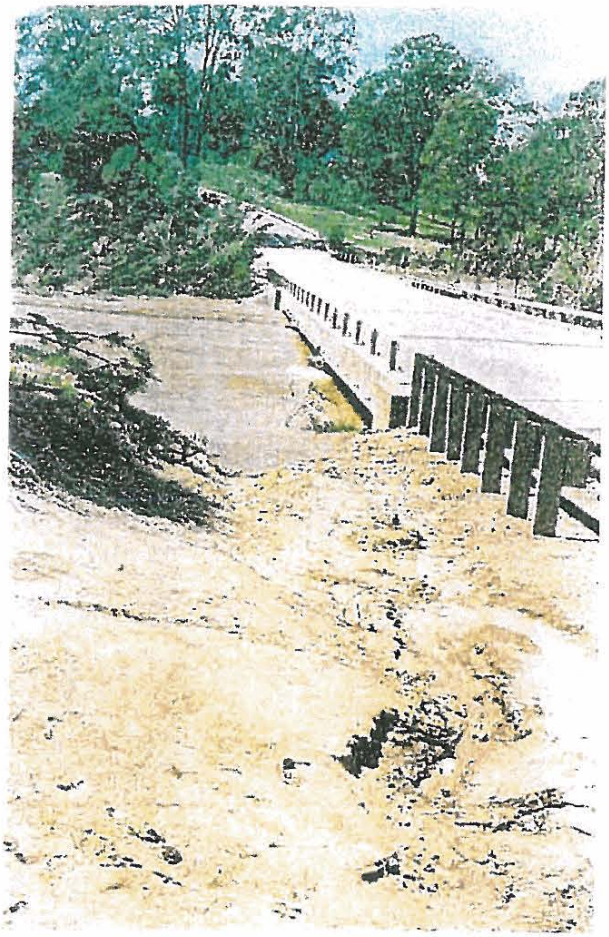

Figure 13-13.1 Colleges Crossing from Left Bank during March Event

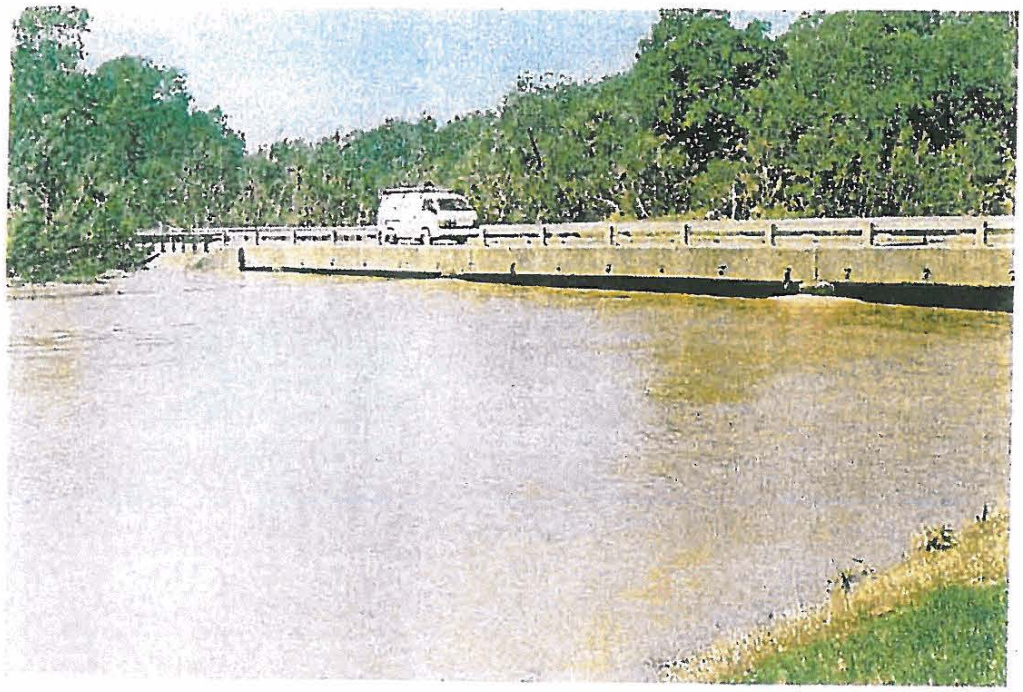

Figure 13-2 Main Span of Colleges Crossing from Upstream during March Event

14. FLOOD MANAGEMENT STRATEGIES FOR FEBRUARY 1999 EVENT FOR NORTH PINE DAM

14.1 General

The strategy adopted for North Pine Dam was in accordance with that specified in the Manual of Flood Releases for North Pine Dam.
Because North Pine was less than 60% full at the start of the event and over 300 mm of rain was required to bring it up to FSL, there was significant warning time at the start of the event prior to gate operations becoming necessary. One of the first runs of *FLOODOPS* that indicated gate operations were likely at North Pine was carried out at 2300 hrs on 8th February using the assumption of 100 mm of rainfall over the next 8 hours. This run predicted a peak level just over EL 39.60 mAHD. In the event a catchment average 76 mm of rain fell over the period with a total of 127 mm of rain falling over the next 48 hours.

A run performed at 0900 hrs on 9th February predicted it would peak at EL 39.78 mAHD at about 0400 hrs on the 10th February.

Preparations for gate openings were made by notifying the Pine Shire Council and the Police. These communications are recorded in the FCC Logs.

Gate operations began at 0530 hrs on 10th February. Initial gate movements were hampered by a sticking brakes on Gates C and E that tripped a circuit breaker. Gate A was ultimately opened and the problem rectified before the other gates needed to be operated. Maximum gate opening of all gates open to Setting No.1 was achieved at 1045 hours on 10th February. The reservoir peaked at EL 39.745 mAHD at 1130 hrs on 10th February.

14.2 Discharge Operations

Date and Time		Item
7th February		Heavy rain in catchment overnight with some minor rises recorded. Downloaded periodically to lap top through the night.
8th February	1000	Began full time monitoring in Flood Control Centre
	1045	BoM advises to expect 150 mm rain over the next 24 hours Operations Engineer advised to ensure staff report to dams
	1205	Dam Supervisor advises North Pine Dam fully operational
	1700	SEQWB formally advised of mobilisation
9th February	0645	Grant St and Young's crossings closed; Dam Supervisor contacts local police, 0715 FCC sends message to Pine Shire Council advising of proposed releases indicating a peak of ≈39.80 mAHD expected in North Pine.
	0805	Dam Supervisor advises FCC people still using Young's Crossing and contacts local police.
	0810	Pine Shire Council respond to our message
	1255	Confirmed advice that NP will operate
	1910	Advised Dam Supervisor that the first gate operation will be in early hours of morning
10th February	0100	Rang Duty Police officer to advise of imminent NP release; Rang PSC at home & at work – no answer.
	0330	Reviewed hydological models; not rising as quickly as predicted, now predict 6-7 am.
	0615	NP attempted to open Gate C; problem with electrical overload, Gate A opened instead. Problem with Gate C solved soon after and Gate A shut, Gate C opened.
	0630	PSC contacted re release.
	- 1135	All gates progressively opened to Setting 1 as water level rises to a peak of EL 39.745 mAHD.
	1726	FCC authorises Dam Supervisor to open all gates to Setting 2 according to Manual sequence if required.
		Gates progressively closed as level drops towards FSL 39.60 mAHD
12th February	0002	Second last gate (Gate E) closed
	0642	Young's Crossing being used by cars despite having water halfway across road. Grant's Crossing still impassable (flow 16 m^3/sec)
	1110	North Pine advised to revert to normal staffing with reporting requirements for levels at start of shift, regularly throughout the day and last thing at night. To revert to full 24 hour operation in the event of rain.
13th February	0145	Final gate closed. Full time monitoring of lake levels continued from FCC.

15. FLOOD MANAGEMENT STRATEGIES FOR MARCH 1999 EVENT FOR NORTH PINE DAM

15.1 General

The strategy adopted for North Pine Dam was in accordance with that specified in the Manual of Flood Releases for North Pine Dam. The event was relatively minor and, as discussed elsewhere, primarily resulted due to the saturated catchments and the full storages.

15.2 Discharge Operations

The following tabulation summarises the principal decisions taken in operating North Pine Dam during the March flood event.

Date and Time		Item
28th February	2050	Discussion with Garry Grant (SEQWB) indicated a gate was likely to be opened in the morning to drain the excess storage in North Pine. Calculations indicated one gate open to 'Setting 1' would drain the excess in 32 hours.
1st March	0630	Heavy rain in Pine River catchment causes rises in the storage. Decision to mobilise. Pine Rivers Shire Council (PSC) advised we plan to make release sometime after 0730 hrs. Requested PSC to close Young's Crossing.
	0715	BoM advise heavy rainfall over next three hours as front moves from Fraser Island south (Falls of 140 mm recorded over Sunshine coast hinterland)
	0825	Gate C opened to Setting 1
	1745	Gate E opened to Setting 1
2nd March	0415	Gate A opened to Setting 1 following heavy rain
	0720	Permission given to Dam Supervisor to exercise Cone valve regulators
	1003	Gate A shut in response to falling storage level
	1500	58 mm rain recorded at dam in previous two hours
	1625	Gate A opened to Setting 1
	1800	Gate D opened to Setting 1
	1845	Gate B opened to Setting 1; NP peaks at 39.77 mAHD
	2025	Gate B shut in response to falling storage level
	2315	Gate D shut in response to falling storage levels
3rd March	0205	Gate A shut in response to falling storage levels
	1630	Rainfall in catchment; Gate A opened to Setting 1
	2130	Decision to keep three gates open for moment as more inflow indicated by rises at Baxter's Creek
4th March	0815	Decision to keep three gates open in order to reduce the time

Date and Time		Item
		Young's Crossing is out of action.
	1735	Gate A shut as water level falls through EL 39.65 m
5th March	0522	Gate E shut as water level falls through EL 39.56 m
5th March (contd)	1025	Dam Supervisor rang to advise people using Young's Crossing despite having a flow of 19 m^3/sec.
	1145	Gate C shut with water level at EL 39.55 m
	1200	SEQWB and Police contacted and advised of cessation of operations.
		Ongoing monitoring of headwater levels

16. THE IMPACT OF WIVENHOE DAM ON THE FEBRUARY FLOOD EVENT

16.1 The Effect on the River Crossings

Figures 16.1 to 16.4 summarise the impact of Wivenhoe Dam on the crossings downstream of the dam during the February 1999 flood event. These charts show the period of inundation of Fernvale Bridge, Burton's Bridge, Kholo Bridge and Mt Crosby Weir Bridge with Wivenhoe Dam and without Wivenhoe Dam.

The results are summarised in the following Table.

Bridge	Discharge to Render Untrafficable (m^3/sec)	Period of Inundation with Wivenhoe Dam	Period of Inundation without Wivenhoe Dam
Fernvale Bridge	2000 m^3/sec	0 days	1.9 days
Burton's Bridge	250 m^3/sec	9.2 days	7.0 days
Kholo Bridge	550 m^3/sec	5.9 days	6.3 days
Mt Crosby Weir Bridge	1900 m^3/sec	0 days	2.0 days

These results are typical of flood mitigation dams where the peak is mitigated but the duration is prolonged. The inundation periods for Burtons and Kholo bridges would have been marginally longer had it not been for the fact that both Wivenhoe and Somerset were significantly drawn down prior to the event.

16.2 The Effect on Urban Flooding

The effect of urban flooding is summarised in Figures 16.5 to 16.7. These figures provide the flood heights at Moggill, Jindalee and the Port Office gauge. Significant flood damages begin to occur in Brisbane once the discharge exceeds approximately 4000 m^3/sec and the City Gauge level exceeds about EL 2.0 metres.

The following table summarises the impact of Wivenhoe Dam on the crossings downstream of the dam during the February 1999 flood event. These charts show the period of inundation of Fernvale Bridge, Burton's Bridge, Kholo Bridge and Mt Crosby Weir Bridge with Wivenhoe Dam and without Wivenhoe Dam.

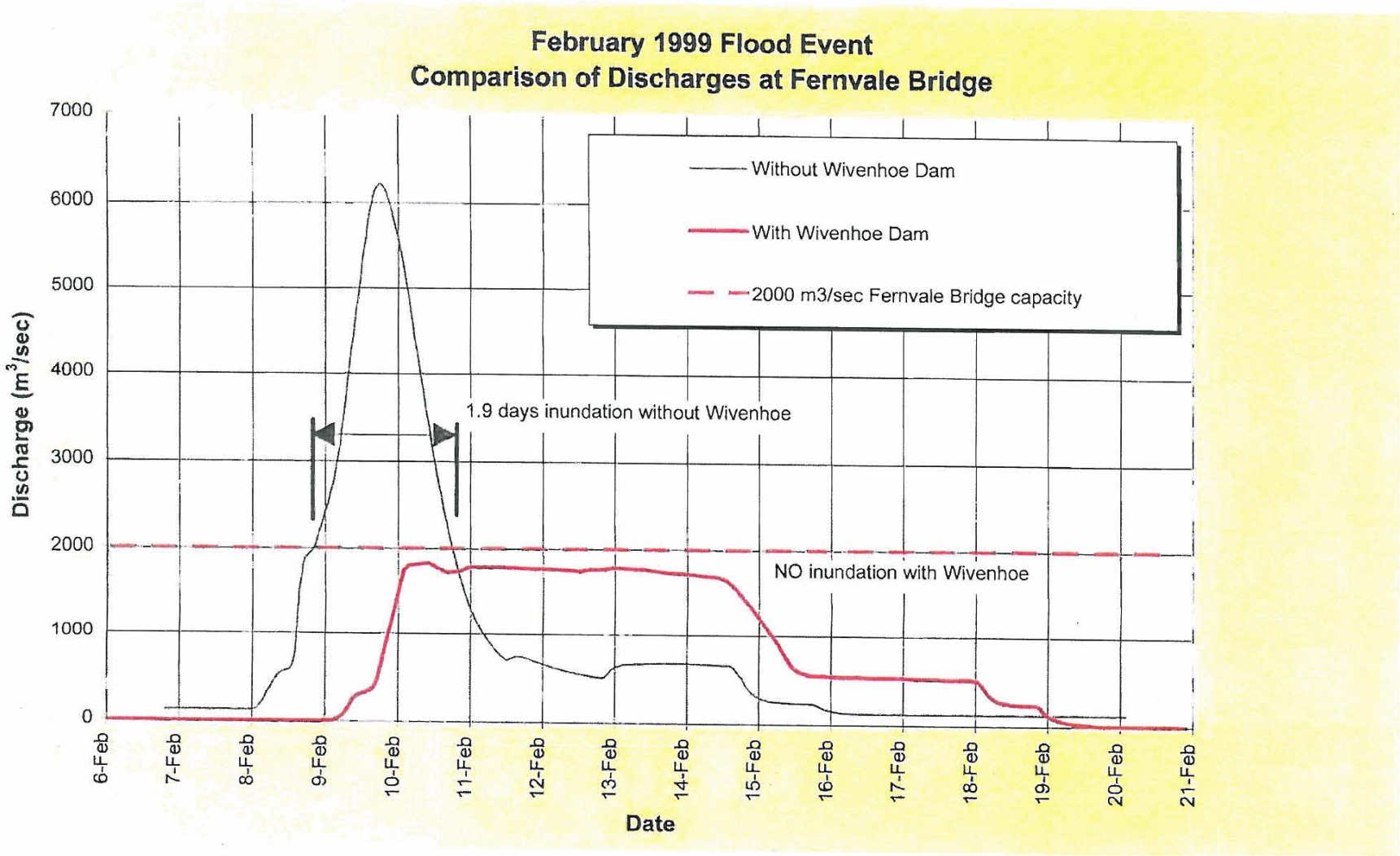

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FIGURE 16.1

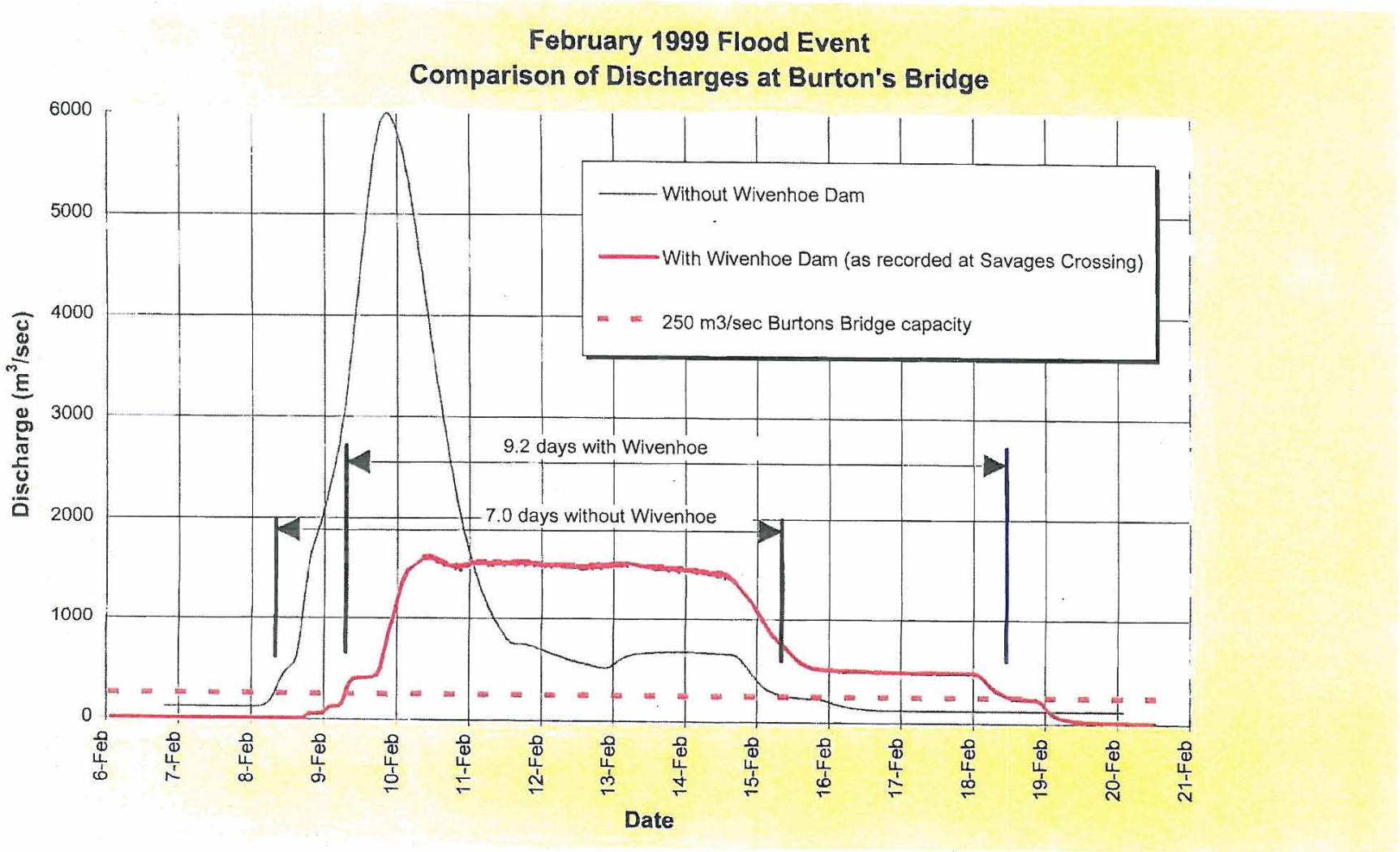

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FIGURE 16.2

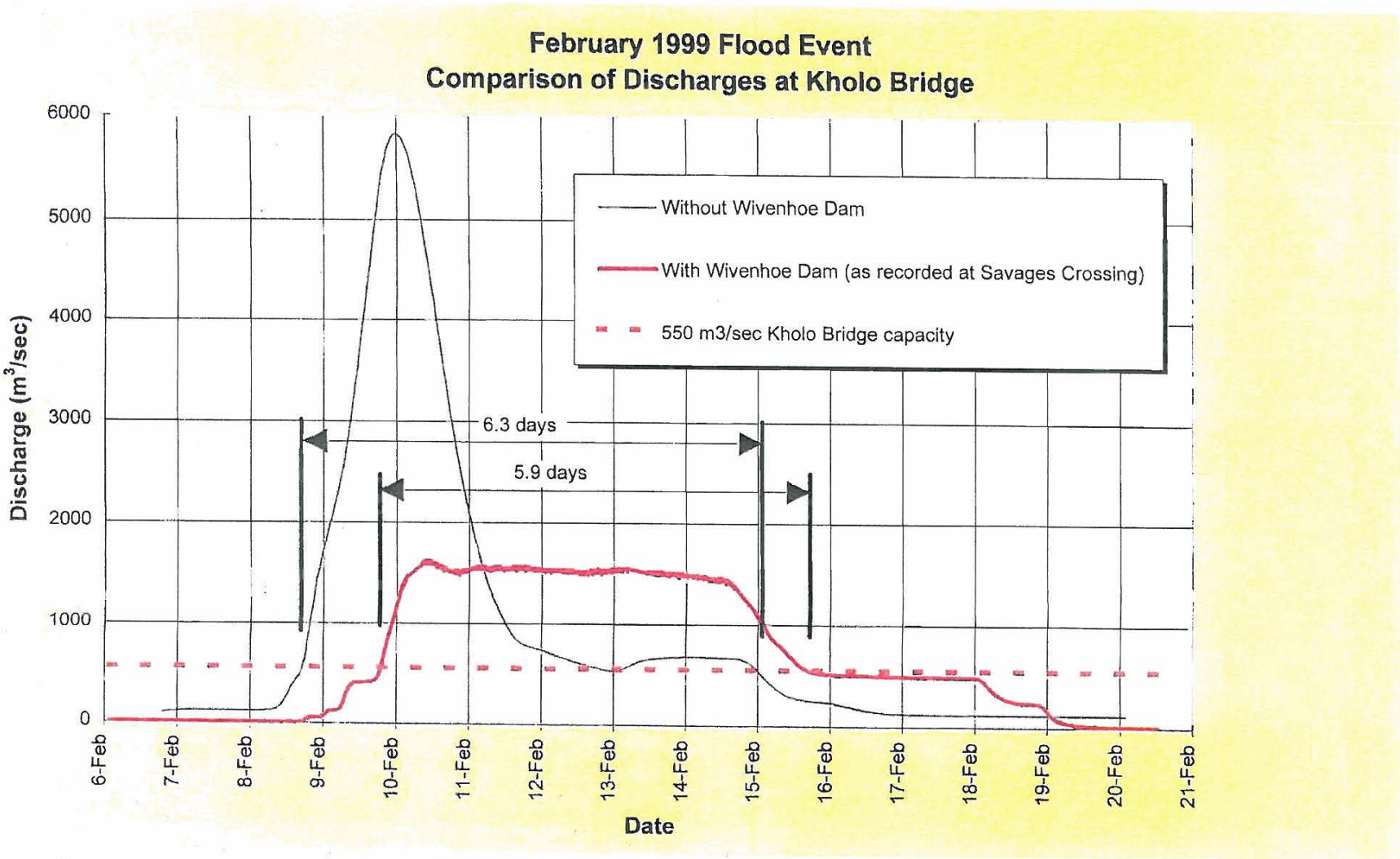

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FIGURE 16.3

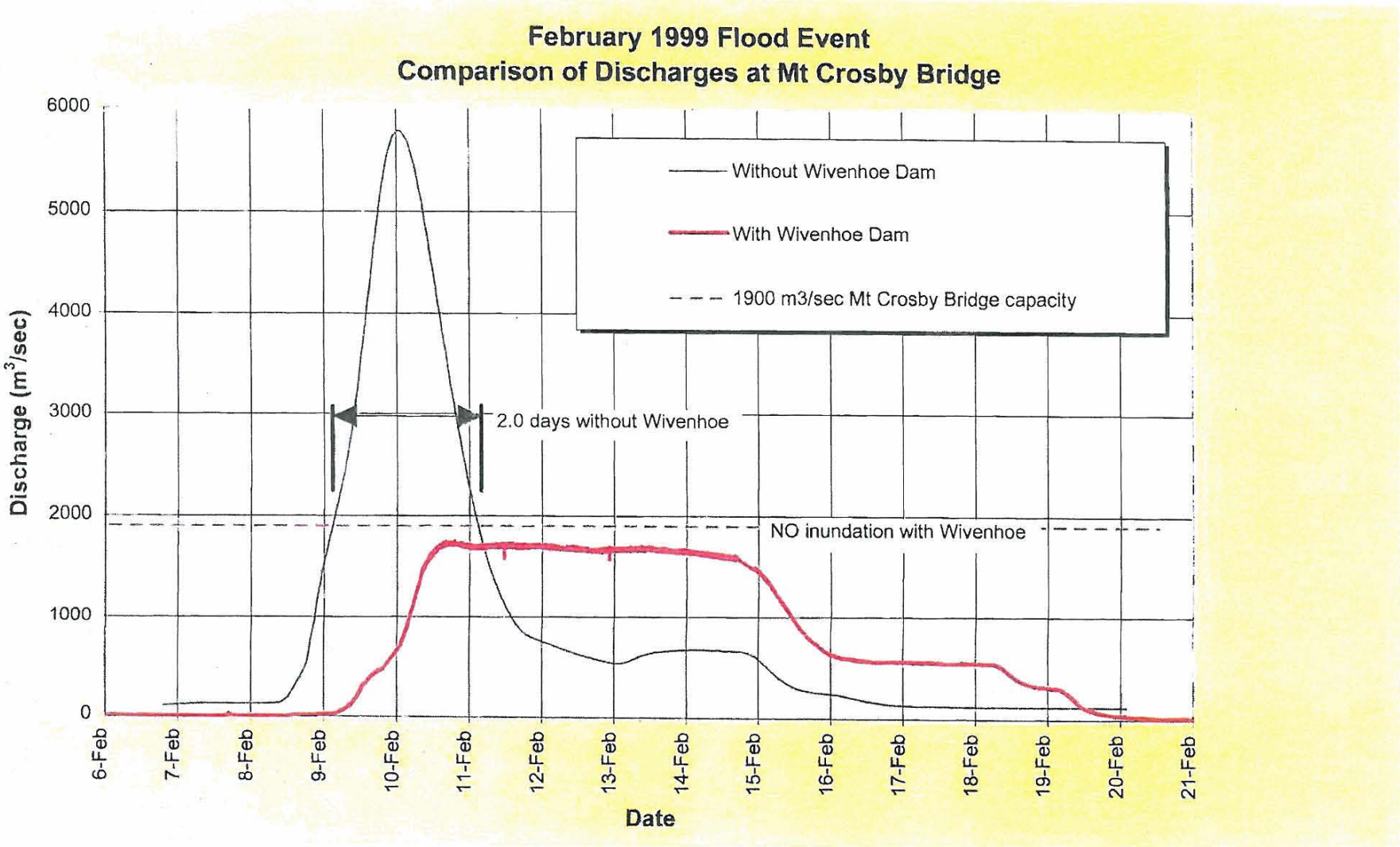

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FIGURE 16.4

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With Wivenhoe Dam in place the February event avoided perhaps $100 million worth of flood damages[7] and 1500 houses. As shown in the summary table, the February 1999 event was not of the same order of magnitude as the January 1974 event in the lower reaches of the Brisbane River. As stated elsewhere in this report, this was primarily due to the lack of runoff in the southern part of the catchment.

Location	Maximum Level February 1999 event with Dam	Maximum Level February 1999 event No Wivenhoe	January 1974 Level (No Wivenhoe Dam)
Moggill	1.5 mAHD	14.4 mAHD	19.9 mAHD
Jindalee	2.3 mAHD	7.95 mAHD	14.1 mAHD
Port Office Gauge	1.3 mAHD	2.5 mAHD	5.5 mAHD

Overall, the flood was just the right volume to provide maximum mitigation for downstream effects.

16.3 Effect on Bank Slumping

Every effort was made during operations for both events to minimise slope stability problems associated with rapid drawdown of water levels. This was done by not using the minimum gate operation intervals specified in the flood manuals. This was especially so for the reduction in flow from 1800 m^3/sec to 550 m^3/sec during the February event. This reduction was carried out over 24 hours using a one hour interval between successive gate operations. This interval was three times the minimum specified in the Flood Operations Manual.

Figure 16.8 provides a comparison of the water levels at Lowood during the period both 'with Wivenhoe Dam' and 'without Wivenhoe Dam'. It shows that the rates of rise and fall were similar for both conditions. It also demonstrates that, wherever reasonable, the time intervals between successive gate operations should be maximised.

17. COMMISSIONING OF THE REAL TIME FLOOD MODEL

17.1 General

Completion of these two flood events means that consideration should now be given to the commissioning of the Real Time Flood Model. The operators of the dams now have had significant experience in the operation of the model and parts of it have performed creditably.

In particular, it would appear appropriate to commission most components of the ALERT network and the *FLOODCOL* data collection system. The following notes are, however, relevant:-

(a) While *FLOODCOL* has been shown to be relatively reliable, there are still a number of 'bugs' that need to be fixed. These include the input of 'Wivenhoe Dam gate and regulator data and the soil moisture accounting models;

(b) Arrangements need to be made for the ongoing maintenance of the Real Time Flood Model following the completion of the commissioning phase. It is suggested

[7] Flood damages were based on the Snowy Mountains Engineering Corporation report for the Cities Commission on the "Brisbane River Flood Investigations, Final Report", November 1975. The damages were inflated to 1999 prices from those figures based on Figure 15 of that report.

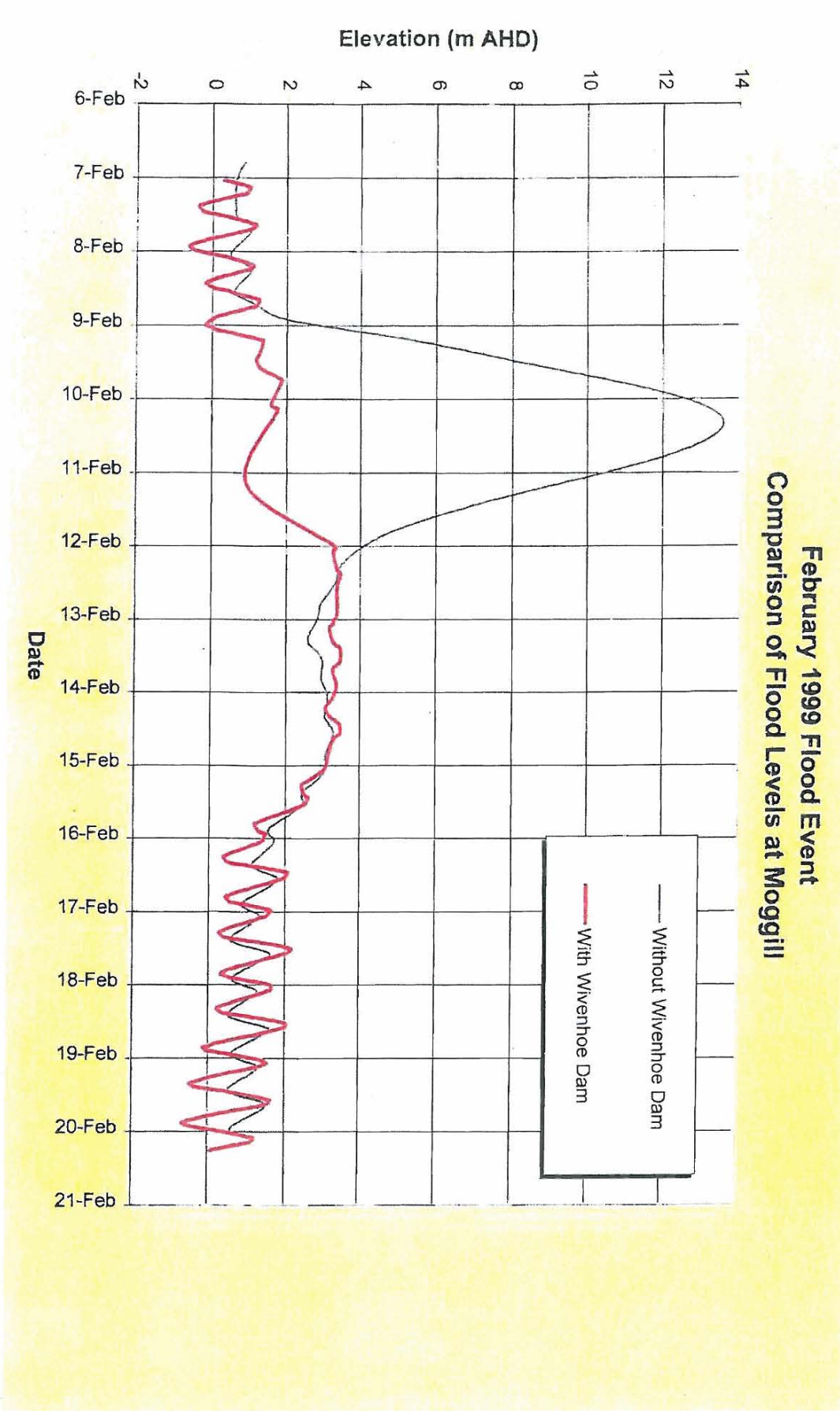

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FIGURE 16.5

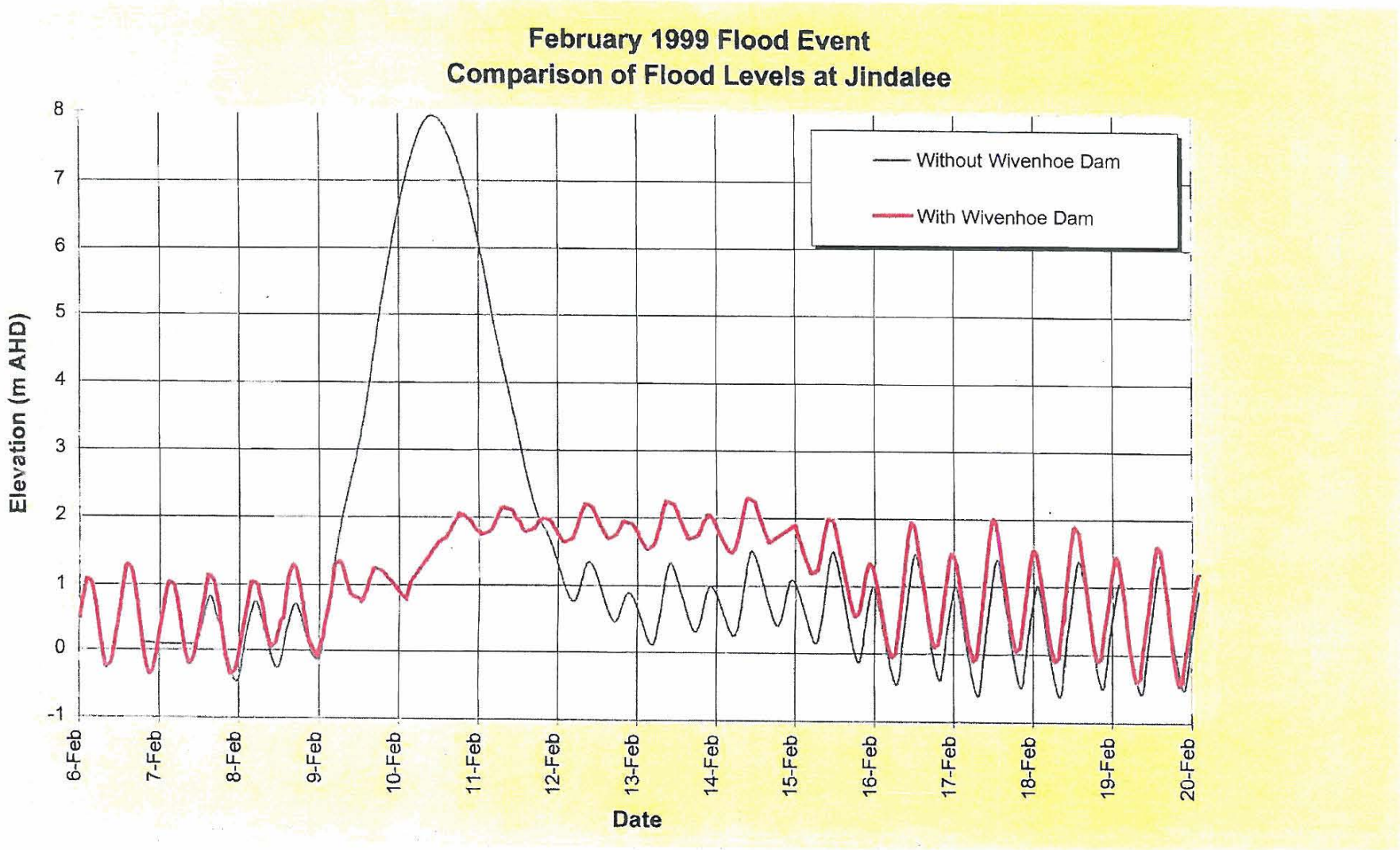

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FIGURE 16.6

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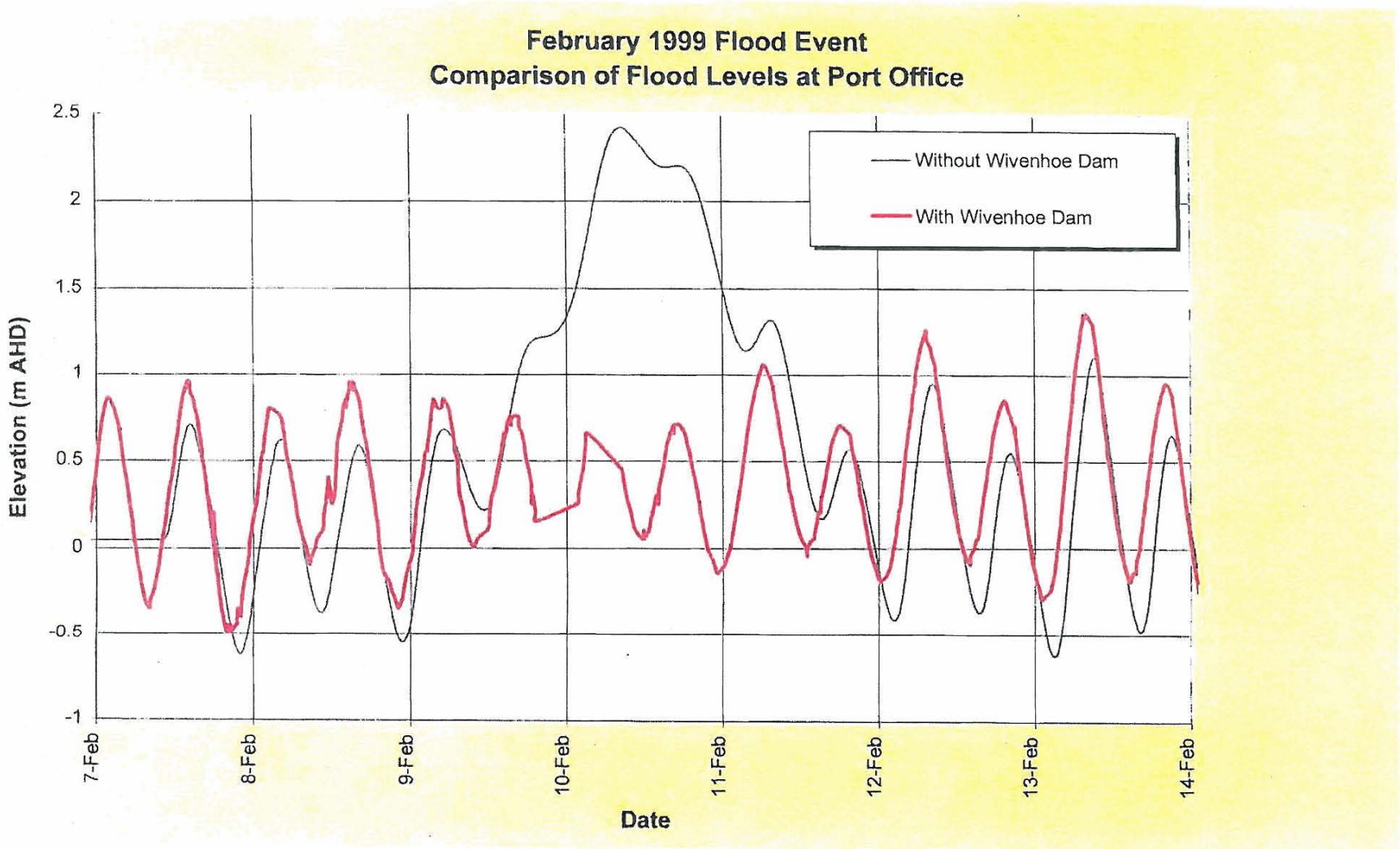

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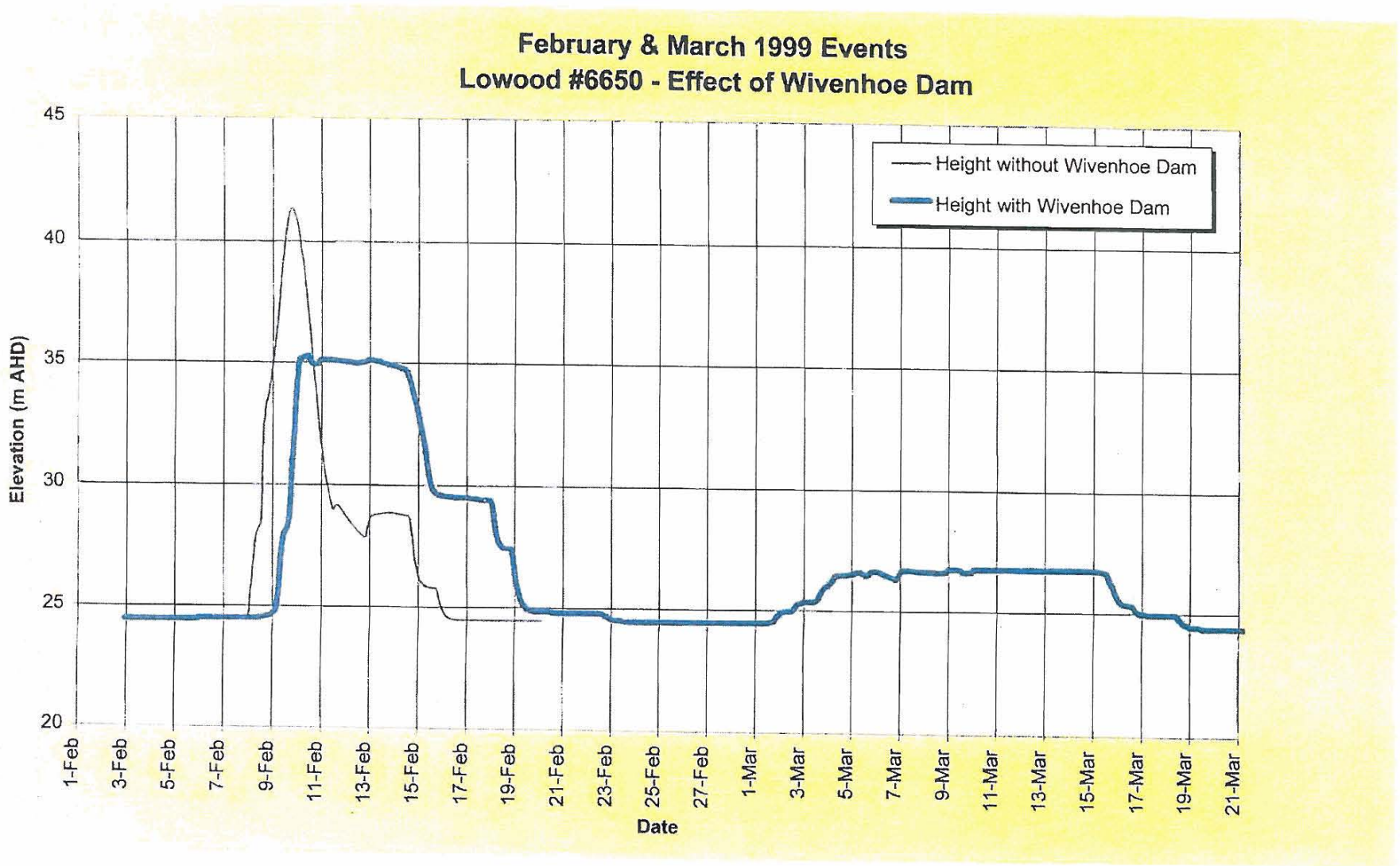
FIGURE 16.7



kp.a.lowood.h-no dam.xls

FIGURE 16.8

SOQ.002.001.0709

that DNR's Surface Water Assessment group be engaged to undertake this work. Members of this group undertook the initial development of the model and are well qualified to carry out the work or alternatively organise others to do the work.

(c) DNR State Water Projects have no arrangement with the DNR Surface Water Assessment group to maintain the back-up machine (named SWAGGY and currently housed in Charlotte Chambers) and to maintain technical support for the FCC machine. SWAGGY is currently maintained on a 'goodwill' basis by SWA.

(d) The 'alpha' version of the BoM's new PC version of *FLOODCOL* is nearly ready for distribution. It is currently envisaged that the new program will ultimately replace the UNIX based *FLOODCOL* program. However, the new program may not have some of the existing *FLOODCOL* features (such as the dam data and the soil moisture accounting models) and these will need to be added on before being installed. The SFOE understands the links are far more user friendly on the new program and it should not present significant problems.

(e) The FLOODOPS section of the RTFM still contains some 'bugs' especially in relation to storage volumes. Fixes were worked out to get around these problems during flood operations. However, when FLOODOPS is upgraded to incorporate the revised gate operations routines, these bugs should be found and fixed.

17.2 Future Direction of RTFM

The original brief for the development of the RTFM called for it to be developed on UNIX based system under OSF/Motif GUI. This decision was made at the time because UNIX was the only true multi-tasking system with a Windows interface. The HP Workstation was selected as the development platform because of the superior floating point numerical processing power and the reliability of the product.

The future direction of the RTFM software should now be considered by the SEQWB given the;

- Recent advances in computing power and operating system.
- Cost of maintaining the current UNIX workstation
- Development of Windows NT based ENVIROMON Alert data collection system

The Microsoft Windows NT/Windows98 operating systems is now a true multi-tasking system widely accepted in the market place. It has replaced many UNIX based system because of its lower operating costs. Its GUI is superior to the OSF/Motif based systems as the development of the OSF/Motif product has stagnated in the face of Windows NT's market dominance. The computational power available on "Intel" based computers is now sufficient to run hydraulic models during flood operations. The larger user base of the Windows NT system ensures that the system will advance ahead of UNIX /OFS/Motif. LINUX a shareware public domain version of UNIX for intel based system is gaining popularity amongst academics but it doesn't offer a real alternative at this point in time.

The development of ENVIROMON and the BoM commitment to maintain this system into the future through contributions from users throughout Australia

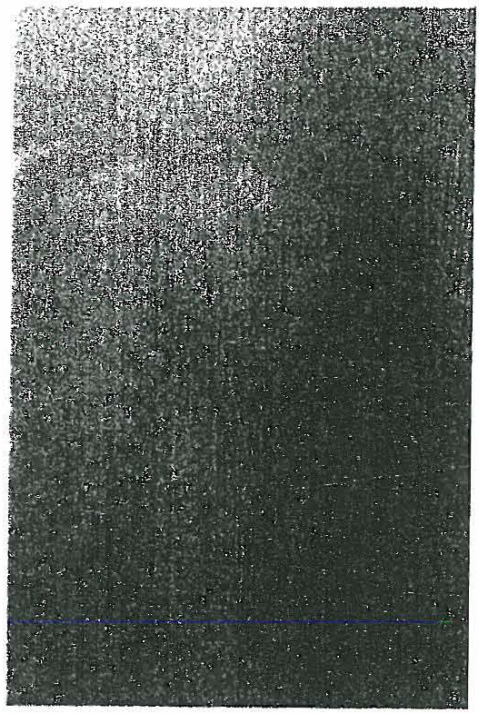
18. RECOMMENDATIONS FOR CHANGES TO THE FLOOD OPERATIONS MANUALS

18.1 Wivenhoe Dam Gate opening Sequences

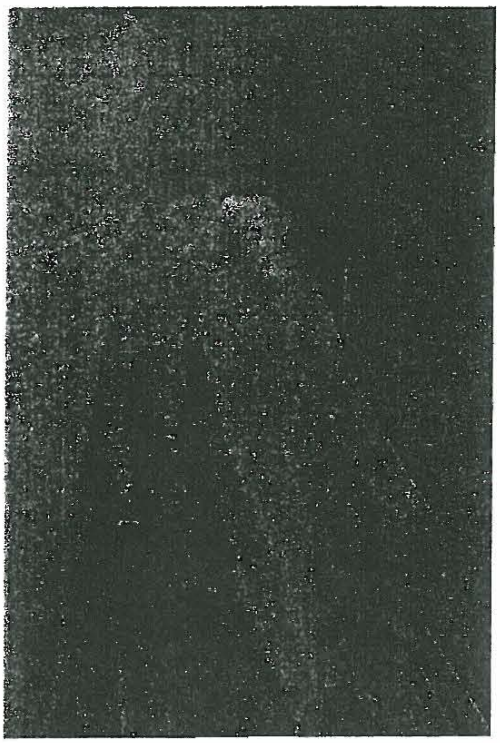
One of the principal proposed changes to the Wivenhoe Dam and Somerset Dam Manual is in the recommended gate opening sequence for Wivenhoe Dam.

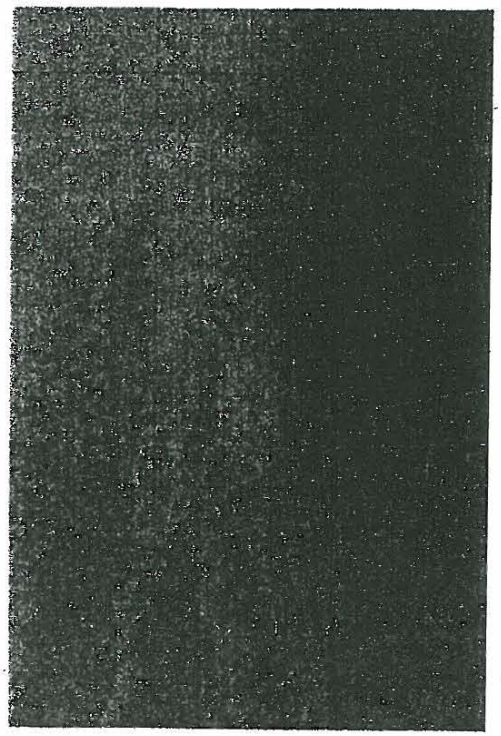
On several occasions gates 2 or 4 were opened only to find that there was a tendency for the discharge jet to impact on the sidewall of the spillway plunge pool excavation. When this occurred, it was found necessary to immediately reduce the opening of the gate 2 or 4 back to what it was and then open the adjacent side gate a further 0.5 metres instead. This limited the impact on the sidewall and allowed the opening of gate 2 or 4 to proceed as the next opening. The overall impact is that gates 1 and 5 should be opened earlier in the future to limit the impacting of the side flows on the sidewalls of the spillway plunge pool excavation. The recommended gate sequencing is shown in the following Table.

While the changes in the sequencing are relatively minor, they will also have the beneficial impact that gate openings will not need to be over-ridden when reservoir levels approach the top of closed gates at EL 73.0 mAHD.



Figures 18.1 and 18.2 Outflow from gates 4 and 5 with Gate 4 at 3.5 metres and Gate 5 at 1.0 metre open. Note impact of jet on sidewall of spillway.





Figures 18.3 and 18.4 Outflow from gates 4 and 5 with Gate 4 at 3.0 metres and Gate 5 at 1.0 metre open. Note improved clearance for jet on sidewall of spillway. The situation was further improved with Gate 5 at 1.5 metres open.

Gate Sequence	Gate to be Operated	Gate 1 Opening	Gate 2 Opening	Gate 3 Opening	Gate 4 Opening	Gate 5 Opening
1	3	-	-	0.5	-	-
2	3	-	-	1.0	-	-
3	3	-	-	1.5	-	-
4	3	-	-	2.0	-	-
5	3	-	-	2.5	-	-
6	3	-	-	3.0	-	-
7	3	-	-	3.5	-	-
8	4	-	-		0.5-	-
9	2	-	0.5		-	-
10	3	-	-	4.0	-	-
11	4	-	-		1.0-	-
12	2	-	1.0			
13	5	-	-			0.5
14	1	0.5	-			
15	4	-	-		1.5	
16	2		1.5			
17	5	-	-			1.0
18	1	1.0	-			
19	4	-	-		2.0	
20	2	-	2.0			
21	5	-	-			1.5
22	1	1.5-	-			
23	4	-	-		2.5	
24	2	-	2.5			
25	3	-	-	4.5		
26	5	-	-			2.0
27	1	2.0	-			
28	4				3.0	
29	2	-	3.0			
30	3	-	-	5.0		
31	5					2.5
32	1	2.5				
33	4				3.5	
34	2		3.5			
35	5					3.0
36	1	3.0				
37	4				4.0	
38	2		4.0			
39	5					3.5
40	1	3.5				
41	4				4.5	
42	2		4.5			
43	5					4.0
44	1	4.0				
45	4				5.0	
45	2		5.0			
47	5					4.5

Gate Sequence	Gate to be Operated	Gate 1 Opening	Gate 2 Opening	Gate 3 Opening	Gate 4 Opening	Gate 5 Opening
48	1	4.5				
49	5					5.0
50	1	5.0				
Thereafter in the order 3,4,2,5,1 with all gates within 0.5 metres of the adjacent gate.						

In general terms the above table indicates that gates 2 and 4 should be opened once gate 3 reaches an opening of 3.5 metres and gates 1 and 5 should be keep within an opening of 1.5 metres of the adjacent gates 2 and 4.

18.2 Flow Reductions from Gates/Sluices Accompanied by Opening of Regulators

The situation whereby discharge from a gate or sluice is replaced by discharge from a regulator is not covered in either of the Manuals of Flood Operations. It is believed that the intent of the Manuals is that such a replacement is reasonable. i.e. If, for instance, 50 m^3/sec is discharging from a radial gate at Wivenhoe, it is reasonable to shut the gate and immediately replace this discharge by opening up the regulators to 50 m^3/sec without having the mandatory 20 minute interval following closure of a gate before the regulator is opened.

If shutting of the gate is immediately followed by an equivalent opening of the regulators, the river flow is virtually unaffected by the change of control within a short distance downstream. Whereas, if the minimum intervals are observed, there will be a definite fall in river levels followed by a similar rise for much farther downstream.

The immediate flow replacement is to be recommended.

18.3 D'Aguilar Highway Bridge

It was not until we were well into the drainage of Somerset Dam flood storage that we were advised that the headwaters of Somerset Dam were inundating the D'Aguilar Highway bridge. We now understand that the bridge becomes untrafficable when the storage level exceeds EL 102.035 mAHD.

The inundation level of the D'Aguilar Highway bridge is not stated in the flood manuals. it should be if this level is to become a consideration in the operation of Somerset Dam it should be included in the manual.

18.4 Drainage Sequences to be used when Wivenhoe Dam has NO Inflows

The March 1999 event highlighted the case when inflows occur into Somerset Dam without any corresponding inflows occurring into Wivenhoe Dam. The operating sequences for Somerset Dam rely on holding back Somerset until EL 102.45 m is reached or Wivenhoe peaks.

Neither of these events occurred in the March event because the quantity of the Somerset inflow was too small and because there was virtually no inflow into Wivenhoe from the remainder of the catchment.

As discussed in Section 12, the situation was addressed in this instance by routing the expected inflows into Somerset through the dam and determining the rate of discharge needed to drain the storage in about seven days from the peak reservoir level. In utilising this strategy, the Duty Engineers were able to also rout the same flows through Wivenhoe in what was determined to be a reasonable time.

This approach may not be the ideal solution in every case and consideration should be given to incorporating an appropriate strategy into the Manual of Flood Operations.

18.5 Consideration of the Effect of Wivenhoe Hydro Power Station

It became apparent late in the operation of the February event that the operation of the Wivenhoe pumped storage scheme was significantly affecting the storage levels being measured in Wivenhoe Dam.

Earlier in the February event we contacted the power station and we were advised that releases had been relatively minimal and that they should not affect the operation of Wivenhoe. We were also told that Wivenhoe power station is operated remotely from Tarong Power station and that it was not possible to predict when and for how long the station would operate.

The operating range of the Splityard Creek storage is from EL 133.5 mAHD to EL 168.0 mAHD. This is an operating range of 24,750 ML and represents an operating range of 0.23 metres in Wivenhoe Dam.

The other significant fact is that the power station has the capacity to discharge water from Splityard into Wivenhoe at a rate up to about 640 m^3/sec. It is also capable of pumping water out of Wivenhoe at a rate in excess of 280 m^3/sec. These are significant discharges when you are trying to release discharges of similar magnitude or less from Wivenhoe through the spillway.

Consideration should therefore be given to the following:-

(a) Defining a Full Supply Level in Wivenhoe which takes account the storage level in Splityard ... e.g. A level of 67.00 mAHD with Splityard at FSL.

(b) This is probably most significant when returning Wivenhoe back to FSL at the end of an event. However, it also has implications at changeover levels for changes of operating procedures. It may also be critically important during extreme floods when the water level approaches embankment crest level.

(c) In the critical situation when problems are being experienced at Wivenhoe, should the SFOE be given any powers to limit the discharge into Wivenhoe?

(d) The establishment of an ALERT sensor to measure headwater elevations in Splityard Creek Dam to enable Wivenhoe headwaters to be adjusted for the volume stored in Splityard.

18.6 North Pine Dam Close Down Sequence

The 'close down' sequence for North Pine Dam is ill defined. It could be assumed that the reverse of the rising sequence shown in the Manual. However, the title of Table E1 in the North Pine Dam Flood Releases indicates that these are 'minimum gate openings' and it was decided to use extra gate openings on the falling limb of the storage levels to minimise the time the gates were open.

It should be noted that the minimum gate opening and closing intervals were observed at all times during this sequence

It would seem appropriate to use more gate openings than listed in Table E1 whenever small long duration floods occur requiring prolonged gate operations. Some thought could be given to whether this option should be formally addressed in the North Pine Dam flood manual.

APPENDIX A

ABRIDGED FCC EVENT LOGS FOR FEBRUARY 1999 EVENT

APPENDIX A — ABBRIDGED FCC EVENT LOGS

FEBRUARY 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
		At the start of the event there were flood warnings already out for a number of Queensland rivers including Dawson, Moonie and Condamine
Sun 07/02/99	10:06	BoM Quantitative Precipitation Forecast 9am Mon 20-30mm isolated 50mm
Sun 07/02/99	16:00	BoM Quantitative Precipitation Forecast 3pm Mon 20-30mm isolated 50mm
Sun 07/02/99	19:30	Routine Handover of Duty Engineer from Don Cock to Peter Allen (Normally it would have occurred Monday morning, however, Don Cock was heading for Goondiwindi following morning)
Sun 07/02/99	21:50	Data downloaded to PC - Somerset at EL 93.72 and rising steadily at 80 mm/hr
Mon 08/02/99	2:35	Data downloaded to PC - heavy rain locally: 18-25 mm over previous 6 hours; 40-50 mm over previous 24 hours; 1.5 metre rise in Stanley at Peachester; Somerset 93.83 m AHD, No rise in Wivenhoe
Mon 08/02/99	10:00	Began full time monitoring of rainfall & river heights in FCC
Mon 08/02/99	10:45	Advice from Terry Malone (BoM) to expect up to another 150 mm over next 24hrs
Mon 08/02/99	10:45	PA rang John Ruffini & John Tibaldi to advise of developing situation and requested that Dam Supervisors report to dams and begin preparations
Mon 08/02/99	11:30	Doug Grigg advised he would be at Wivenhoe soon
Mon 08/02/99	11:30	Somerset @ EL 94.28 m AHD; Wivenhoe @ 64.18 m AHD; North Pine @ 35.13 m AHD
Mon 08/02/99	12:05	Brett Schultz advised North Pine at EL 35.12 and all operational. Monitoring of rainfall & river heights in progress - ELs agree with ALERT
Mon 08/02/99	12:05	Doug Grigg advised Wivenhoe at EL64.11 and all operational. Monitoring of rainfall & river heights in progress - ELs agree with ALERT
Mon 08/02/99	12:18	Wayne Nevin heading back to Somerset; Wayne advised he thinks the office level sensor is not reading accurately
Mon 08/02/99	12:21	Initial BoM flood warnings for Maroochy River and adjacent coastal streams
Mon 08/02/99	12:24	Initial BoM flood warning for Mary River [Note: Further warnings followed but are not recorded in this abridged version of the Log]
Mon 08/02/99	12:39	*Floodops* runs predict (if 150 mm of rain falls over next 24hrs) then Wivenhoe will peak at EL 70.05 m AHD. [165 mm was actually recorded as a catchment average]
Mon 08/02/99	14:45	PA: Decided to wait until later in afternoon to see if forecast rain eventuated before formally declaring mobilisation
Mon 08/02/99	16:45	Terry Malone (BoM) advised heavy rain will continue for another 12 hours: He also advised that a Duty Meteorologist would be on duty until 02:00 Tuesday but that the Flood Warning Centre would re-open next morning
Mon 08/02/99	17:00	SEQWB formally advised of mobilisation to FCC
Mon 08/02/99	17:08	Initial BoM flood warning for Stanley River and Upper Brisbane River
Mon 08/02/99	17:18	Initial BoM flood warning for Lockyer, Bremer & Warrill Creek
Mon 08/02/99	18:20	Duty Engineer Don Cock rang to check situation and advised he would be back in Brisbane by 11:00 am Tuesday
Mon 08/02/99	21:25	Wayne Nevin advised DNR phones at Somerset out of action; Communications to proceed through SEQWB office phones
Mon 08/02/99		Tested radio communications with Wivenhoe and Somerset Dams
Tue 09/02/99	4:30	John Tibaldi rang providing details of proposed shift arrangements for each of three dams - Rosters to run 7am to 7pm and 7pm to 7am
Tue 09/02/99	5:30	Advised BoM, discussed situation with Peter Baddiley: Releases expected during the day with low level crossings to be closed
Tue 09/02/99	6:20	Advised Garry Grant (SEQWB)of situation and planned releases
Tue 09/02/99	6:45	Brett Schultz advises all OK, Grant St and Young's Crossings shut; Indicate he will contact local police, FCC to contact Pine Shire Council
Tue 09/02/99	7:15	Pine Shire Council answering service - Message sent advising releases are expected from North Pine with a peak of about EL 39.8 M AHD
Tue 09/02/99	7:45	Terry Malone (BoM) advises low developing in Hervey Bay, predict 3800 m3/sec inflow to Somerset
Tue 09/02/99	8:00	Shifts at dams commence
Tue 09/02/99	8:05	Brett Schultz noted people still going across crossing - has advised police
Tue 09/02/99	8:10	Pine Shire responded to our message: Advised to expect a release ~200 m^3/sec about 18:00 - 20:00 hrs today and a peak of 39.8 M AHD
Tue 09/02/99	8:33	Rob Titmarsh directed to raise the crest gates at Somerset
Tue 09/02/99	8:36	Garry Grant (SEQWB) advised of Gate openings at Somerset
Tue 09/02/99	8:45	Contacted Esk Shire to get Savages Crossing & Twin Bridges closed (& any others) Dennis Misso to call back

APPENDIX A **ABBRIDGED FCC EVENT LOGS**

FEBRUARY 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
Tue 09/02/99	9:00	Advised Maurie Maguire (Esk SC) that we will make releases from Wivenhoe beginning about midday- early afternoon, Expected release 1600 m^3/sec.
Tue 09/02/99	9:25	Rob Titmarsh advises all gates at Somerset raised
Tue 09/02/99	9:28	Darryl Hickey advises BCC Flood Centre now operational. Want to know when we are releasing
Tue 09/02/99	10:30	Advised Doug Grigg to shut regulator in preparation for release
Tue 09/02/99	10:37	Doug Grigg advises that a man is trapped in a caravan at Twin Bridges. Doug to advise progress. PA decides to defer opening.
Tue 09/02/99	10:46	Releases to be made as soon as man rescued. All preparations complete
Tue 09/02/99		Advice received that man was rescued Out of order??
Tue 09/02/99	11:40	Advised Maurie Maguire (Esk SC) that we will release up to 1600 m^3/sec very soon
Tue 09/02/99	11:48	David Gill advised we are opening 1st gate ASAP
Tue 09/02/99	11:53	Rob Gorian advised Wivenhoe Gate 3 opened to first increment at 11:50
Tue 09/02/99	12:55	Confirmed advice with Pine Shire that we will operate North Pine
Tue 09/02/99	15:11	Fax to Wivenhoe - open Gate 3 to 4m at min interval of 10 min
Tue 09/02/99	15:35	Advised police communications of need to close Kholo Bridge
Tue 09/02/99	15:47	Advised Peter Burrows (Ipswich CC) that Kholo bridge will be closed shortly
Tue 09/02/99	15:48	Dennis Misso confirmed that Burtons Bridge is closed
Tue 09/02/99	16:00	Gate 3 open to 4 m
Tue 09/02/99	16:15	Fax to Wivenhoe - open Gate 2 & 4 to 0.5 and then Gate 3 to 4.5m at min interval of 10 min
Tue 09/02/99	16:19	BoM QPF forecast Somerset / Wivenhoe forecast 10mm to 20mm over 24hrs to 3pm wed, North Pine 10mm to 20mm over 24hrs to 3pm
Tue 09/02/99	16:30	Doug Grigg (Wivenhoe) advises that Gate 2 = 0.5 Gate 3 = 4.0 Gate 4 = 0.5 Verbal
Tue 09/02/99	17:10	Fax sent to Wivenhoe Dam advising them to open Gate B and D to 2.5m in 10mm increments
Tue 09/02/99	18:02	Fax from Don Cock to Wivenhoe Dam confirming gate openings Gate 1 and 5 = 0.5m Gate 2 and 4 then opened to 4m at 0.5m 10 minute intervals
Tue 09/02/99	18:30	Fax from Wivenhoe Dam Gates 2 and 4 at 3.0m Gates 1 and 5 at 0.5m
Tue 09/02/99	18:30	(Wivenhoe) verbal approval to open Gates 1 and 5 to 1.0m then advise FCC
Tue 09/02/99	19:00	Don Cock: Fax to Wivenhoe dam to open Gate 2 and Gate 4 to 3.5m
Tue 09/02/99	19:10	Brett Schultz (North Pine) verbal message forecasting gate operations early morning
Tue 09/02/99	20:15	19:22 collector on HP stopped receiving data from system, *Floodops* not operational, Warren Shallcross was called.
Tue 09/02/99	21:00	Collector down, 1.5 hrs ahead of predictions of Somerset, Using 'Peter 9' taking Gregor's as 'gospel'; peak > 6000 @ Gregor's, Keeping Wivenhoe ~ 1400 m^3/sec (T/W doesn't quite reflect this) peaking at midnight at Lyons Bridge.
Tue 09/02/99		BoM will update at 22:00 BoM stills predicts 2200 m3/sec at Mt Crosby. We won't change as yet. Somerset gates open; all sluices shut.
Tue 09/02/99	21:10	Somerset advise EL 102.48 and are checking to se if regulators are completely submerged (cannot operate if they are)
Tue 09/02/99	21:10	Somerset EL 102.48 (2hrs ahead of what model prediction of reaching this level at 22:45)
Tue 09/02/99	21:28	Somerset advises that regulators are 3/4 covered
Tue 09/02/99	21:40	Conversation with John Mulheron, preferable to do closure during daylight. Investigate opening a sluice in Somerset and store it Wivenhoe until morning.
Tue 09/02/99	21:58	Advised Wayne Nevin (Somerset) to prepare to open sluice
Tue 09/02/99	22:03	John Clarke (Kilcoy SC) advised that Somerset would peak ~ 103.0 M AHD + and would peak ~ midday 10/2/99
Tue 09/02/99	22:20	Fax not received by Somerset, advised by phone to proceed with opening of sluice, and report back.
Tue 09/02/99	22:24	BoM duty forecaster: comparison of estimated peak discharge was good. Advised BoM that Wivenhoe discharge will be held at 1500 m3/sec until morning if possible. Rain is clearing according to BoM.
Tue 09/02/99	22:30	John Mulheron advised of our intention of opening a sluice in Somerset and rather than letting it pass directly through Wivenhoe we will store it, (with a consequent rise of ~ 0.2m in Wivenhoe) until the morning when we will reassess situation.
Tue 09/02/99		BoM have advised that there is no significant rain in sight
Tue 09/02/99	22:35	Somerset EL 102.66 Sluice 'L' is open
Tue 09/02/99	23:20	Somerset advise no calls until 24:00 as they are inspecting the galleries
Wed 10/02/99	0:00	Fax to Wivenhoe to close Gate 3 in intervals of 0.5 m until 3.0m and advise when achieved.
Wed 10/02/99	0:00	Above fax corrected to indicate closure of Gate 3 to 4.0m in 0.5m increments
Wed 10/02/99	0:05	Advised that Gate 3 closed to 4.0m

APPENDIX A **ABBRIDGED FCC EVENT LOGS**

FEBRUARY 1999 Event

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Date	Time	Action/Comment
Wed 10/02/99	0.08	Somerset reverted to 1hr reports.
Wed 10/02/99	0:03	faxed North Pine re proposed gate openings
Wed 10/02/99	1:00	Rang duty officer Police re imminent release at North Pine (minimum impact). Rang Pine SC (Colin Rocket) at home and at work with no answer
Wed 10/02/99	1:20	Data collector problem: It is thought the restoration of a rating from an original corrupted a file which caused system to lock up whenever it was attempted to write to it.
Wed 10/02/99	2:40	Instructions to Wivenhoe to close Gate 2 by 0.5 to improve potential margin against inundation at Mt Crosby weir bridge.
Wed 10/02/99	2:50	Tried to contact BoM to confirm level at Lowood, #6650 Lowood 'A' 33.59 @ 2.26am #6647 Lowood 'B' 34.02 @ 2:16 Difference in discharge would be enough to close Crosby.
Wed 10/02/99		Decided to shut one opening @ Wivenhoe in case, There will be a relative 4hr delay (6.3 Lyons to Lowood 2hrs Wivenhoe to Lowood) Travel time Lowood to Crosby ~ 10hrs Therefore will not affect until midday.
Wed 10/02/99	2:15	Wivenhoe confirmed Gate 2 closed 3.0m
Wed 10/02/99	3:15	Advised police re Mt Crosby weir bridge may go out.
Wed 10/02/99	3:30	Reviewed NP fixed case FEB08021999: Case was re-run and compared with actuals.- observed levels are marginally lower; #6762 recalibrated to observe gauge board value. May not need release until 6-7am
Wed 10/02/99	3:50	Collector dead unable to restart it from inside *Floodcol*. Switched to *FloodPC*, decided not to call JR or WS to investigate as no gate openings planned for next several hours.
Wed 10/02/99	4:10	Malcolm Lane expects NP to reach EL 39.65 [FSL] at approx 05:15. He will advise police and FCC prior to any openings
Wed 10/02/99	4:18	North Pine Dam 'rate of change' calculations faxed to FCC
Wed 10/02/99	4:30	Tried to ring BoM re which Lowood station to adopt but no answer as yet. [Lowood A and Lowood B were giving ~0.4 metre difference]
Wed 10/02/99	5:00	Brian Keech, BoM advised they will chase up an observed level at Lowood gauge.
Wed 10/02/99	5:11	North Pine advise that they will spend the next 10 min checking equipment and will open a gate when the level reaches EL 39.65 M AHD.
Wed 10/02/99	5:30	Brian Keech BoM rang, He has not been able to confirm which Lowood station is correct but he suspects that the lower value is the correct one. He will try to get a level from Lowood this morning.
Wed 10/02/99	5:40	Notes on run 'Peter10' Repeated WIVOPS run. WIVOPS begins with an open closing of a Somerset sluice. It was decided not to implement this closely spaced opening and closing - most likely a 'bug' in the program.
Wed 10/02/99		However, FCC will confirm prior to any increases in discharge
Wed 10/02/99	6:15	North Pine attempted to open Gate 'C' to the first increment but the brake coupling had rusted onto the shaft and that lead to the motor tripping out on overload. They found that Gate 'A' would open so they opened it to increment 1.
Wed 10/02/99		They then repaired the fault and opened Gate 'C' satisfactorily, Gate 'A' was then closed. They estimate that they have 45min before the next opening is required.
Wed 10/02/99	6:30	Contracted Colin Rocket Pine River SC re North Pine release
Wed 10/02/99	6:45	Faxed BoM Terry Malone up to date data on releases from Wivenhoe and Somerset
Wed 10/02/99	7:00	John Clarke Kilcoy SC- advised that Somerset would peak at ~ 18:00 hours approx 103.3m AHD
Wed 10/02/99	7:00	Fax of gate openings log from North Pine Dam
Wed 10/02/99	7:37	North Pine expect to open next Gate 'E' to setting 1.
Wed 10/02/99	8:05	Fax from SEQWB re #6569 - problem is ours it seems (O'Reilly's Weir)
Wed 10/02/99	8:27	John Read (North Pine) EL 39.713 they will open the 3rd gate when the level reaches 39.715 and will confirm opening
Wed 10/02/99	8:43	North Pine Gate 'A' opened 1 notch
Wed 10/02/99	8:57	Advised Doug Grigg that Wivenhoe will peak at 19:00 hours at EL 70.485
Wed 10/02/99	9:40	North Pine Dam Gate 'B' opened 1 increment as instructed.
Wed 10/02/99	9:45	Doug Grigg advises that Gate 4 impacting on flow from Gate 5 - will video problem
Wed 10/02/99	10:10	Vim Balachandran (ESK SC) provided the following feedback: @ 8:15am level was 0.3 below underside; @10:00am lapping underside
Wed 10/02/99	10:18	Wivenhoe Gate 4 discharge is impinging on right wall of spillway (1.0 3.0 4.0 3.5 1.0 Gate openings).
Wed 10/02/99		Decided to close Gate 4 from 3.5 to 3.0 to limit any impinging on wall. Next gate openings will need to be Gates 1 & 5 to 1.5m before raising Gates 2, 3 & 4 again.
Wed 10/02/99	10:35	Doug Grigg advised Gate 4 closed to 3m. Doesn't seem to have fixed the problem.
Wed 10/02/99	10:55	Malcolm Lane - North Pine Water Quality - turbidity problem. Would like to shut outside gates.

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Date	Time	Action/Comment
Wed 10/02/99	11:35	Brett Schultz rang to advise North Pine at 39.744. When reaches 39.745 propose to open radial Gate B to increment 1. There will then be 5 gates open.
Wed 10/02/99	12:00	North Pine. All gates open to Setting 1;. Gate B opened at 11:35.
Wed 10/02/99	16:45	Wivenhoe gates opened to 1.5 3.0 4.0 3.0 1.5
Wed 10/02/99	16:55	Wivenhoe flow pattern now restored
Wed 10/02/99	17:26	Fax to North Pine to authorise opening according to sequence to lake level up to Setting 2 if required for all gates. NP to ring FCC and get approval before opening.
Wed 10/02/99	18:00	Wivenhoe peaks at EL 70.42 m AHD (observed). This is 0.03 metres below level provided by ALERT #6640. Level plateaus & holds at about this level.
Wed 10/02/99	18:30	Discussions with Wivenhoe re: which gate is the most appropriate to open. Doug Grigg advised that outer gates are performing their tasks only reasonably. So a 0.5m additional opening is in order for next opening.
Wed 10/02/99	18:15	John Tibaldi confirmed Mt Crosby weir level OK. Based on this info, release strategy will continue. (Q=1724m3)
Wed 10/02/99	18:45	Doug Grigg tried to open Gate 1 by another 0.5m but problems with side wall impact eventuated. Approval given to cancel this opening and instead open Gate 3 by another 0.5m to a total opening of 4.5m.
Wed 10/02/99	19:00	Wivenhoe Gate 3 opened to 4.5m. Wivenhoe operators favour opening Gates 2 & 4 next, for flow control and containment reasons.
Wed 10/02/99	19:35	Wivenhoe Gate 3 open to 4.5m and Gate 5 closed to 1.5m.
Thu 11/02/99	2:00	North Pine Gate D closed. @ EL 39.715
Thu 11/02/99	4:50	Wivenhoe Gate 3 opened to 5.0m
Thu 11/02/99	6:15	Peter Allen advised Peter Baddiley Wivenhoe discharge 1635 at 4:50. Likely to open another gate at 11:40 to increase discharge to 1685 with aim of
Thu 11/02/99		keeping Crosby open. NP has 3 gate openings and currently holding. Cyclone Rona declared. Heading south and likely to hit coast between Mackay and Townsville.
Thu 11/02/99	6:35	Spoke to John Tibaldi re potential gate openings. Decided to open 1 and 5 next to 2 metres followed by 2 and 4 to 4 metres. J Ruffini and D Cock to visit Wivenhoe. They will observe the openings and confirm this decision.
Thu 11/02/99	7:30	Wivenhoe advised that TW recorder not working, will read manually. Level is 36.58
Thu 11/02/99	7:45	Peter Allen advised Gary Grant (SEQWB) current status of dams. Will brief him again later in the day.
Thu 11/02/99	7:50	Wivenhoe TW gauge is OOA. Dam operators were advised that we don't need to fix it in near future. No need to read TW manually. No benefit at this stage. Rob Gorian will contact Paul Martin to see who can repair it.
Thu 11/02/99	8:05	North Pine Gate A shut
Thu 11/02/99	8:55	Peter Allen briefed Doug Grigg on strategy.
Thu 11/02/99	9:40	SES contacted Tom Fenwick re family trapped in Kilcoy and Tom was advised all crest gates and one sluice were open and we were about to open another sluice.
Thu 11/02/99	9:50	Bradley Alderton re recompilation. He will contact Warren with request for a number of files to be sent to him. PA to send gate rating file to him in Melbourne at B.Alderton@BoM.gov.au
Thu 11/02/99	10:00	Tried to contact Somerset by phone no success and left message at SEQWB. Tried to contact via RADIO no success.
Thu 11/02/99	10:43	Rang David Gill (SEQWB) and suggested he get someone to check batteries on the alert stations to prepare for any closely spaced subsequent event.
Thu 11/02/99	10:46	Warren Shallcross has spoken to Bradley Alderton and has sent required files.
Thu 11/02/99	10:55	Fax to R Titmarsh Somerset to open sluice M immediately
Thu 11/02/99	11:10	Fax to D Grigg Wivenhoe to open Gate 1 or 5 from 1.5 to 2.0 metres
Thu 11/02/99	11:20	D Cock rang re Wivenhoe gate openings. Gate 1 has been opened to 2.0 metres. They are now going to close Gate 1 to 1.5 and open Gate 2 to 4.0 metres. They will report relative merits.
Thu 11/02/99	11:25	R Titmarsh rang. Sluice M began opening at 11:10 and completed at 11:20
Thu 11/02/99	11:33	D Cock from Somerset. Experiment with Gate 2 was not as good as opening Gate 1 to 2.0 metres. Decided to open Gate 1 to 2.0 metres and close Gate 2 back to 3.5 metres
Thu 11/02/99	11:48	B Alderton rang. Has received PA flow file. He is still having trouble getting source file from W Shallcross. B Alderton to keep PA informed
Thu 11/02/99	12:00	Rang D Cock re impacts at Fernvale and Crosby. Fernvale approx 300 above water and can take more. Crosby marginal Don will assess on visit this
Thu 11/02/99		afternoon. Crosby at 7:30am water lapping underside of weir bridge. This corresponds to an alert level of 11.88 to 11.95 metres
Thu 11/02/99	12:40	J Mulheron rang for status. Informed of status and that we had opened another sluice (total of 2) at Somerset to bring level in Somerset to below

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Date	Time	Action/Comment
Thu 11/02/99		102.035 (deck level of Daguilar highway bridge. He asked be advised of Somerset level as it came in. PA advised him he would be visiting Fernvale and Crosby this PM to look at clearances and impact on side of spillway plunge pool.
Thu 11/02/99		He requested PA to ring on his return
Thu 11/02/99	13:12	J Mulheron (SEQWB) advised of Somerset levels and O'Shea's crossing
Thu 11/02/99	14:30	R Titmarsh advises phone back on line
Thu 11/02/99	14:45	P Allen rang from Mt Crosby. Water lapping deck beams. Water to be kept below this level 11.97 at 14:46. Traffic control from 7am to 7pm by Bill Hester (BCC) 3403 9829 0419 793176
Thu 11/02/99		
Thu 11/02/99	15:00	B Alderton rang re computer program
Thu 11/02/99	15:30	J Mulheron (SEQWB) updated on releases
Thu 11/02/99	18:00	Fernvale bridge is 2.26 below kerb on bridge same as at 10:30. Savages and Crosby remaining steady
Thu 11/02/99	18:28	J Tibaldi advised that at 18:20 water was lapping Mt Crosby deck beams but at 18:00 water was marginally higher.
Thu 11/02/99	20:00	J Tibaldi advised gate opening at Wivenhoe are 2.0, 3.5, 5.0, 3.5, 1.5
Thu 11/02/99	20:42	Discussion re next gate opening. Lockyer has dropped 5 m^3/sec in last 12 hrs, therefore if we wait 12 hrs before next gate opening. Both dams are dropping slowly. Level at Crosby is stable although 2 gate openings today
Thu 11/02/99	22:30	Discussion with J Tibaldi re manning North Pine. JT suggests one man from Friday. JT to ring again Friday morning
Fri 12/02/99	0:00	Wivenhoe Gate 5 opened to 2.0 metres
Fri 12/02/99	0:02	Malcolm (North Pine) advised he will close Gate E. Fax to follow
Fri 12/02/99	6:42	Malcolm to look at crossings d/s of North Pine. Grants crossing impassable with water knee deep. Young's crossing bridge is out of water but has water half way across road. Cars using the crossing
Fri 12/02/99	7:50	D Grigg reported some erosion of sandstone on right bank berm. Approx 3 cu metres
Fri 12/02/99	8:00	Briefed D Gill (SEQWB) Gate opening since 00:00 is 2.0, 3.5, 5.0, 3.5, 2.0 Next opening proposed at 12:00. Current outflow 1726 m^3/sec. Somerset 2 sluices open. North Pine one gate open.
Fri 12/02/99	8:55	D Grigg discussed erosion at Wivenhoe with D Cock
Fri 12/02/99	8:55	Floodcol alarm monitor not working (System reported)
Fri 12/02/99	9:21	Return fax from SEQWB re stream height station 6755. There appears to be some differences between PC Floodcol and HP Floodcol. Could be because HP recycle
Fri 12/02/99	10:30	North Pine fax Gates A, B, D, E closed Gate C open
Fri 12/02/99	10:45	D Gill rang to confirm SEQWB were checking and replacing Alert station batteries. This is being done progressively by MRD
Fri 12/02/99	11:10	North Pine to revert to normal staffing. Malcolm to staff dam over weekend from 8am to 4:30pm. To report levels on waking in morning and on going to be each night. One gate open at this stage.
Fri 12/02/99	11:21	Rang B Schultz to advise of above North Pine staffing. Brett to maintain contact with Malcolm Lane and revert to 24 hour operation if heavy rain occurs.
Fri 12/02/99	11:25	Fax to D Grigg Wivenhoe re Gate 2 opening at 12:00 from 3.5 metres to 4.0 metres
Fri 12/02/99	12:10	D Grigg reported opening of Gate 2 to 4.0 metres caused flow impacting on left wall. It was decided to close Gate 2 back to 3.5 metres and open Gate 1 to 2.5 metres
Fri 12/02/99	12:15	Fax advising earlier incorrect reporting of Gate 1 open to 3.0 metres. Correct opening is 2.5 metres
Fri 12/02/99	12:25	D Grigg advises gate movements complete. Flow has stopped impacting on wing walls.
Fri 12/02/99	15:02	D Gill advised that one gate left open at North Pine. Might remain open for a week depending on inflow
Fri 12/02/99	16:00	BoM fax: Forecast nil rain at Somerset, Wivenhoe and North Pine in next 24 hours
Fri 12/02/99	16:40	Fax from North Pine showing gate movements til 14:05
Fri 12/02/99	17:00	Fernvale bridge dropped 40 mm since 6:30am
Fri 12/02/99	18:20	Fax from North Pine showing gate settings
Fri 12/02/99	19:35	A Maughan Wivenhoe, advises Gate 5 opened to 2.5 metres. Gates now 2.5, 3.5, 5.0, 3.5, 2.5
Fri 12/02/99	20:28	Fax from Somerset confirming sluice K opened
Sat 13/02/99	5:30	Fax from Wivenhoe showing gate openings
Sat 13/02/99	7:00	Fernvale bridge level dropped 40mm 17:00 12/2/99
Sat 13/02/99	8:30	G Grant (SEQWB) rang. PA advised Somerset at EL 101.01 with 3 sluices open, North Pine EL 39.61 with 1 gate open, Wivenhoe EL 69.22 with gates at 2.5, 3.5, 5.0, 3.5, 2.5. We plan to begin ramp down at 24:00 hrs dependant on inflow.

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Date	Time	Action/Comment
Sat 13/02/99		Probably close sluice 3 approx 15:00 14/2
Sat 13/02/99	8:50	Wivenhoe: Erosion of wing walls same as at 12/2/99
Sat 13/02/99	9:08	Somerset regulators now above water. Tailwater 69.30 M AHD
Sat 13/02/99	10:10	Unable to contact D Gill at home, work or mobile. Need to get Savages crossing alert inspected. No valid values since 04:00. DNR station still reporting
Sat 13/02/99	10:25	Steel Tallon (Courier Mail) rang. Referred to SEQWB
Sat 13/02/99	10:40	P Baddiley (BoM) rang. PA advised him of current dam status and planned start of closure at 15:00 14/2/99. Ramp down to take 24 hours at 60 min intervals.
Sat 13/02/99		Somerset to be closed early am 15/2/99. Ex cyclone Rona behaving as predicted at BoM briefing Fri 12/2/99. Now largely stationary and predict southern movement in 12 hours. Suggests we run cases of 50 to 100mm
Sat 13/02/99	11:45	Backup machine HP fully operational. Problem with collector while running backup resolved
Sat 13/02/99	12:00	Malcolm Lane (North Pine) instructed to provide levels when he gets up, when he goes to bed, and at noon. Levels to be used for recalibrating alert stations
Sat 13/02/99	15:50	Malcolm Lane - just about to stop work - NP @ 39.581- Malcolm will check @ 6pm & 10 pm tonight to check levels. He will report in then and we will determine final timing for closure about 2am in the morning
Sat 13/02/99	17:06	Quantitative Precipitation Forecast to 3pm Sunday <5mm
Sat 13/02/99	18:03	NP 39.577 - Looking to closure @ about 01:00
Sat 13/02/99	18:30	Completed review of gate opening order
Sat 13/02/99	22:00	Fax from John Tibaldi re proposed staffing arrangements for Somerset Dam
Sat 13/02/99	22:15	Malcolm Lane - He is to shut off the gate @2:00am tomorrow. He has undertaken to inform local police accordingly, & also Pine Shire. He will ask Pine Shire if they wish to be contacted when it is closed. Malcolm will advise FCC when it is shut
Sun 14/02/99	1:45	Fax from Wivenhoe - Event Log
Sun 14/02/99	1:45	Malcolm North Pine EL 39.557 Gate 'C' closed.
Sun 14/02/99	2:00	Fax from North Pine EL 39.557 and gate settings All gates now closed.
Sun 14/02/99	5:15	Fax from Wivenhoe - operating Log
Sun 14/02/99	7:00	Wayne Somerset EL 99.95 Handing over to Rob Titmarsh and Peter Myatt
Sun 14/02/99	8:15	Fax from Doug / John Tibaldi re suggested closing sequence for Wivenhoe
Sun 14/02/99	8:30	BoM Peter Baddiley advised that rain depression heading SE will probably miss the coast
Sun 14/02/99	11:00	Fax sent to D. Grigg re: closure of Gate 2 from 3.5m to 3.0m
Sun 14/02/99	11:25	Doug Grigg confirmed gate closure sequence
Sun 14/02/99	11:30	Peter???????????? faxed list of suspect stations
Sun 14/02/99	12:00	Fax to Wivenhoe Dam operators??????? to close Gate 4 from 3.5 to 3. Rob Gorian advised???? and lake level 68.41
Sun 14/02/99	12:00	Rob Gorian Wivenhoe Gate 4 closed from 3.5m to 3.0m
Sun 14/02/99	12:30	Revised Wivenhoe gate closing sequence sent. Dam operators to advise senior???? duty engineer hourly of gate closure??? and lake level
Sun 14/02/99	13:00	Spoke to Paul Martin - Rating Mt Crosby complete when water level was =EL11.7 John Ridler verified there was a error in the savages crossing rating
Sun 14/02/99	13:00	Rob Titmarsh 99.66 Somerset EL advised that Also BCC had a ?????????? in the day
Sun 14/02/99	13:00	Wivenhoe Lake level 68.40 Gate 1 closed from 2.5 to 2.0m
Sun 14/02/99	13:15	Rang Rob Titmarsh Somerset asking him to check the to ascertain if regulators work
Sun 14/02/99	13:30	Confusion whether regulators can work once they come out of water
Sun 14/02/99	14:00	Wivenhoe Dam Lake level 68.37 Gate 5 closed to 2.0m
Sun 14/02/99	14:30	Confirmation phone call from Somerset Sluice K closed at 2:30
Sun 14/02/99	17:05	Doug Grigg - Wivenhoe @ 17:00 WL 68.30 Closing Gate 4 from 3.0 to 2.5m
Sun 14/02/99	17:37	Rob Titmarsh Somerset , Sluice M closed at 5:30pm and one Regulated opened (No.12)
Sun 14/02/99	18:00	Doug Grigg- Wivenhoe WL 68.27 Closing Gate 1 from 2.0 to 1.5 m
Sun 14/02/99	18:00	Rob Titmarsh - Somerset WL 99.51 (Rob expressed opinion that flow may have been slowed too much)
Sun 14/02/99	19:00	Wivenhoe EL68.25 closing Gate 5 to 1.5m
Sun 14/02/99	19:12	Nth Pine EL 39.577 static; will read @ 10pm then dawn. (FCC sensor @ 19:18 - last reading)
Sun 14/02/99	20:30	Somerset directed to close sluice K at EL 99.17 (expected to be @ 8:30am) and regulator 2hrs later
Sun 14/02/99	21:05	Wivenhoe Dam - Andrew Maughan WL 68.18 Gate ?? lowered to 2.0m
Sun 14/02/99	23:00	Wivenhoe dam - Andrew Maughan Gate 1 closed to 1.0m; Unable to obtain lake WL - Oil leak in hydraulic ram- being investigated

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Sun 14/02/99	23:06	John Tibaldi - The oil leak will not prevent back up methods of closing gates - WL will be delayed 1/2 hr
Sun 14/02/99	22:45	No raw data since 16:15; Killed system and killed collector; restarted collector with NIL result - Note attached sheet by N Abiitt
Sun 14/02/99	23:10	Wivenhoe EL 68.11; Have located leak in ram -'O' ring - will repair; Don't anticipate any interference with gate closing sequence.
Sun 14/02/99	23:25	Internet radar printout from Mackay Remnant L now over Mackay
Mon 15/02/99	0:10	Wivenhoe - Andrew rang - Lake EL 68.11 - Gate 5 is now 1.0m
Mon 15/02/99	0:13	Hydraulic Oil leak in Ram necessitates a change in closures. Gate 4 will be closed to 1.5m@1am not Gate 2 & at 2pm Gate 2 will be closed
Mon 15/02/99	0:55	Wivenhoe rang - leak fixed- will now close Gate 2 at 1am as originally planned
Mon 15/02/99	1:10	John Tibaldi Level Wivenhoe 68.09 Leak resulting from a faulty o-ring ready to do Gate 4 at 1:00am
Mon 15/02/99	2:18	Wivenhoe - Andrew rang - Lake 68.08, Gate 4 was closed to 1.5m @2:00am
Mon 15/02/99	2:20	Wayne Nevin - fax received @ Somerset although dark colours did not fax well. I undertook to remove the dark colours & re-send
Mon 15/02/99	2:30	re-sent 02:20 hrs fax to Somerset
Mon 15/02/99	2:30	John Tibaldi –> they think they have fixed the problem –>will try closing Gate 1 in accordance with sequence but if they have problems they will switch to Gate 5 instead. I gave them approval to do so.
Mon 15/02/99	3:14	Andrew Maugham Wivenhoe 68.07 Gate 1 closed to 0.5m in accordance with schedule @3:00 Still unable to fix oil leak but still using it.
Mon 15/02/99	3:48	A Maugham oil leak now under control at Wivenhoe
Mon 15/02/99	4:00	J Tibaldi rang to discuss staffing at Wivenhoe. P Allen advised him to maintain shifts until final closure late Wednesday.
Mon 15/02/99	5:08	A Maugham rang. Wivenhoe Gate 2 closed to 1 metre.
Mon 15/02/99	6:05	J Tibaldi rang. Wivenhoe Gate 4 closed to 1 metre
Mon 15/02/99	7:13	R Gorian rang. Wivenhoe Gate 1 now closed
Mon 15/02/99	8:00	P Allen briefed Garry Grant (SEQWB) on current situation and plans.
Mon 15/02/99	8:11	M Lane taken off flood alert. Will report twice a day for next few days.
Mon 15/02/99	8:15	P Allen advised Andrew Underwood (ICC) that flow discharge to 550 m^3/sec and that Kholo should emerge at ~20:00 hrs. We will hold this discharge for 48 hrs and then close off.
Mon 15/02/99	9:00	Wivenhoe gate 2 closed to 0.5 metres.
Mon 15/02/99	9:30	A Molloy (BoM) rang. J Ruffini advised we were releasing at 550 m3/sec and would hold at that level for a few days.
Mon 15/02/99	9:35	BCC rang requesting info on current releases. J Ruffini advised 550 m^3/sec and holding that level til Wed or Thursday. Peak release from dam was 1700 to 1800 m^3/sec.
Mon 15/02/99	12:10	Fax from SEQWB acknowledging sensor repair request for Station 6747 Grain
Mon 15/02/99		Terminal.
Mon 15/02/99	13:00	K Nguyen and P Jukes instructed to do pre draining calcs to Wivenhoe catchment.
Mon 15/02/99	13:50	R Fitzsimon rang from Kholo bridge. Gauge board recorded 1 metre at 13:20. Debris mark peaked at 4.3 metres on gauge board.
Mon 15/02/99	15:45	J Ruffini consults with P Allen re North Pine dam. Decided to allow level to rise above 39.65. If needed, will make release in daylight hours.
Mon 15/02/99	16:00	P Martin - check on stability at Gregor's Ck. He advises rock control unlikely to be a problem at low flows.
Mon 15/02/99	17:02	Fax from Somerset (R Titmarsh) Sluice gate started closing at 17:00. Lake level at 99.025 M AHD
Mon 15/02/99	17:30	Fax from Somerset (R Titmarsh) Sluice gate closed at 17:08. Lake level at EL 99.025 M AHD
Mon 15/02/99	19:45	R Fitzsimon at Kholo Bridge - 0.22 above road at 19:19 - dropped 30mm in 16 minutes
Mon 15/02/99	20:12	Fax to Somerset - Close regulator once EL 99.00 has been reached. Continue to report daily at 6:00 and 22:00 while FCC is operational.
Mon 15/02/99	20:55	R Fitzsimon at Kholo Bridge - At 20:14 Gauge read 0.130 - At 20:40 no water going over bridge. White side boards keeping water out.
Mon 15/02/99	21:20	Fax from Somerset confirming closure of Regulator 12 at 20:25 - EL 99.00 ..... FINAL CLOSURE OF SOMERSET DAM
Mon 15/02/99	21:15	J. Tibaldi reported that Kholo Bridge gauge board for EL 67 - 68 is missing.
Mon 15/02/99	22:00	Wivenhoe EL = 67.91
Mon 15/02/99	23:00	Wivenhoe EL = 67.89
Mon 15/02/99	0:00	Wivenhoe EL = 67.87

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Mon 15/02/99	1:00	Wivenhoe EL = 67.86
Mon 15/02/99	2:00	Wivenhoe EL = 67.85
Mon 15/02/99	3:00	Wivenhoe EL = 67.83
Mon 15/02/99	3:15	Fax from Wivenhoe - Flood Operating Log
Mon 15/02/99	4:00	Wivenhoe EL = 67.81
Mon 15/02/99	5:00	Wivenhoe EL = 67.79
Mon 15/02/99	6:00	Wivenhoe EL = 67.77 , Somerset EL = 99.00. Don Cock talked to John Tibaldi about ???
Mon 15/02/99	6:06	Fax from Wivenhoe - Flood Operating Log
Mon 15/02/99	7:00	Wivenhoe EL = 67.77
Mon 15/02/99	8:00	Wivenhoe EL = 67.75
Mon 15/02/99	8:10	Phone call from Garry Grant (SEQWB) to Don Cock about Burtons Bridge opening - SEQWB agreed to inform the enquirer
Mon 15/02/99	9:10	Doug Grigg reported Wivenhoe EL = 67.74 and confirmed current gate opening settings as: Closed, 0.5, 4.0, 1.0, Closed
Tue 16/02/99	9:15	Advised Peter Burrow at Ipswich City Council that WL Kholo Bridge is below deck but will not drop further until Thursday.
Tue 16/02/99	9:30	R.Fitzsimon - Kholo Bridge WL is 0.5m below wearing surface on U/S side and 0.5-0.7 below on D/S side.
Tue 16/02/99	10:00	David Gill (SEQWB) rang re opening of Bridges. 2pm - 8pm Thursday + 3 hours travel so. Friday morning looks good.
Tue 16/02/99	12:35	JR spoke to Terry Malone (BoM) - suggested a debriefing post event. TM indicated more regular communication would have been more helpful.
Tue 16/02/99	12:50	John Mulheron (SEQWB) rang to discuss whether Burton's Bridge could be opened. There is about 200 m^3/sec unaccounted for inflows which were delaying the fall in Wivenhoe. Until we locate this we cannot reduce the discharge from the dam. PA to investigate further. JM will ring back approx 16:30 to discuss the issue further.
Tue 16/02/99	16:50	Rang John Mulheron (SEQWB) - Explained the "losses" of about 150m^3/sec not yet found. PA indicated he would discuss with J Ruffini overnight. JM to ring back at 20:30 to discuss the situation.
Tue 16/02/99	17:20	John Mulheron & Garry Grant (SEQWB) - John is applying pressure to open Burton's Bridge. PA has undertaken to review the situation to discuss it further at 21:00.
Tue 16/02/99	19:50	PA rang Brian Shannon (SWP, Support panel) to discuss the issue of gate closures to bring Burton's bridge out of water. PA has run a number of cases to test sensitivity.
Tue 16/02/99	21:00	PA rang John Mulheron (SEQWB) to discuss options of reducing discharge and bringing Burton's bridge out of water - presented JM with results of sensitivity studies. (a) If it is left as it is ... it will drain to EL 67 by about 18/2 @ 17:00 (b) If we reduce to 250 m^3/sec (to clear Burton's) straight away, it will take 7 days (ie 23/2 @ 22:00) to drain (c) If we reduce to 250m^3/sec @ 8:00 tomorrow, it will take 6 days to drain (ie 23/2 @15:00) Savage's Crossing will be out for the duration. JM accepted the argument to keep the status quo and to review the situation at 08:00 tomorrow.
Tue 16/02/99	21:45	Rob Titmarsh rang from Somerset. Lake Level 99.02, a rise of 0.02, due to hydro being off line from 13:00 to 20:00
	22:00	Wivenhoe EL 67.59
	22:30	PA fax to North Pine Dam G/B 39.60 EL BCC 39.602 Digital 39.605
Wed 17/02/99	0:00	Wivenhoe EL 67.55
	1:00	Wivenhoe EL 67.53
	2:40	Wivenhoe EL 67.50
	3:00	Wivenhoe EL 67.49
	3:30	Fax from Wivenhoe - Flood Operating Log
	4:00	Wivenhoe EL 67.47
	4:15	Fax from Wivenhoe - Event Log
	5:00	Wivenhoe EL 67.45
	6:00	Somerset EL 99.015
	6:00	Wivenhoe EL 67.41
	6:45	Rob Titmarsh (Somerset) indicated Hydro not working yesterday for a period of time causing water level to rise
	7:00	Wivenhoe EL 67.40
	7:30	Fax from North Pine Dam G/B 39.60, BCC 39.606, Digital 39.609
	8:00	Wivenhoe EL 67.38

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	8:20	Received fax from Somerset - Flood Log Sheets (13 pages)
	8:30	Spoke to John Mulheron and Gary Grant (SEQWB). Advised that we would be commencing shut down when we reach approx EL 67.1 which would be some time tonight depending on the downstream rate
	9:00	Wivenhoe EL 67.37
	9:50	Doug Grigg will be off this afternoon so that he can do the night shift as Andrew's wife has gone into hospital to have a baby
	10:00	Somerset Dam EL 99.01 (Rob Titmarsh)
	10:00	Wivenhoe EL 67.35
	10:30	North Pine EL 39.606
	11:00	Wivenhoe EL 67.34
	12:00	Wivenhoe EL 67.33
	12:00	Fax from North Pine Dam G/B 39.6, BCC 39.605, Digital 39.605
	13:00	Somerset Dam EL 99.01 , Wivenhoe EL 67.32
	13:00	Fax sent to Wivenhoe with draft strategy from Wivenhoe OPT Sheet
	13:30	???
Wed 17/02/99	14:00	Wivenhoe EL 67.31
	15:00	Wivenhoe EL 67.31
	16:00	Somerset EL 99.01 , Wivenhoe EL 67.30
	16:00	North Pine EL 39.604 at 15:00 hr
	16:30	Ian Bilkie of Ipswich CC contacted Don Cock re: rumour that College Xing would not be open tomorrow. Don rang back to confirm & told him Fri am. He will ring back on Thursday to confirm (ph 38107911)
	17:00	Wivenhoe EL 67.29
	18:00	Wivenhoe EL 67.28
	18:10	Garry Grant (SEQWB) spoke to Don Cock re: Wivenhoe close down - SEQWB normally provides a base flow to keep Mt Crosby Weir full for BCC water supply purposes. Average demand @ Weir is 500ML/day or 6 cumecs. Flow is made available through a regulator.
	19:00	Wivenhoe EL 67.27
	19:00	Peter Allen discussed closing down to clear Burton Bridge with John Mulheron (SEQWB). JM was keen to clear bridge by Thursday am. PA explained that he would investigate options and ring JM back.
	19:30	PA rang JM (SEQWB) re: Opening of Burton's Bridge: Option of gate closure of 30mins interval instead of 60mins will achieve objective, but will extend lower Bridges submergence by 8 to 12 hrs.
	20:00	Wivenhoe EL 67.26
	21:00	Wivenhoe EL 67.25
	21:23	Somerset EL 99.01
	21:30	Fax from North Pine for Lake EL 39.60
	21:50	Khanh Nguyen provided info. (AMTD and Deck Levels) on Lower Bridges @ Xings to Garry Grant for preparation of Flood OPT Presentation to SEQWB on Thursday morning
	22:00	Wivenhoe EL 67.23
	23:00	Wivenhoe EL 67.21
	23:04	Faxed to Wivenhoe confirming closure sequences from 23:30 to 1:30 as per earlier advices 17/02/99
	23:08	Received Wivenhoe Dam Event Log
	23:30	Wivenhoe confirmed Gate 4 closed from 1.0 to 0.5; The Gates Setting - Closed, 0.5, 4, 0.5, Closed.
Thu 18/02/99	0:00	Wivenhoe EL 67.20
	23:30	Wivenhoe confirmed Gate 3 closed from 4.0 to 3.5; The Gates Setting - Closed, 0.5, 3.5, 0.5 Closed.
	0:30	Wivenhoe confirmed Gate 2 closed from 0.5 to 0.0(closed); The Gates Setting - Closed, Closed, 3.5, 0.5 Closed.
	1:09	Wivenhoe , Doug Grigg rang, Lake EL 67.20 @1:00 Gate 4 closed , settings now closed, closed, 3.5,closed,closed
	1:33	Wivenhoe , Doug rang, Gate 3 closed from 3.5m to 3m, settings now closed, closed, 3.0,closed,closed
	2:05	Doug Grigg, Wivenhoe 67.19; Gate 3 closed to 2.5m @ hold point for Burtons Bridge
	1:11	recd fax from Wivenhoe - Flood event Log
	3:01	Wivenhoe, Doug rang; Lake EL 67.17 @ 3:00
	4:00	Wivenhoe, Doug rang; Lake EL 67.15 @ 4:00
	5:01	Wivenhoe, Doug rang; Lake EL 67.13 @ 5:00

APPENDIX A — ABBRIDGED FCC EVENT LOGS

FEBRUARY 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

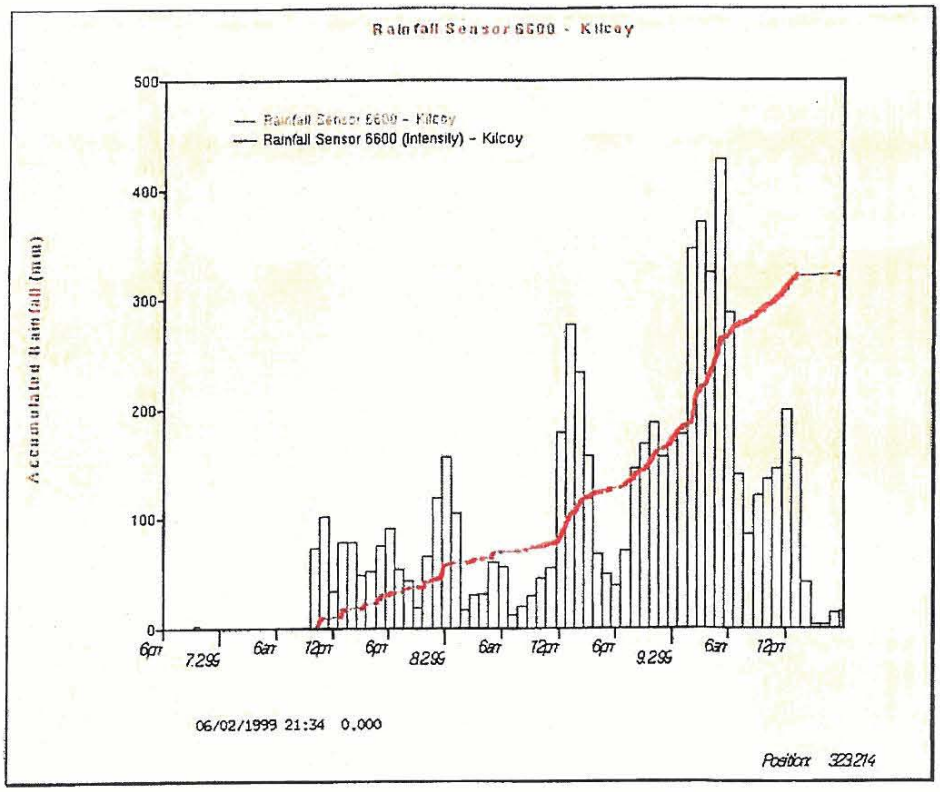
Date	Time	Action/Comment
	6:01	Wivenhoe, Doug rang; Lake EL 67.12 @ 6:00
	6:28	Somerset, Rob Titmarsh rang ; Lake EL 99.01 @ 6:30
	7:00	Wivenhoe WL 67.10; Doug Grigg reports there is still 0.6m over Burton's Bridge. Request to Doug to check bridge at 9:00 AM
	7:10	Rob Titmarsh @ Somerset; Hydro station will be closed for repairs over next weekend, therefore expect small rises in level. Advice regarding planned maintenance on the sluices next week (& ongoing for the next few months)
	7:15	North Pine Lake Level = 39.607m (refer fax)
	8:05	John Tibaldi rang from Wivenhoe; Lake EL 67.10; John estimates a difference in gauge board readings of up to 1cm.
	8:20	John Tibaldi rang from Burton's Bridge. The water is lapping the timber at the upstream side. There is about 150mm of water over the bridge decking.
	8:23	Rob Titmarsh rang requesting instructions for the crest gates
	8:52	David Gill (SEQWB) rang requesting approval to flush regulators. Advised to wait until flow at Burton's Bridge had settled down. Also any flushing should be carried out one at a time.
	8:55	Advised Rob Titmarsh to lower crest gates at Somerset
	9:00	John Tibaldi rang en route to Burton's Bridge; Lake EL 67.09
	9:20	John Tibaldi - Burton's Bridge has approx 100-150mm of water over it.
	9:30	Peter Birkles from Splityard - Max Q with 2 units approx = 320 x 2 cumecs - Monitor MW output - may be only discharge approx = 60 cumecs
	10:00	Wivenhoe 67.09
	10:15	John Tibaldi advised that there is no longer water over Burton's Bridge
	11:00	J. Tibaldi - Wivenhoe EL 67.09
	12:00	J. Tibaldi - Wivenhoe EL 67.09
	12:15	J.Tibaldi - Burton's Bridge has dropped about another foot
	13:00	Wivenhoe EL 67.09 (R.Gorian)
	14:00	Wivenhoe EL 67.10
	14:00	Peter Birkles - Splityard releasing? at 330 cumecs
	15:00	Wivenhoe EL 67.10 (R.Gorian) - opened Regulator No 1 at 15:13 for purpose of Wivenhoe Township - will keep open for approx 1 hour
	16:00	Wivenhoe EL 67.11 (R.Gorian)
	16:30	R.Gorian @ Burton's Bridge WL 500mm below deck
	16:30	Garry Grant (SEQWB) confirmed that we should take FSL as 67 plus a full Splityard. Commence closure at 19:00 based on the information at 14:00.
	17:00	Wivenhoe EL 67.11
	18:00	Wivenhoe EL 67.10
	19:00	Fax to Wivenhoe advising to commence closure at 19:30

APPENDIX B

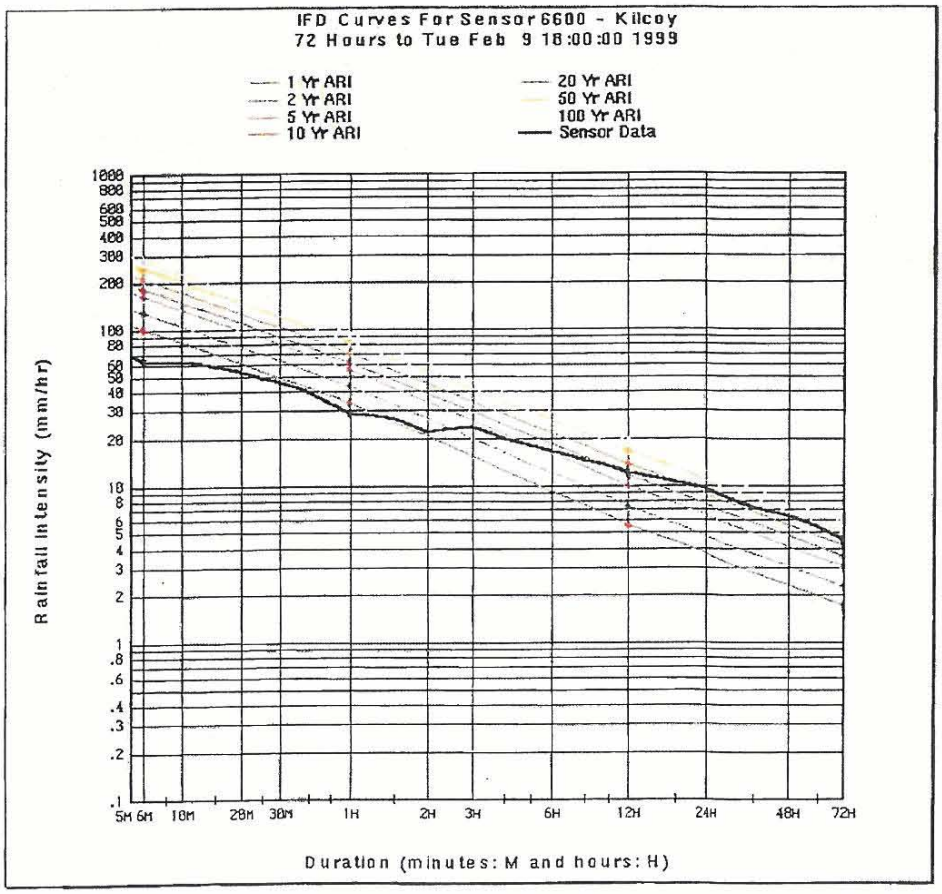
REPRESENTATIVE CUMULATIVE RAINFALL AND IFD CURVES FOR FEBRUARY 1999 EVENT

APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event



Somerset Catchment - Rainfall Sensor 6600 - Kilcoy



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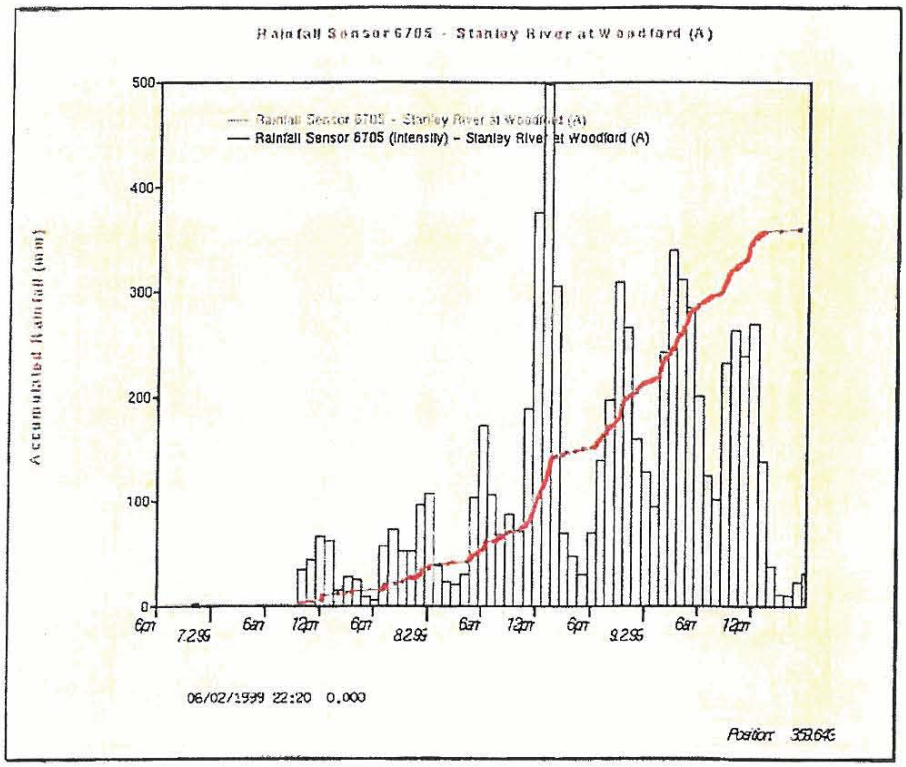
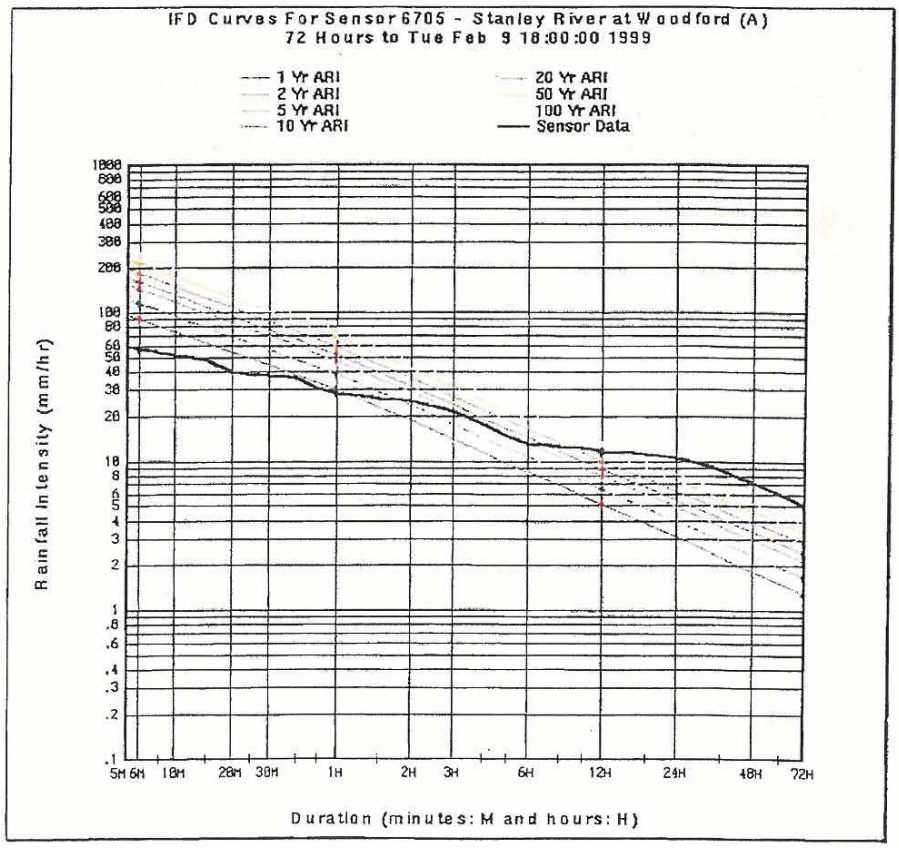
Cumulative Rainfalls & IFD Curves for February 1999 Event



Somerset Catchment - Rainfall Sensor 6705 - Stanley River at Woodford (A)



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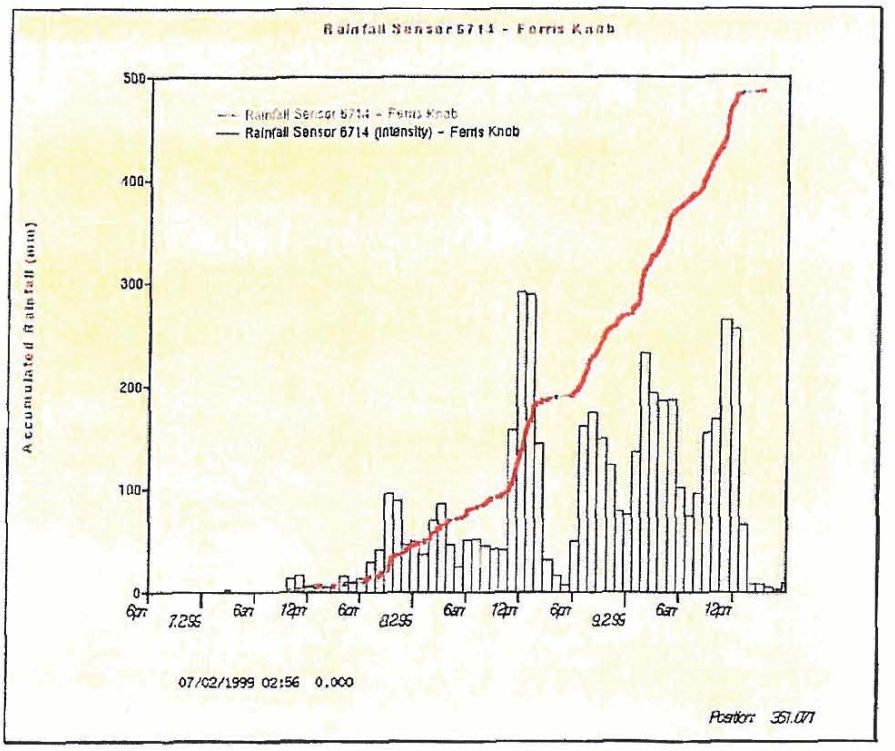
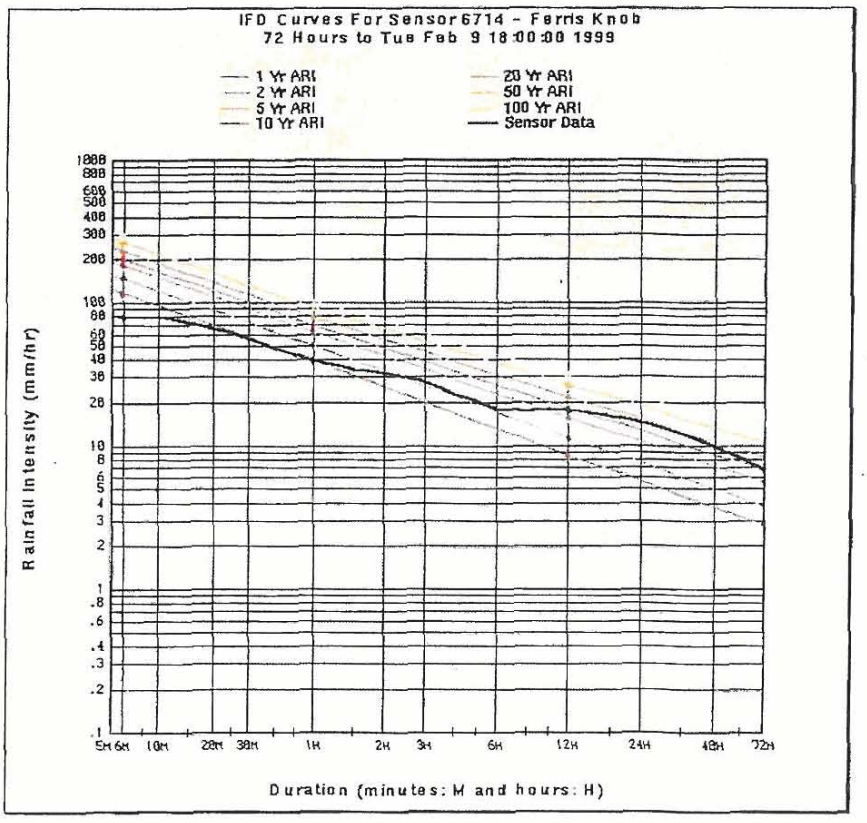


Somerset Catchment - Rainfall Sensor 6714 - Ferris Knob



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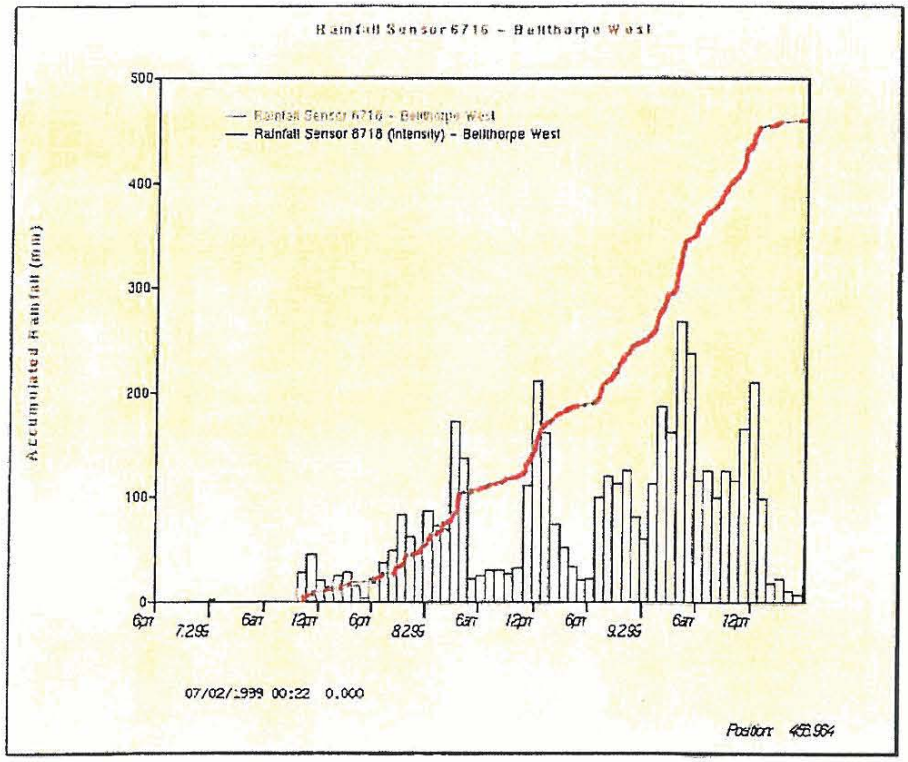
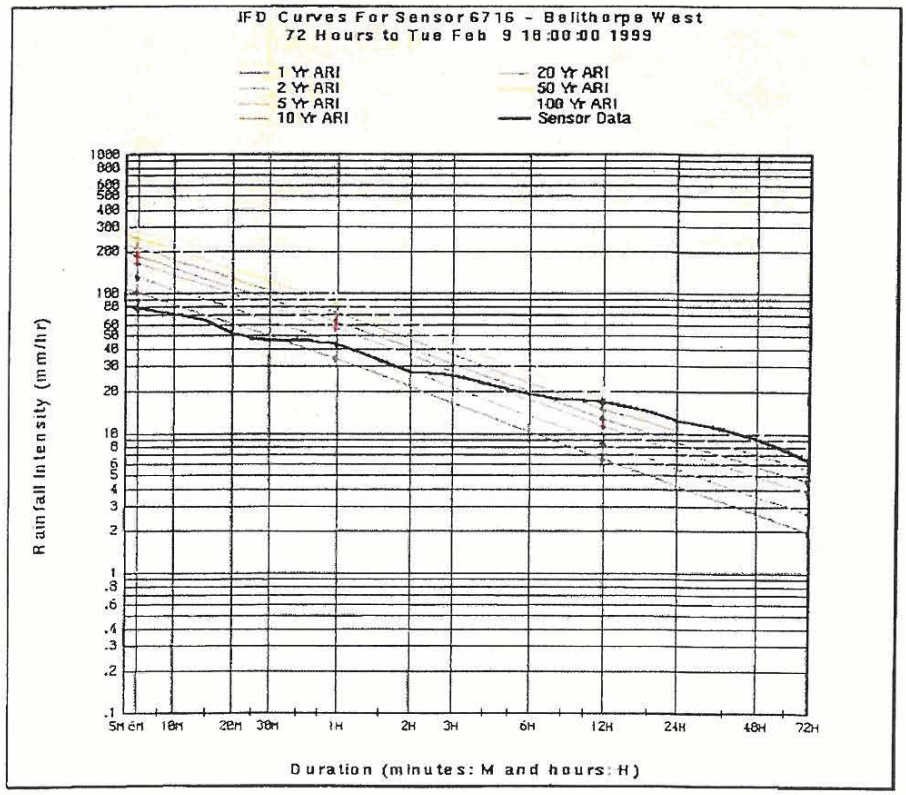


Somerset Catchment - Rainfall Sensor 6716 - Bellthorpe West



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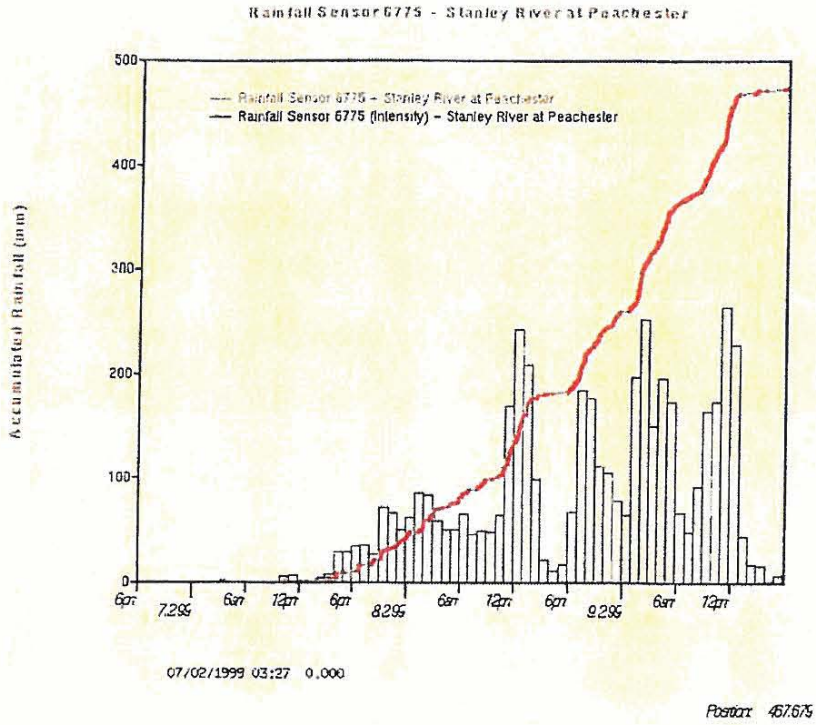
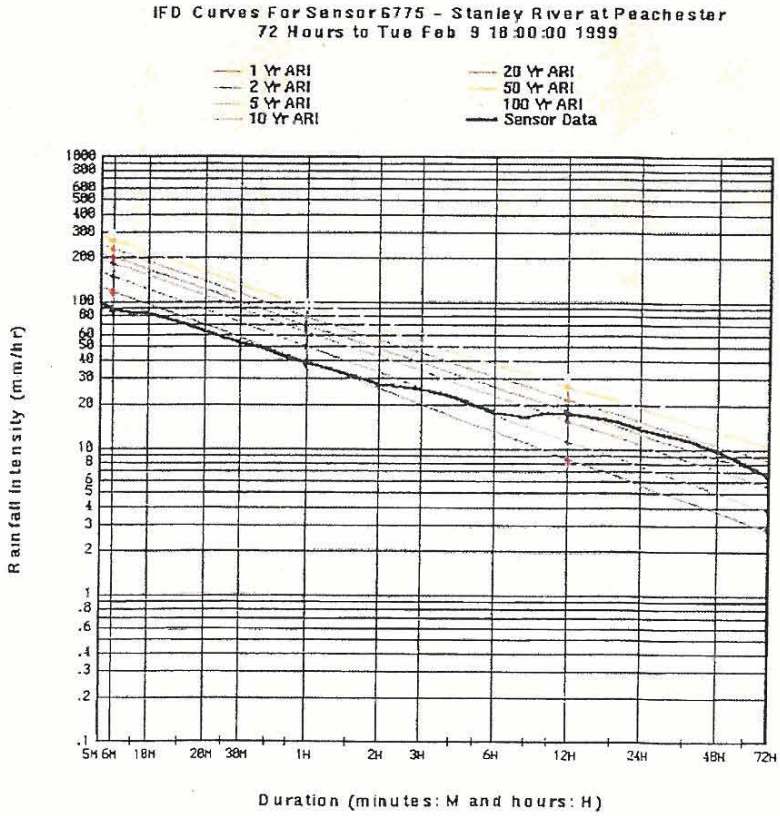


Somerset Catchment - Rainfall Sensor 6775- Stanley River at Peachester



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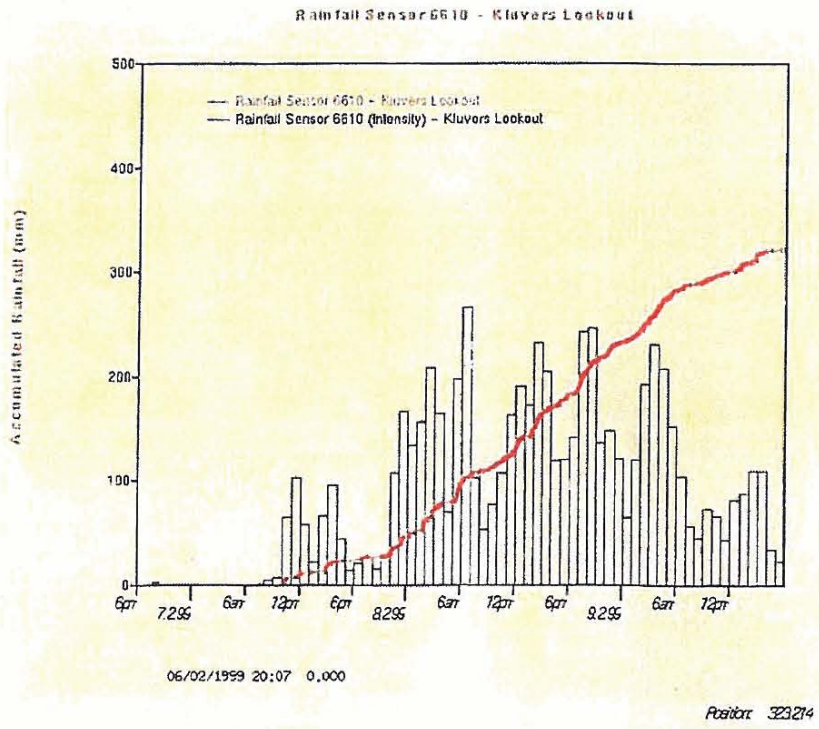
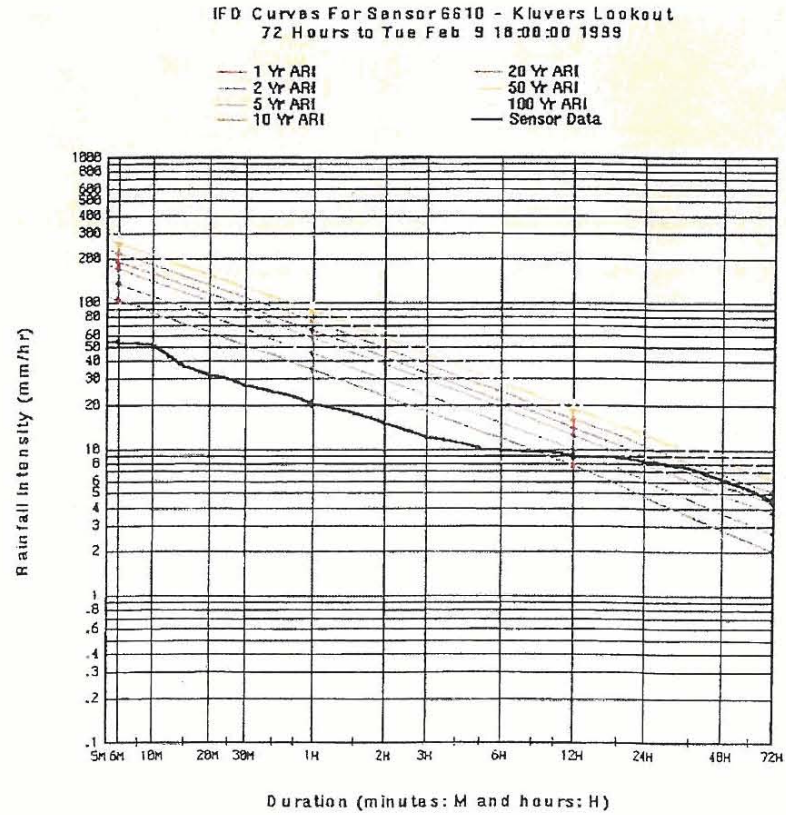


Pine Catchment - Rainfall Sensor 6610 - Kluvers Lookout



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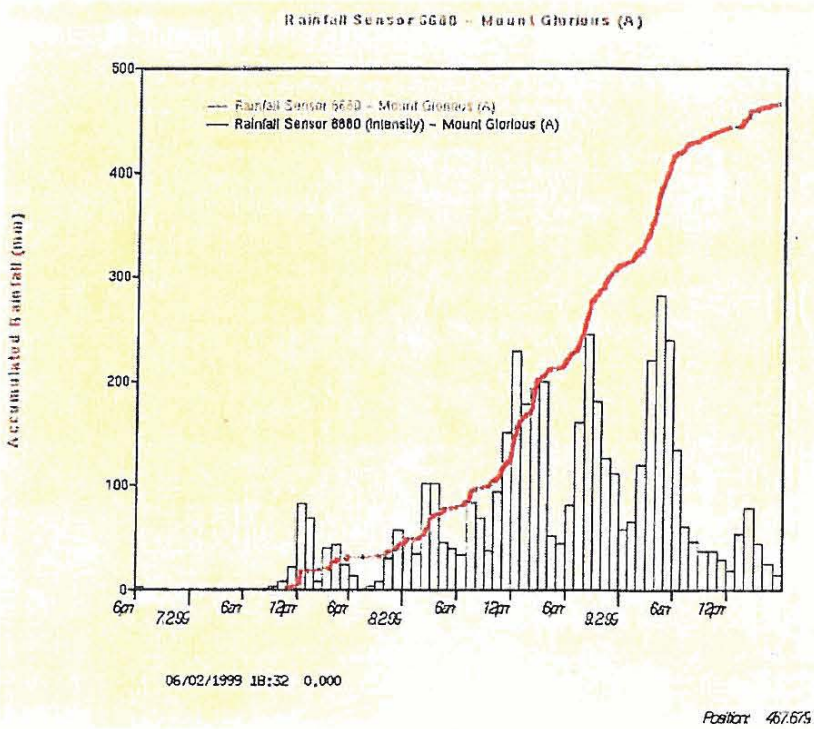
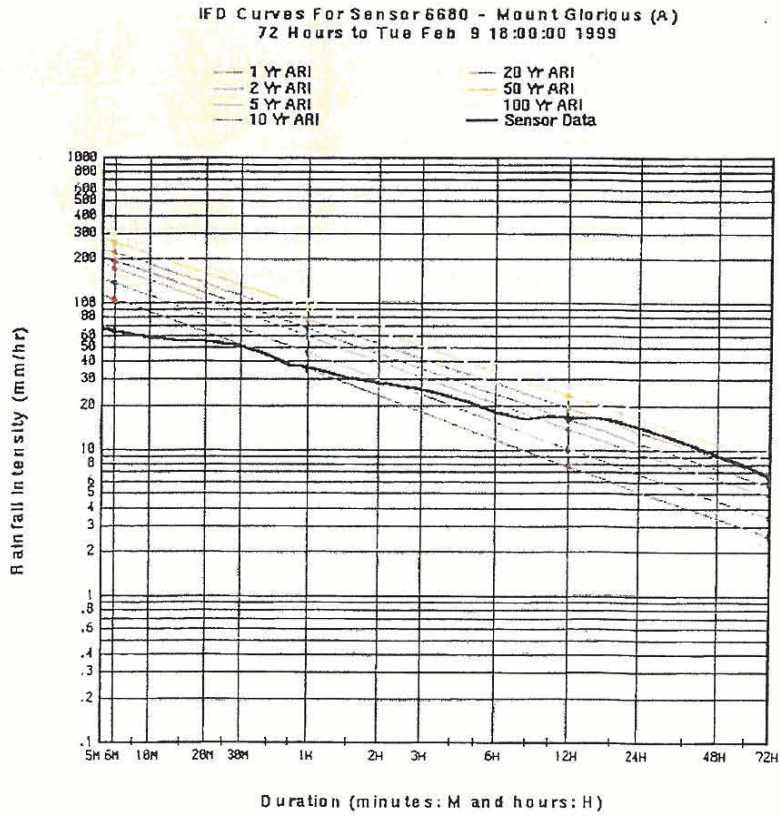


Pine Catchment - Rainfall Sensor 6680 - Mount Glorious



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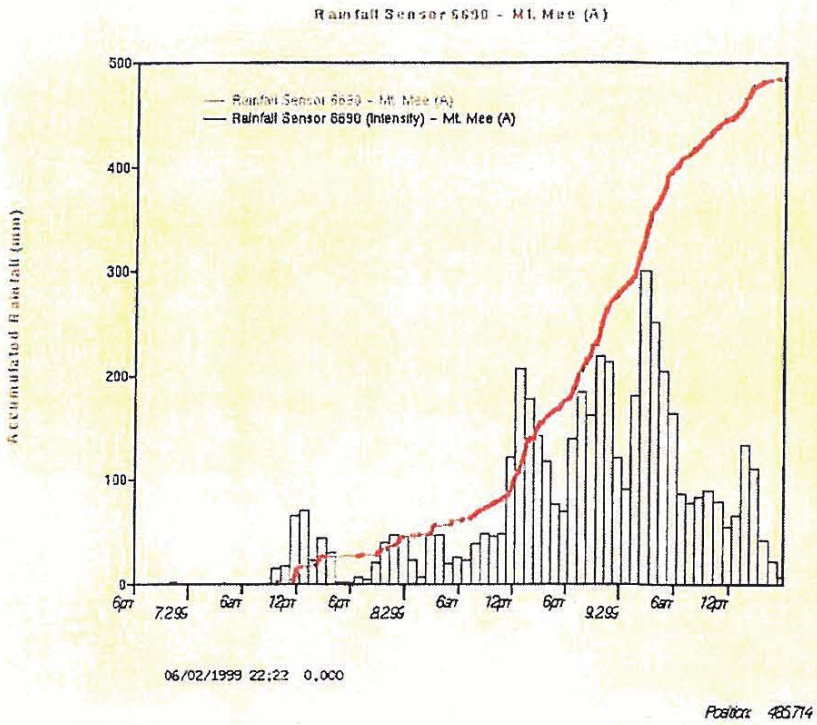
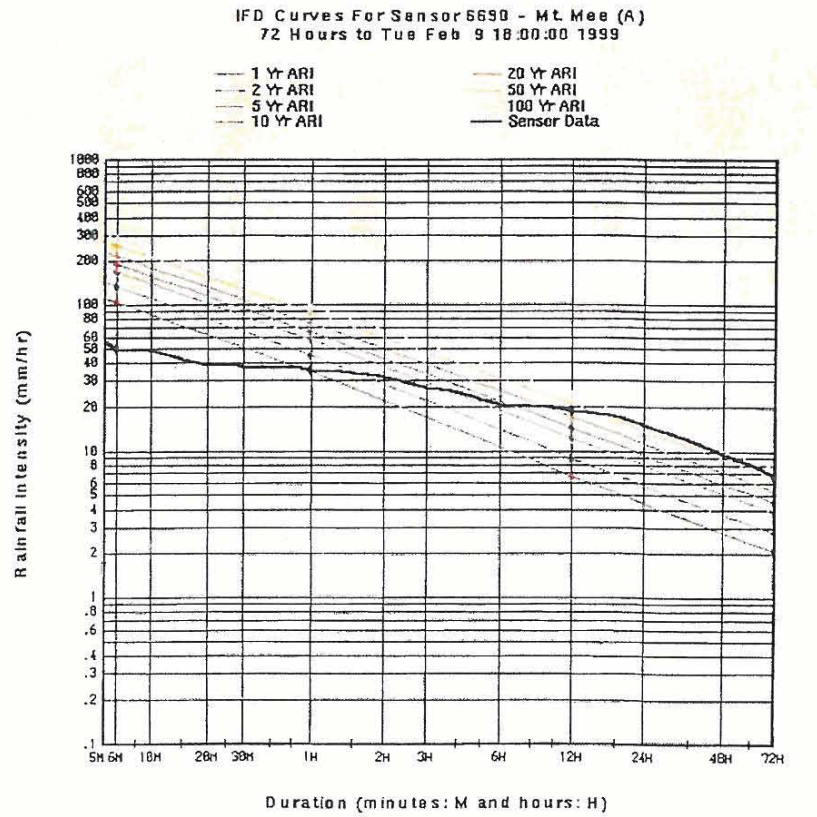


Pine Catchment - Rainfall Sensor 6690 - Mount Mee



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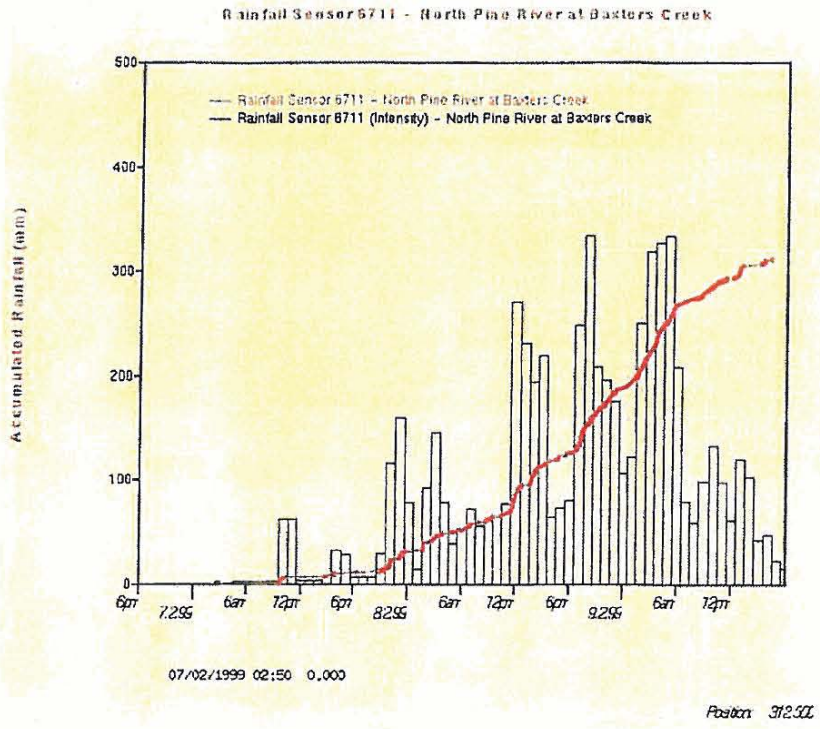
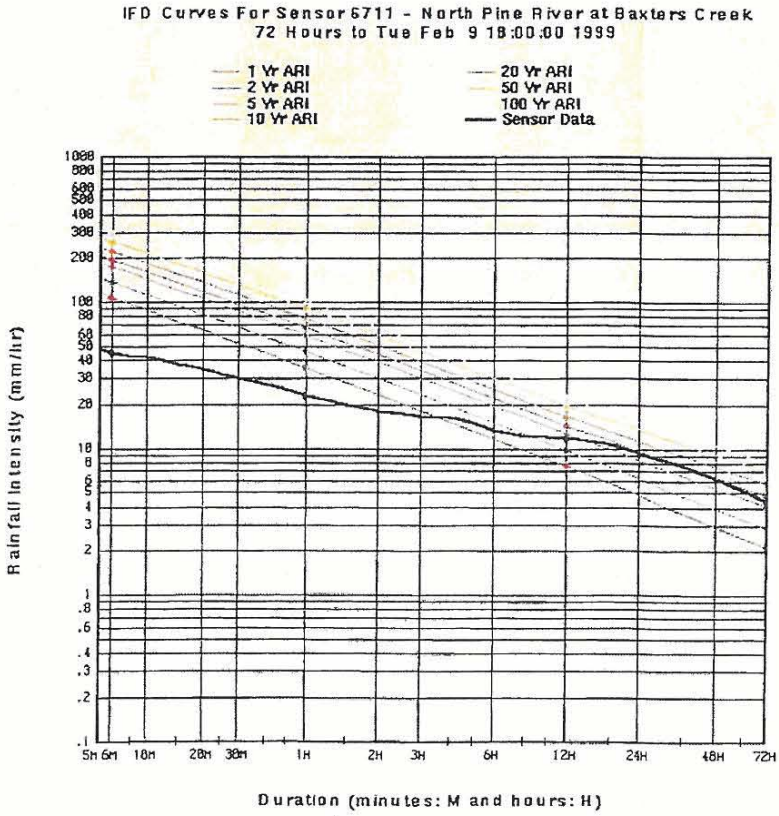


Pine Catchment - Rainfall Sensor 6711 - North Pine River at Baxters Creek



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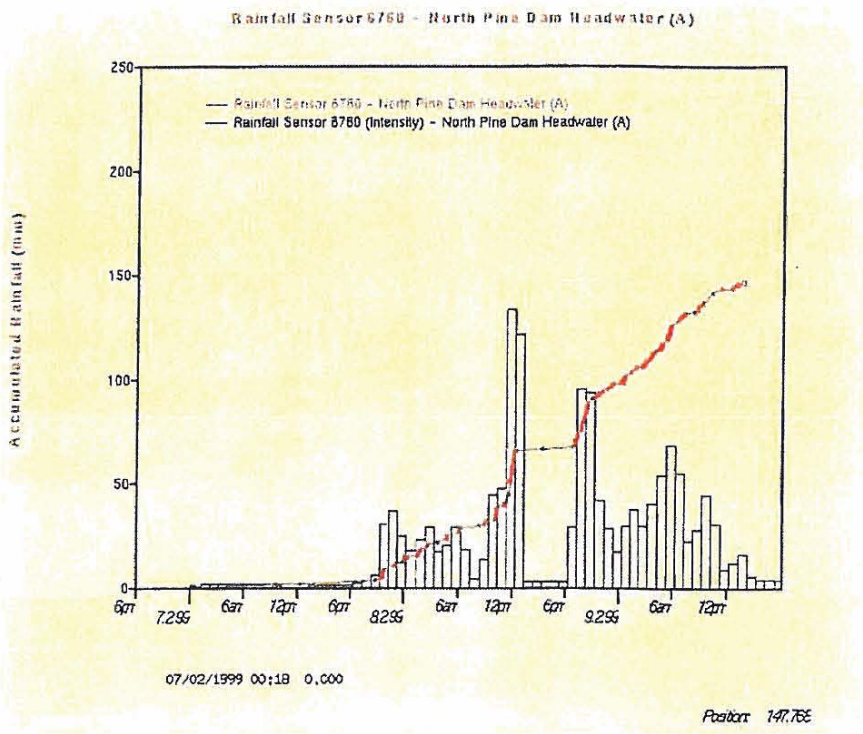
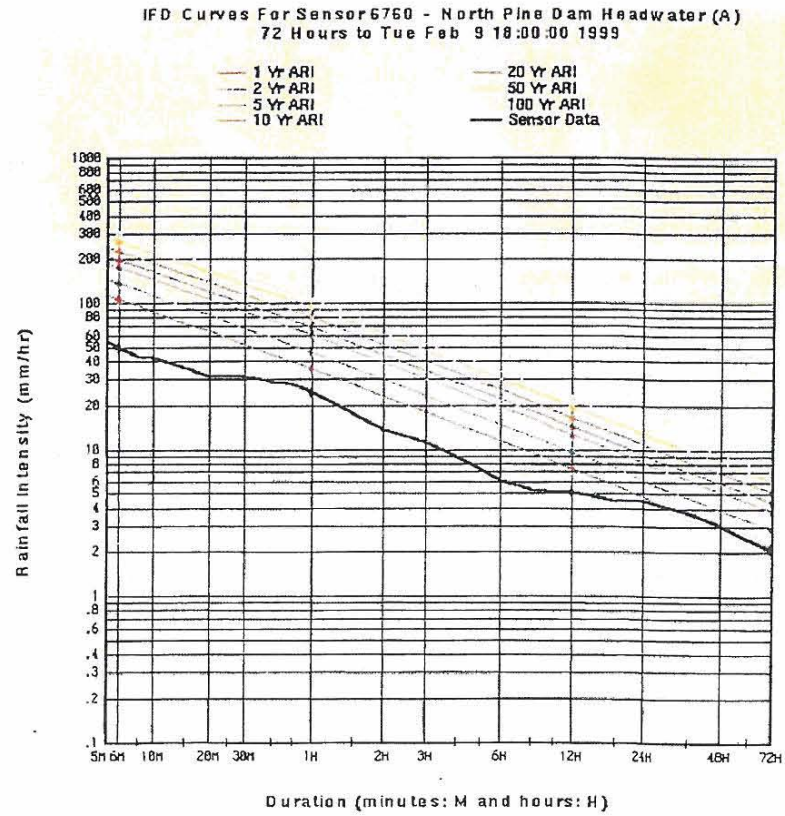


Pine Catchment - Rainfall Sensor 6760 - North Pine Dam Headwater



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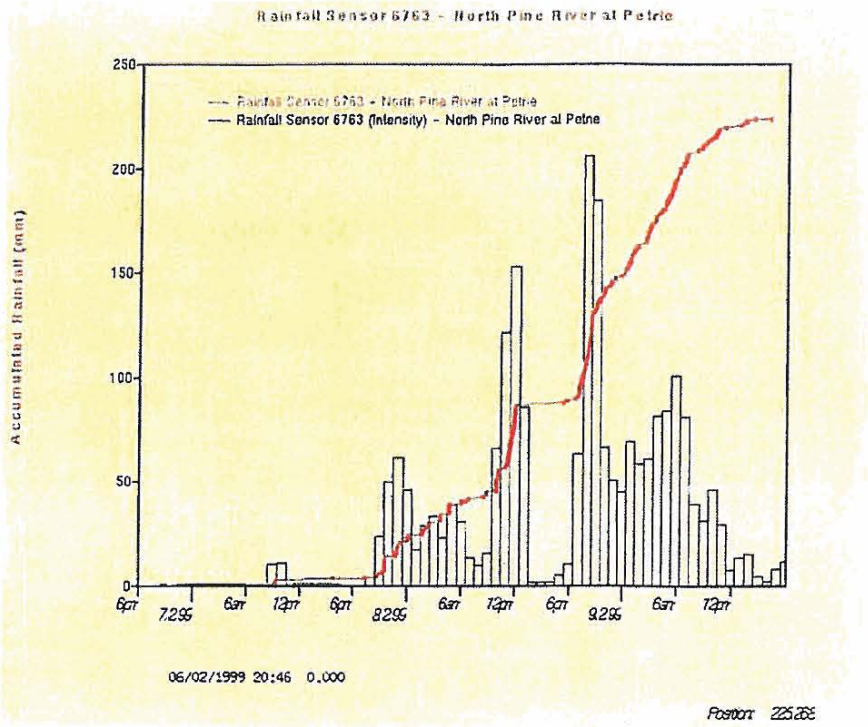
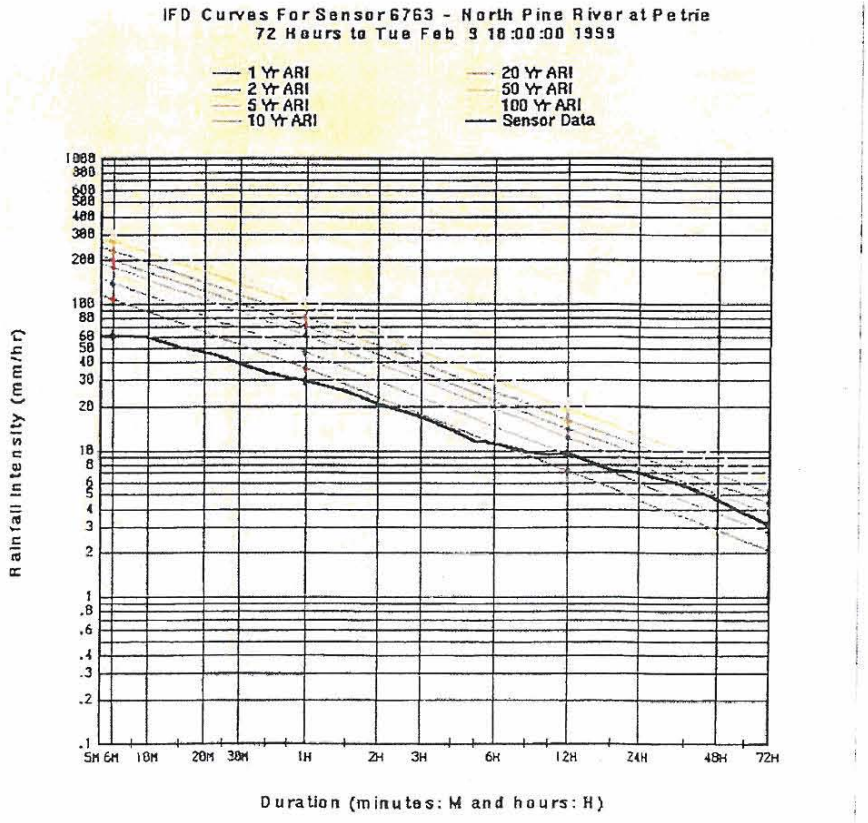


Pine Catchment - Rainfall Sensor 6763 - North Pine River at Petrie



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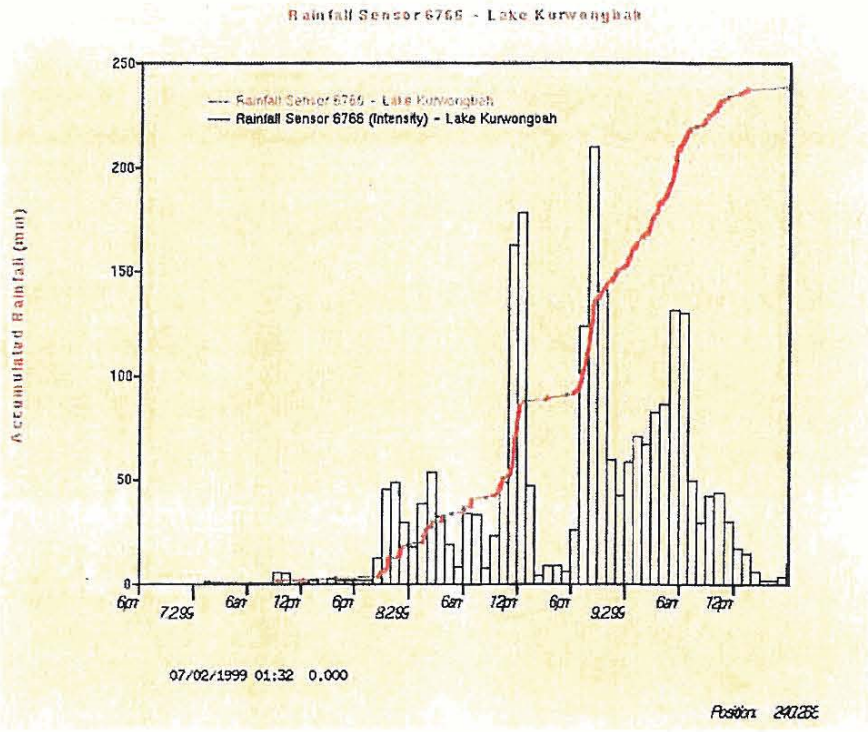
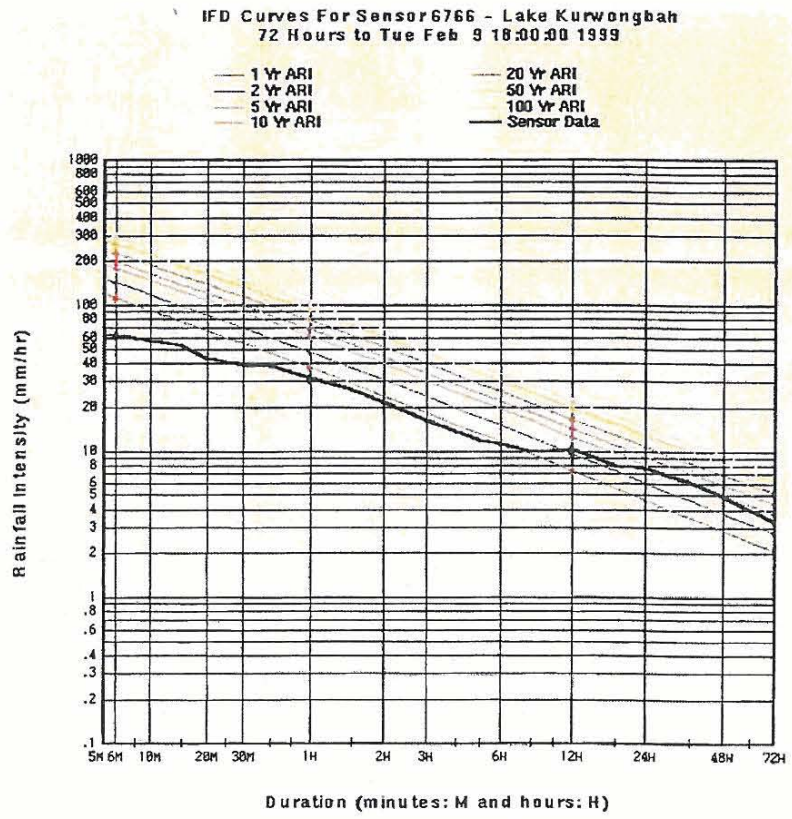


Pine Catchment - Rainfall Sensor 6766 - Lake Kurwongbah



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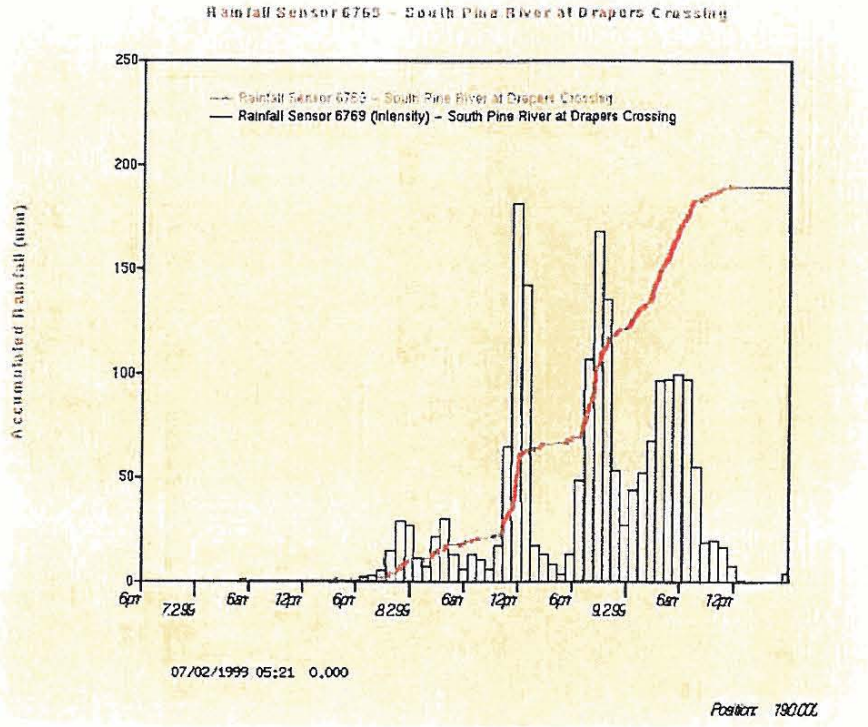
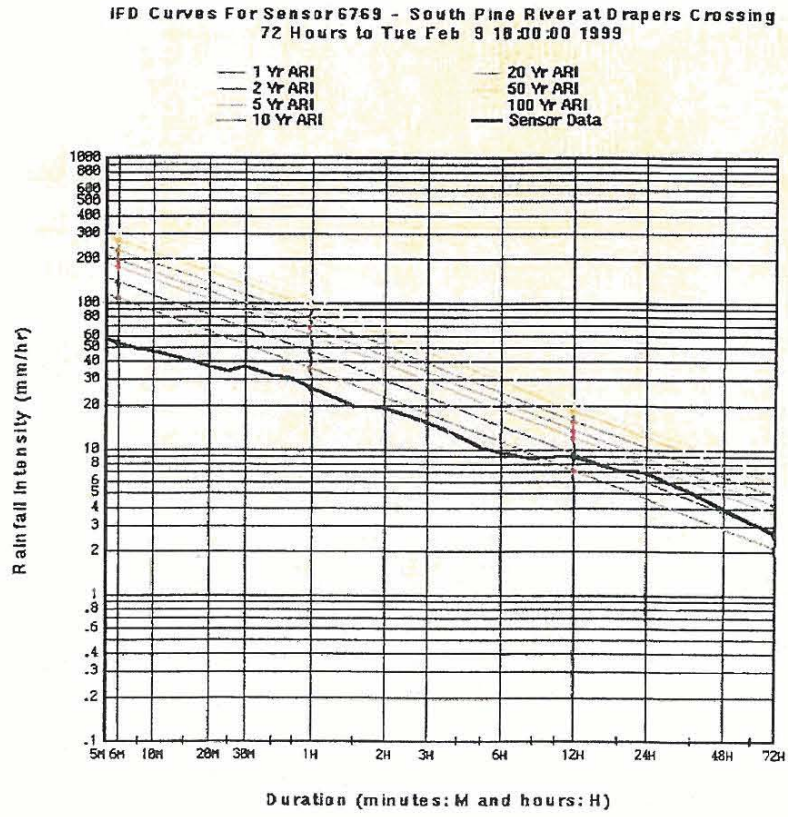


Pine Catchment - Rainfall Sensor 6769 - South Pine River at Drapers Crossing



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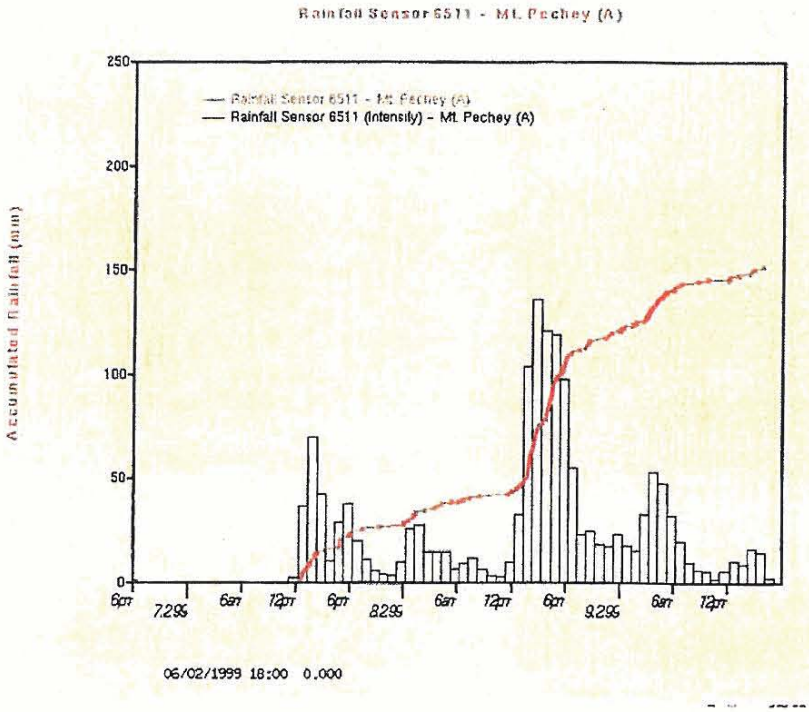
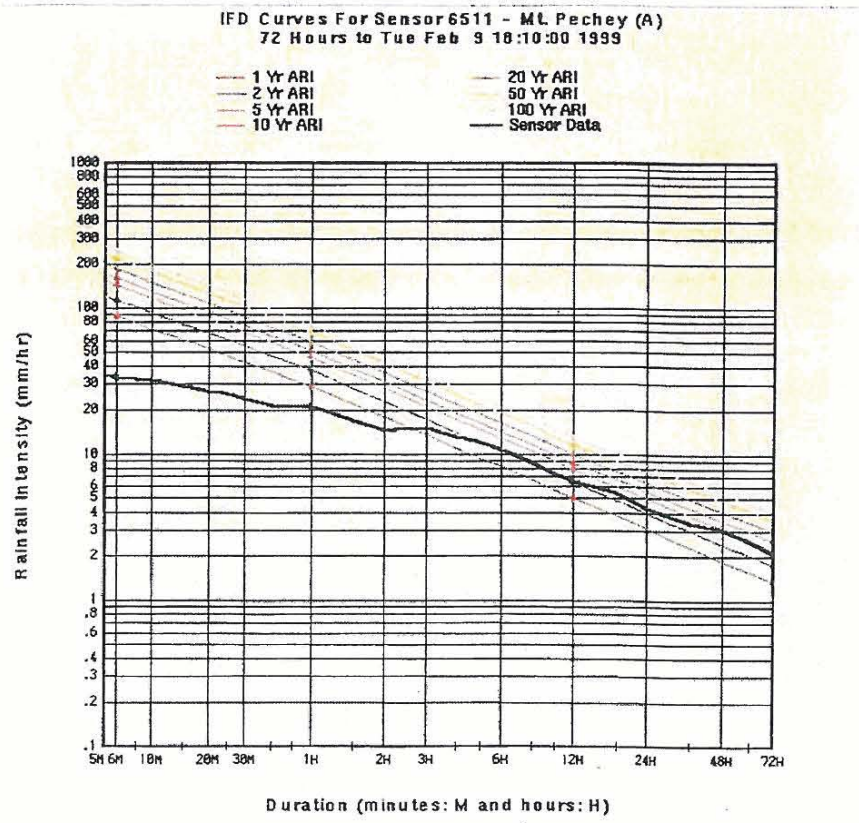


Upper Brisbane Catchment - Rainfall Sensor 6511 - Mount Pechey



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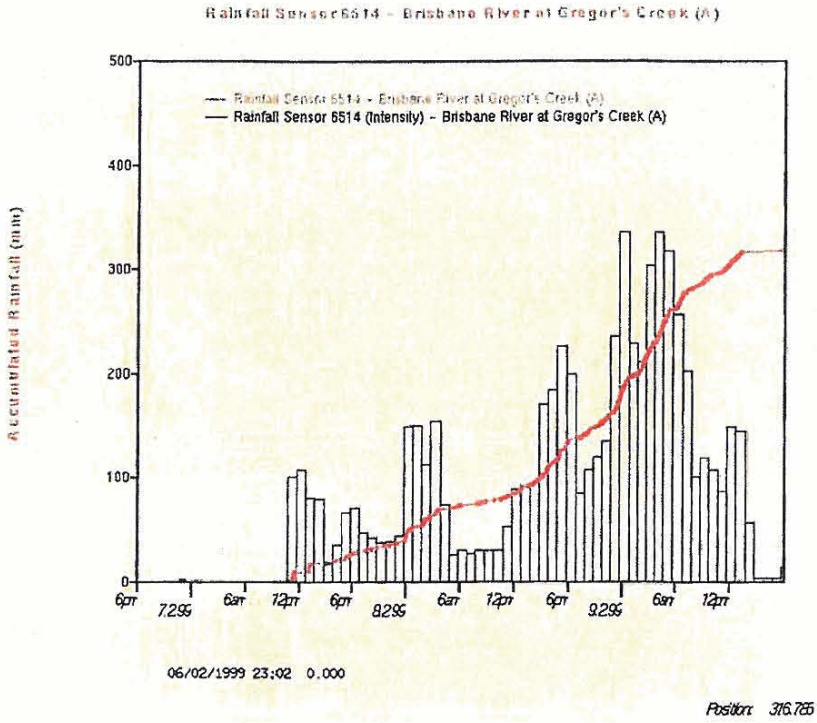
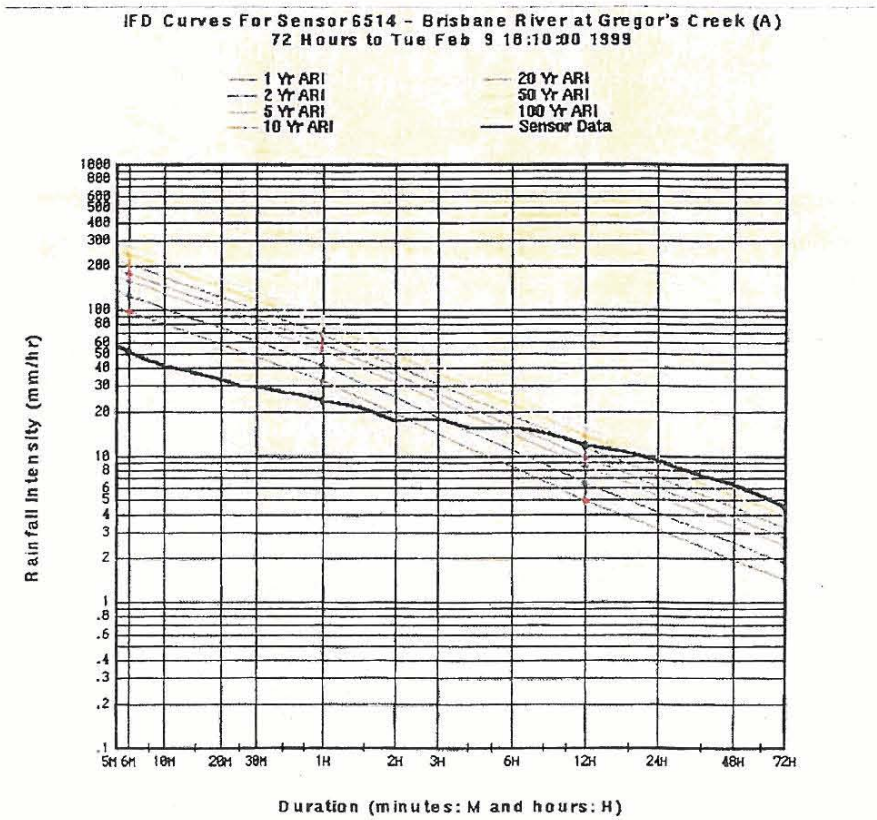


Upper Brisbane Catchment - Rainfall Sensor 6514 - Brisbane River at Gregor's Creek



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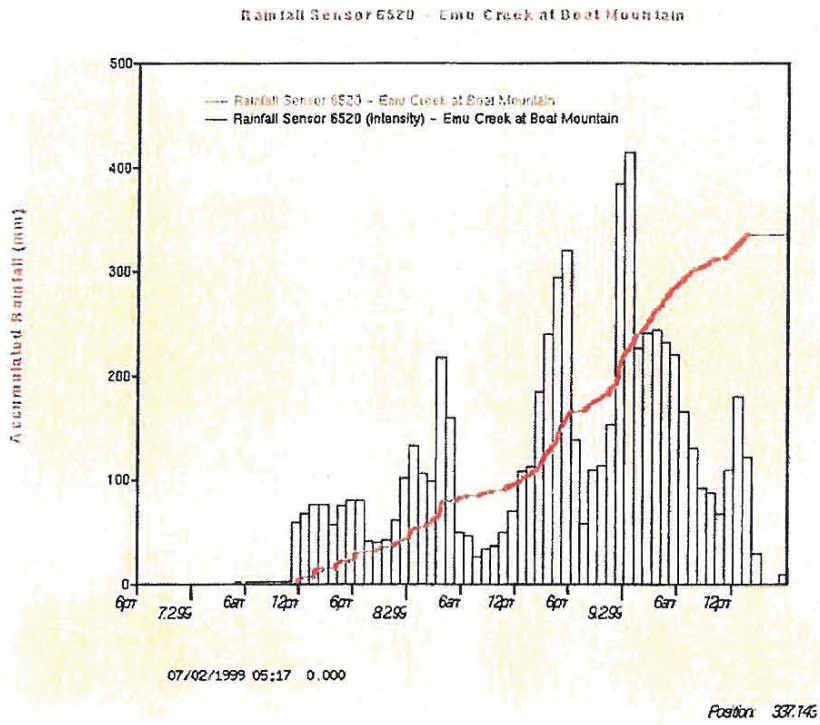
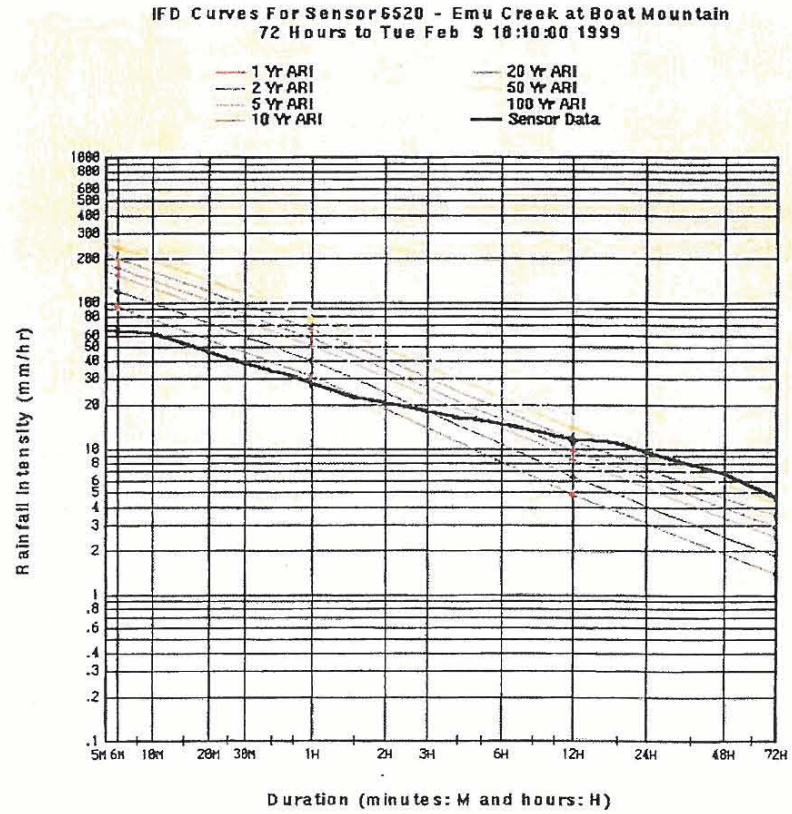


Upper Brisbane Catchment - Rainfall Sensor 6520 - Emu Creek at Boat Mountain



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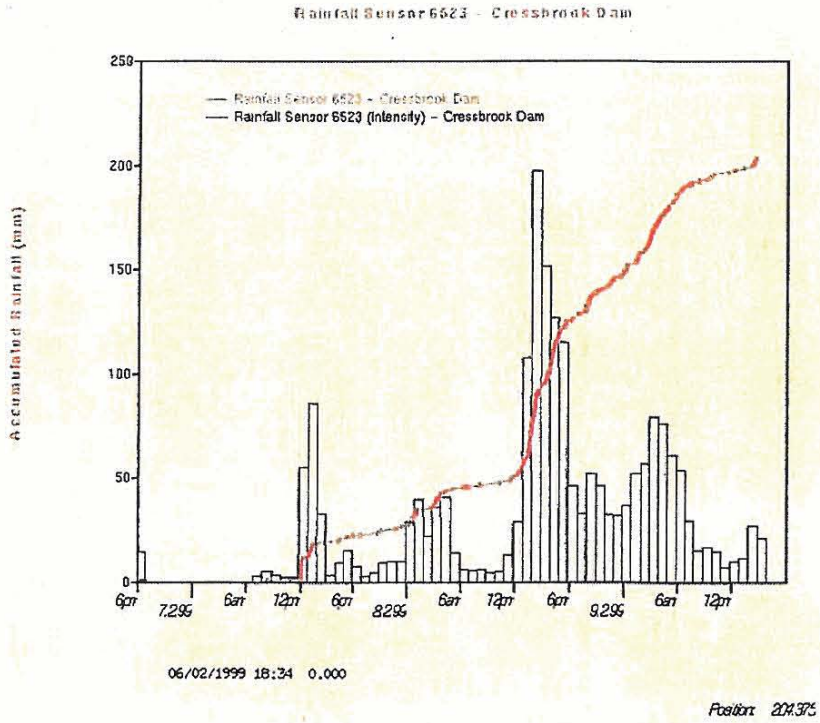
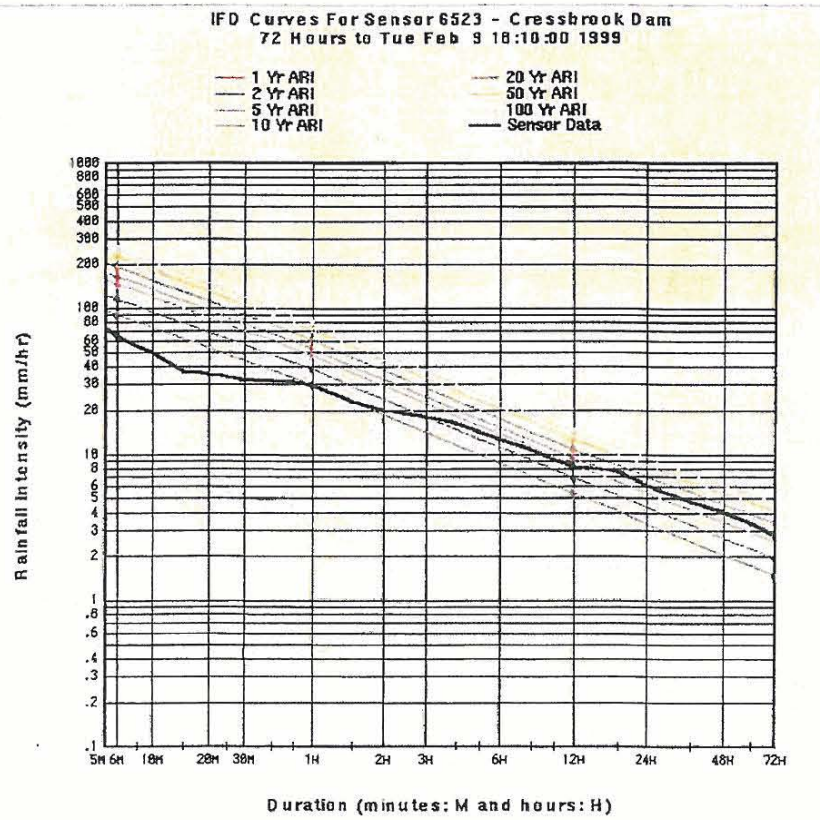


Upper Brisbane Catchment - Rainfall Sensor 6523 - Cressbrook Dam



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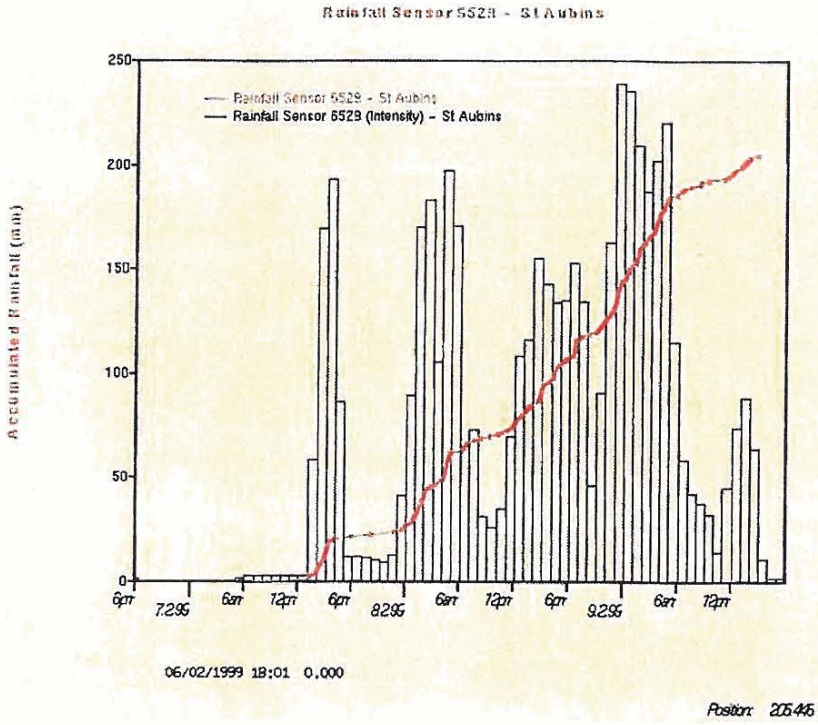
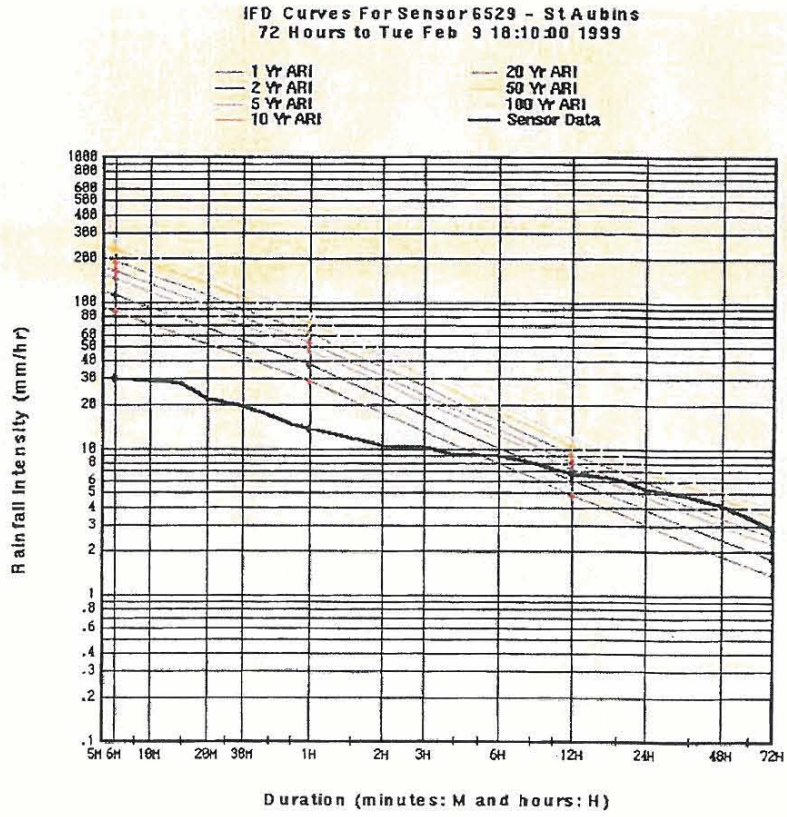


Upper Brisbane Catchment - Rainfall Sensor 6529 - St Aubins



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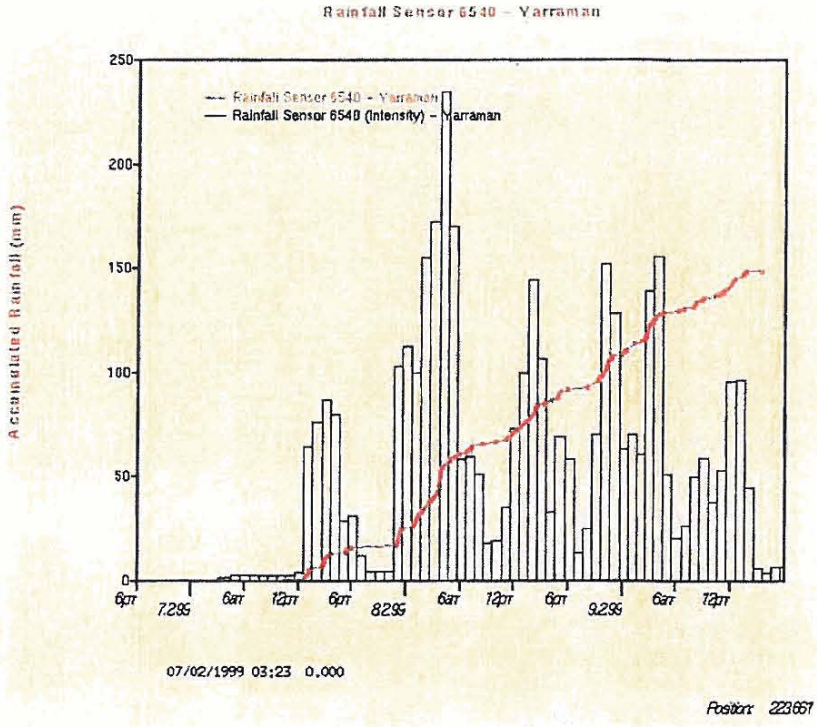
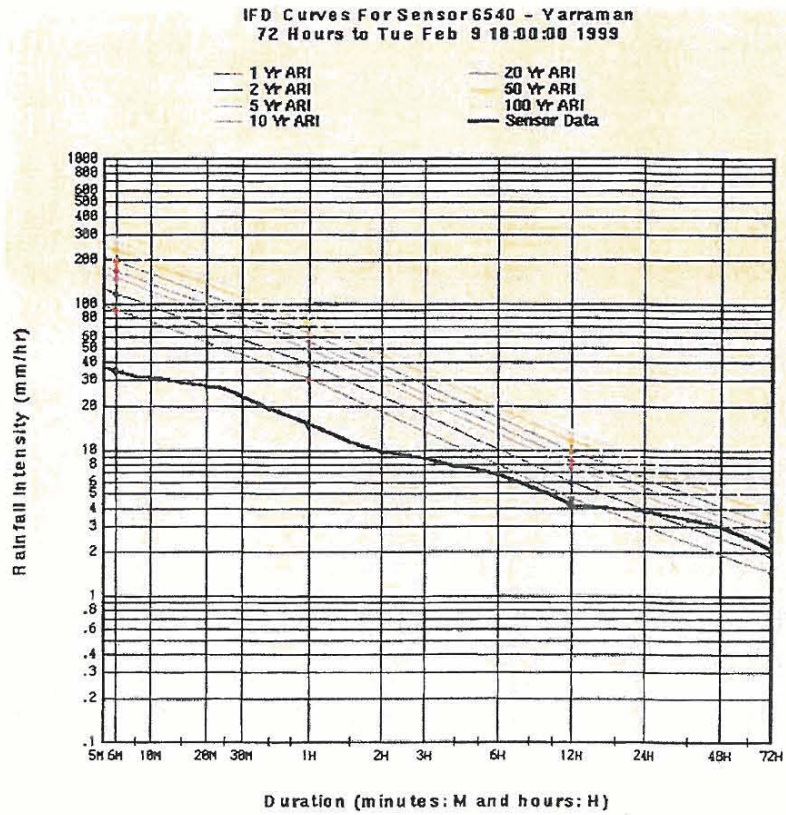


Upper Brisbane Catchment - Rainfall Sensor 6540 - Yarraman



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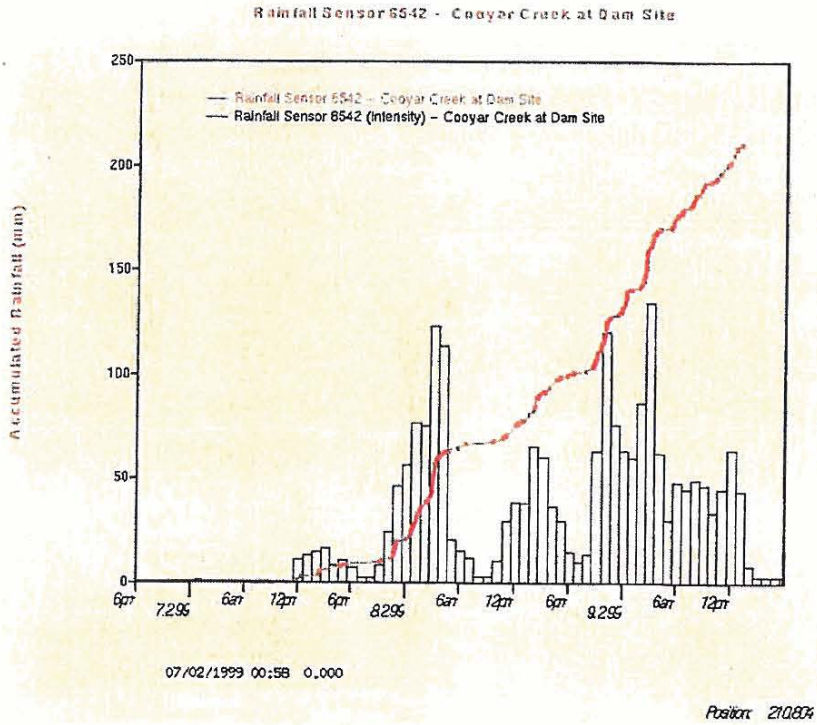
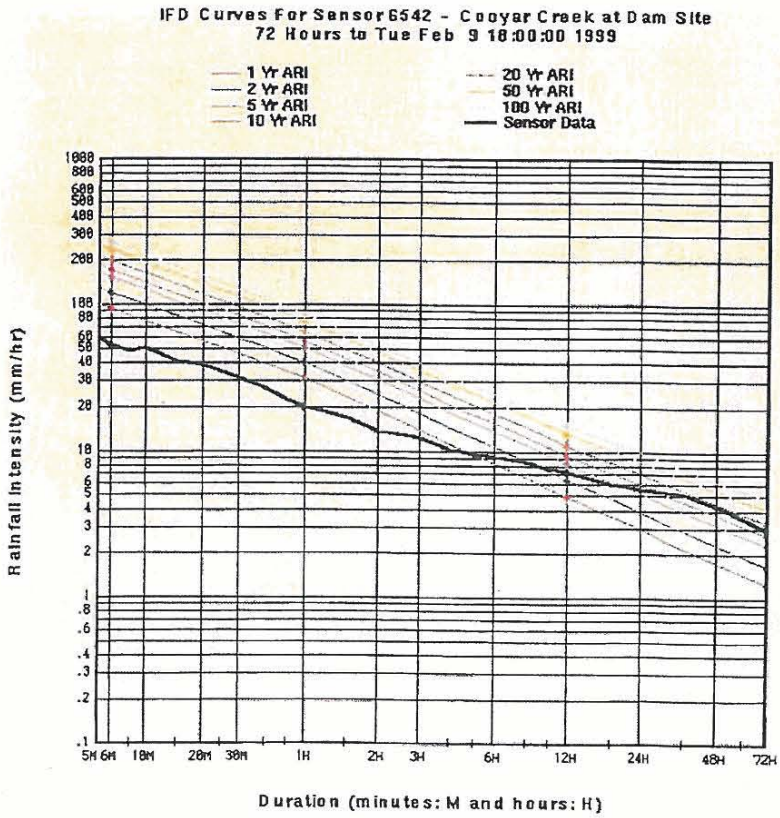


Upper Brisbane Catchment - Rainfall Sensor 6542 - Cooyar Creek at Dam Site



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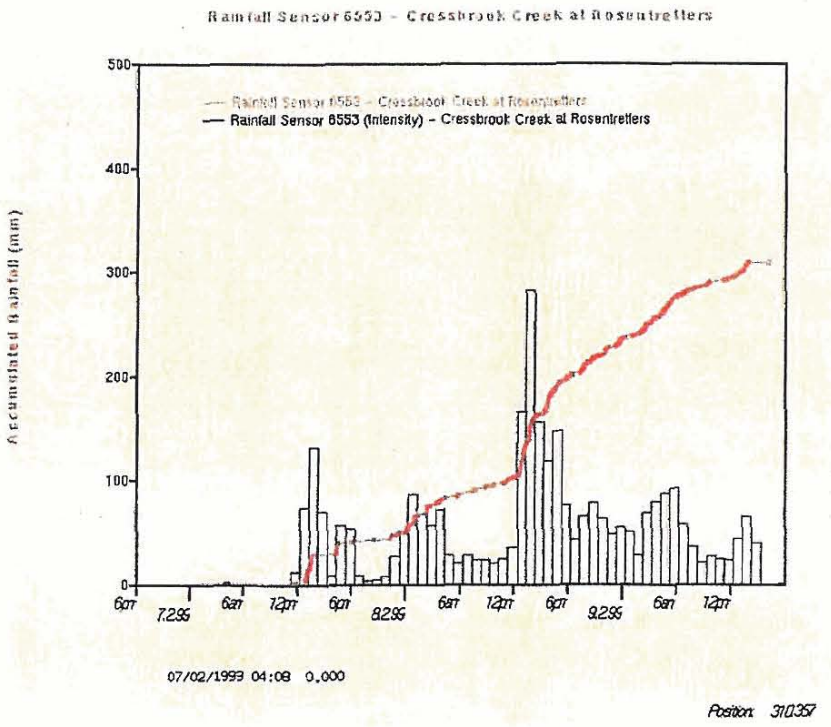
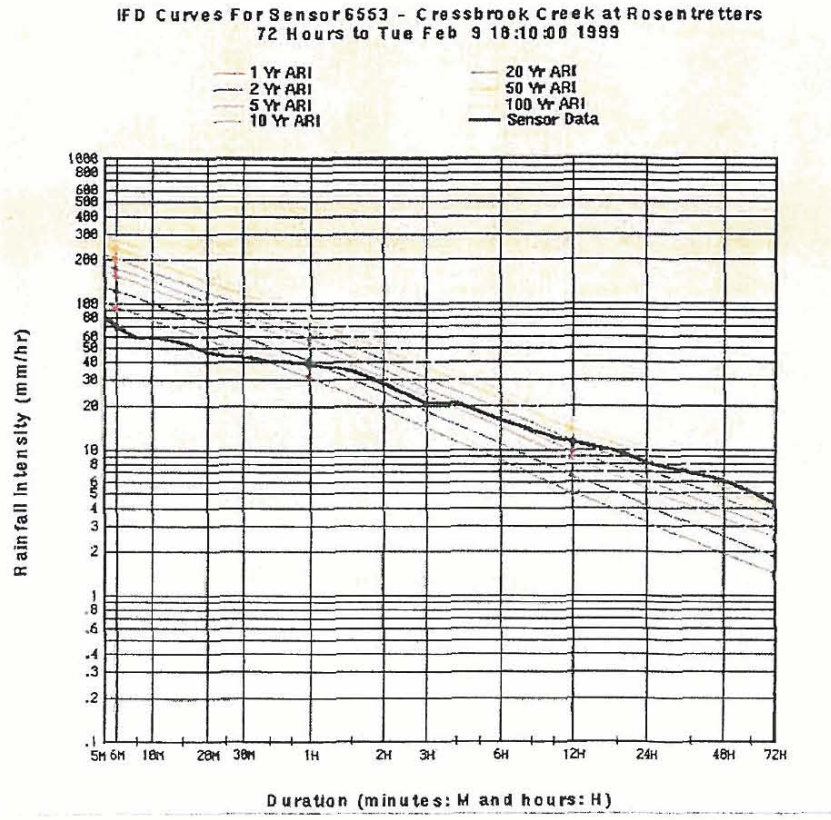
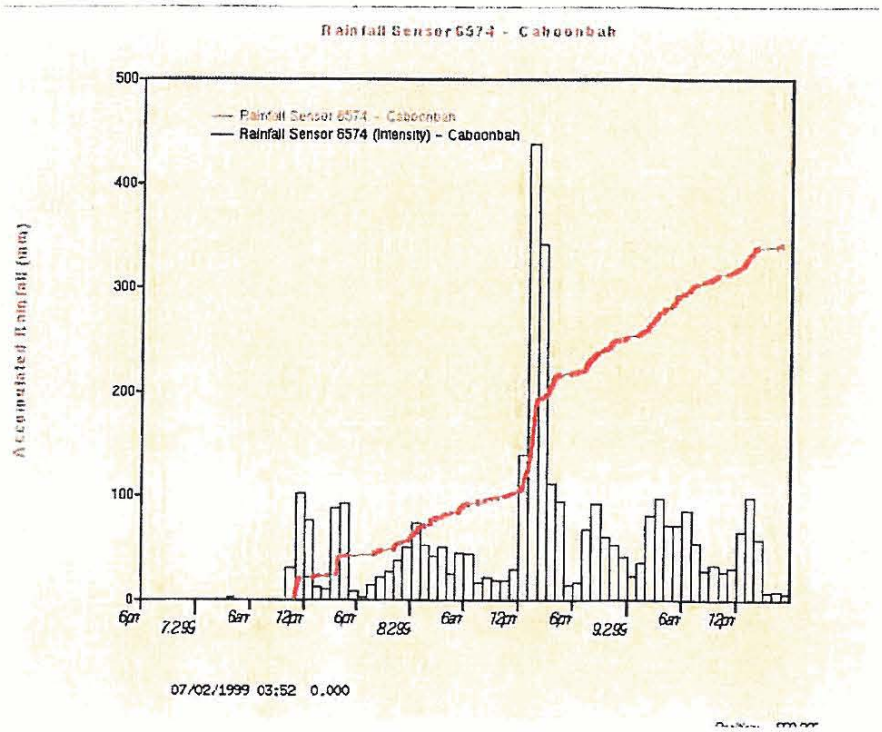


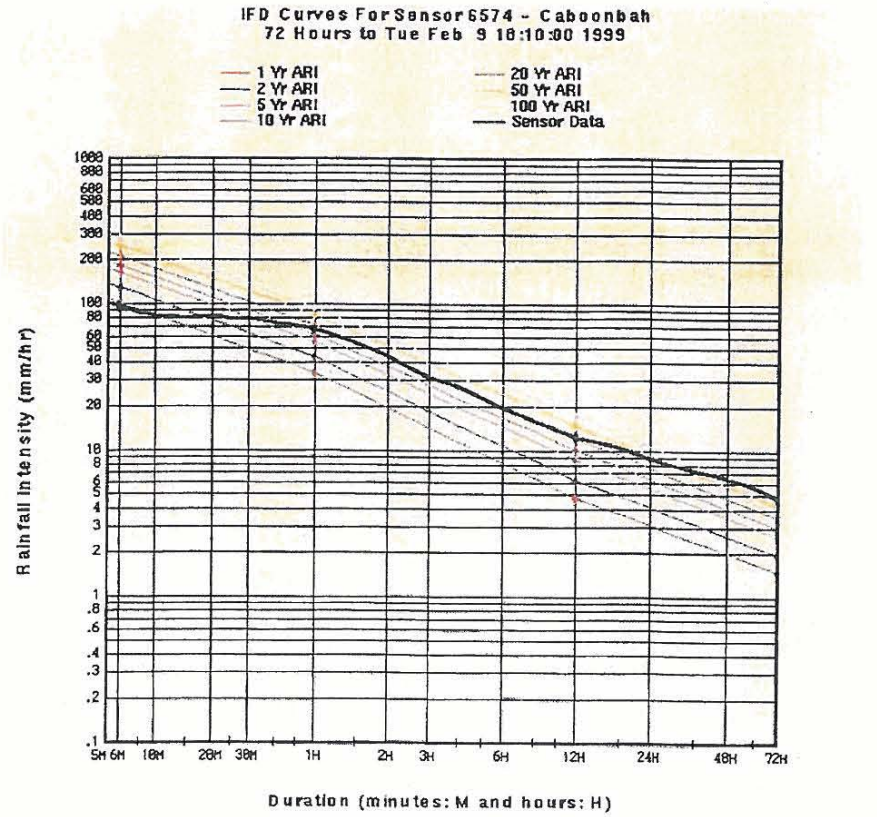
Upper Brisbane Catchment - Rainfall Sensor 6553 - Cressbrook Creek at Rosentretters



APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event

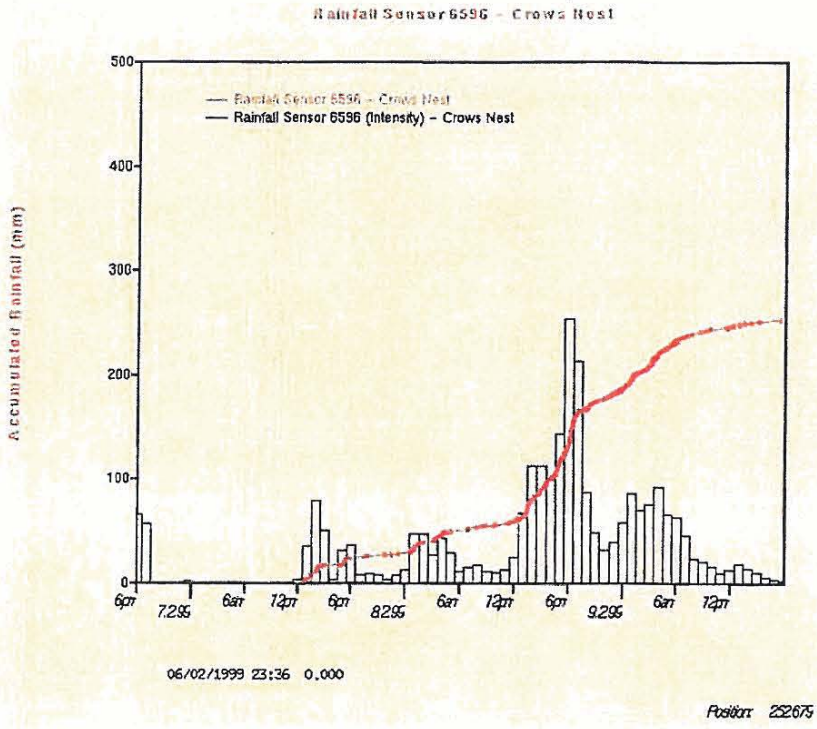


Upper Brisbane Catchment - Rainfall Sensor 6574 - Caboonabah

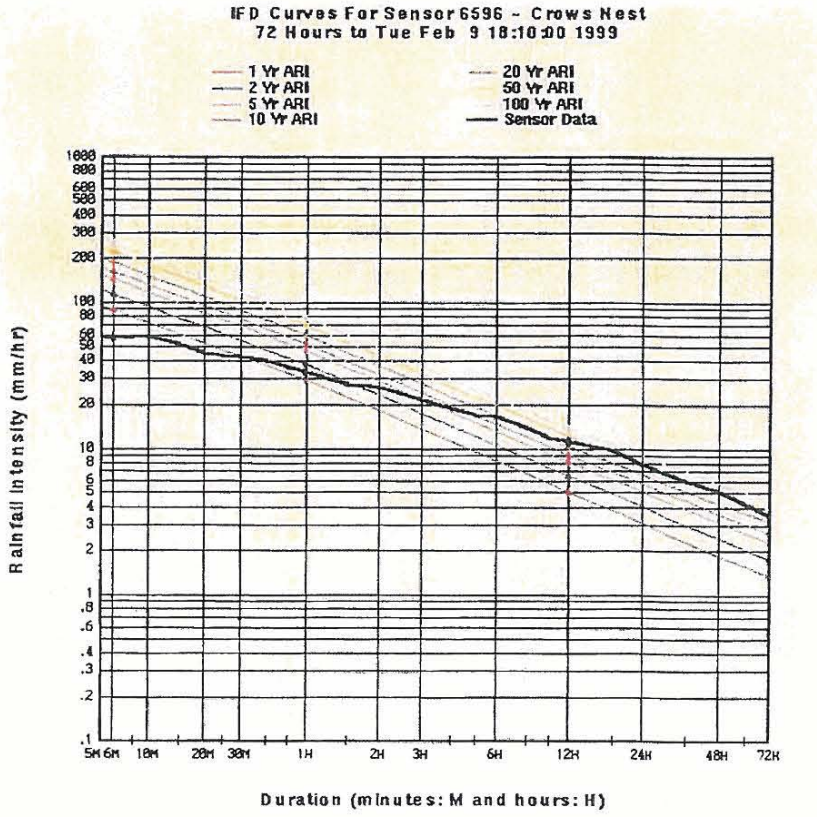


APPENDIX B

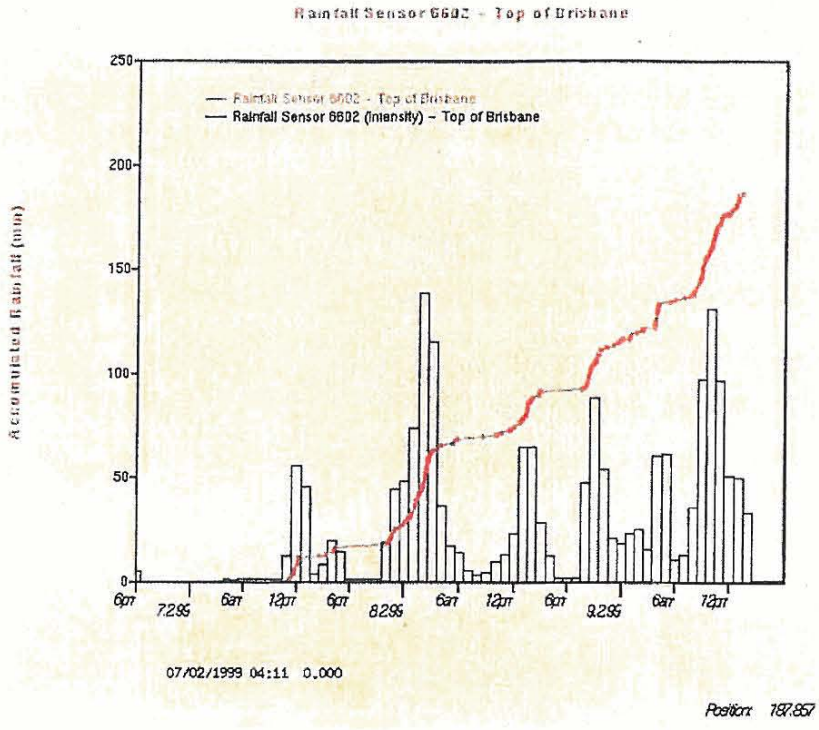
Cumulative Rainfalls & IFD Curves for February 1999 Event



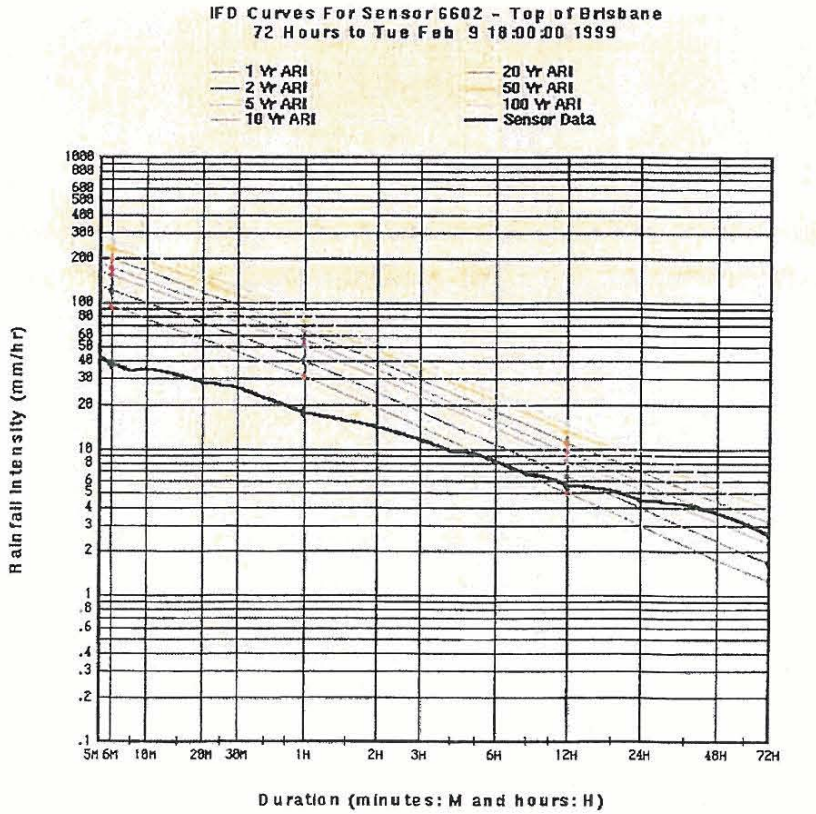
Upper Brisbane Catchment - Rainfall Sensor 6596 - Crows Nest



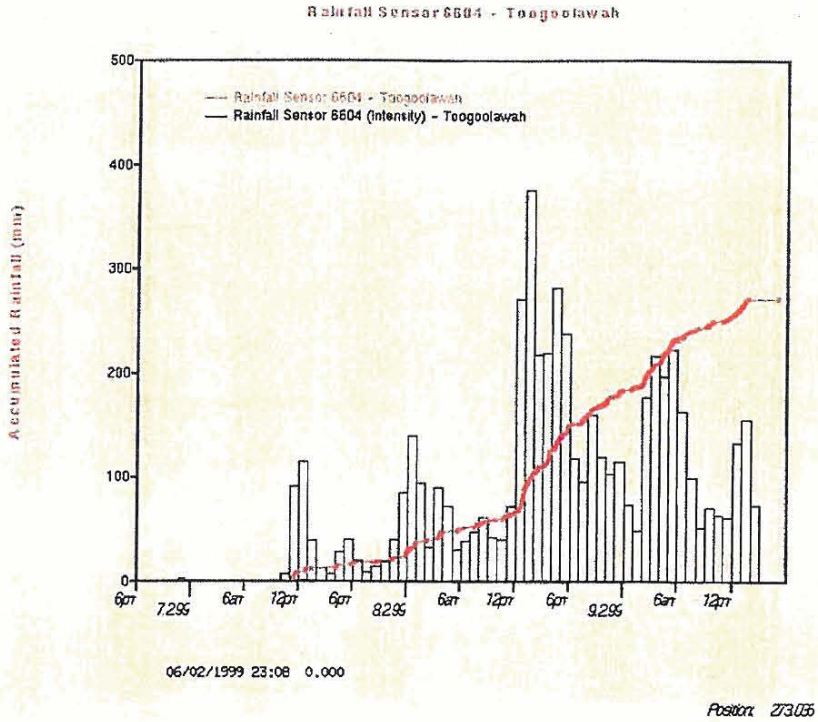
APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event



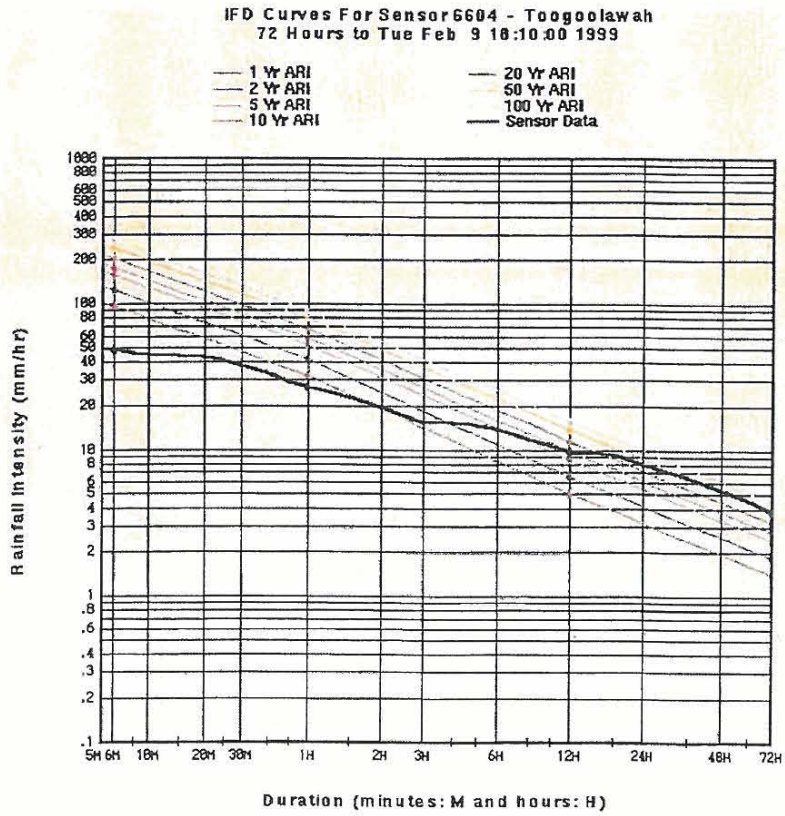
Upper Brisbane Catchment - Rainfall Sensor 6602 - Top of Brisbane



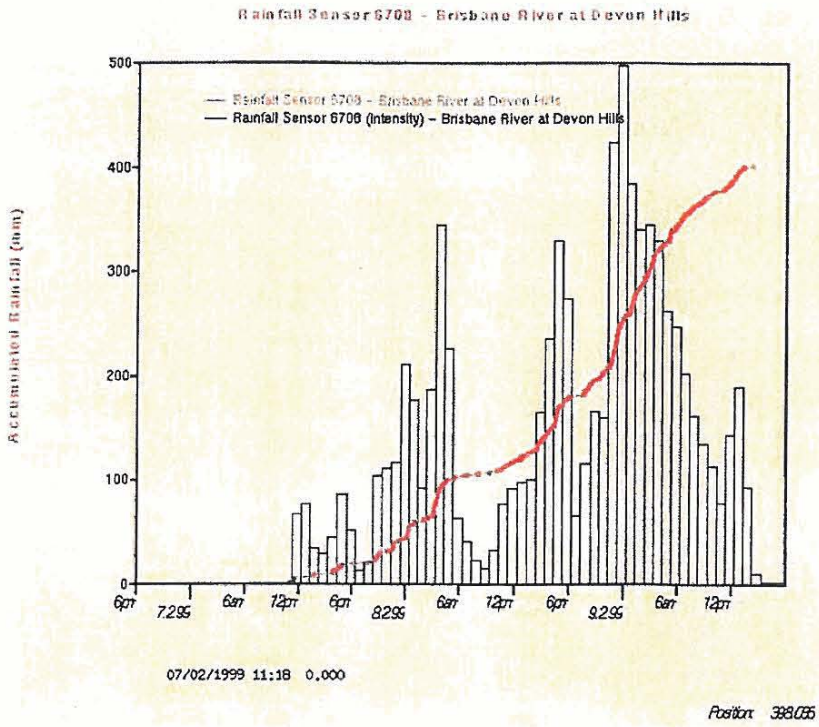
APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event



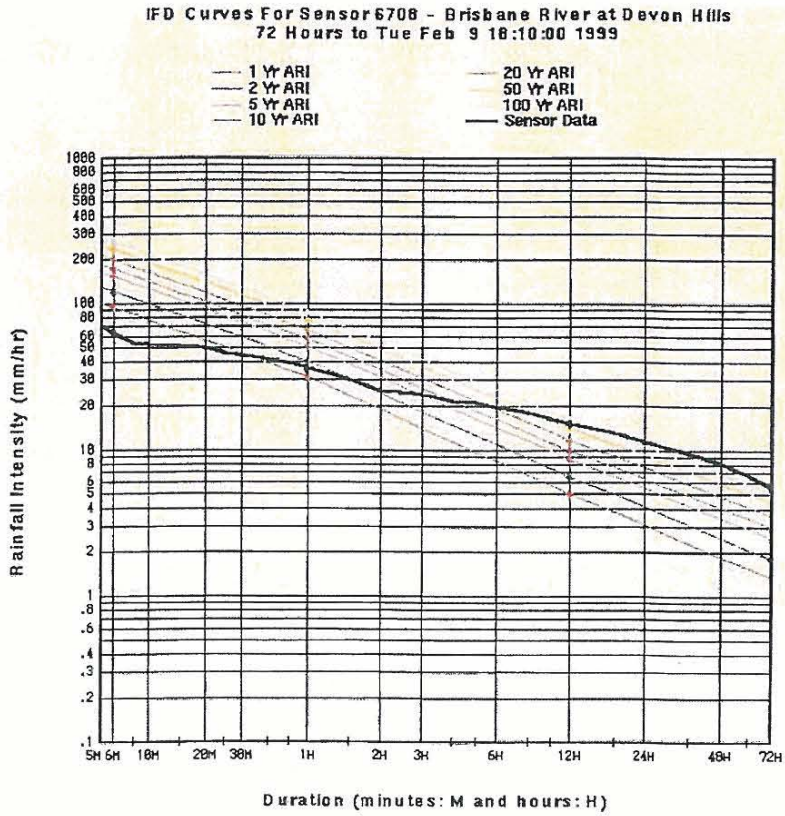
Upper Brisbane Catchment - Rainfall Sensor 6604 - Toogoolawah



APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event



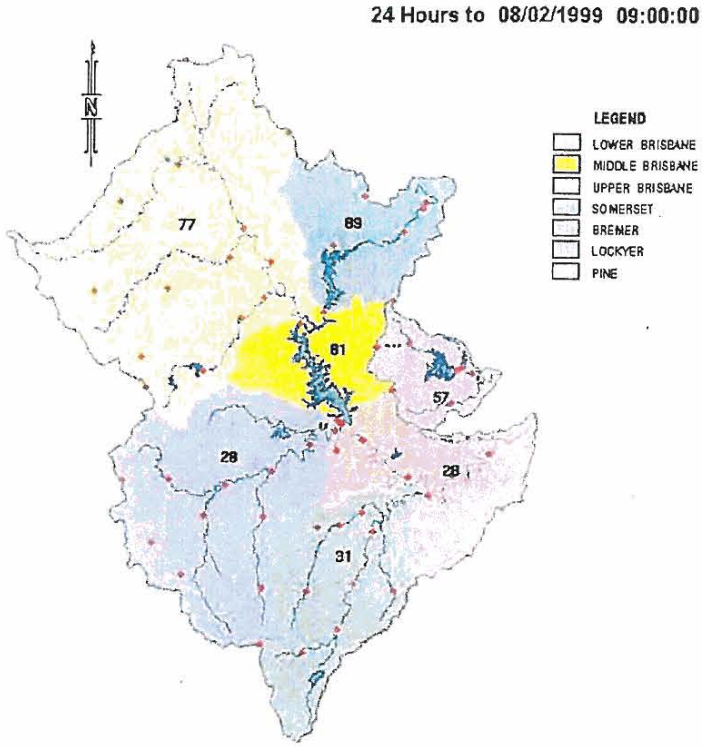
Upper Brisbane Catchment - Rainfall Sensor 6708 - Brisbane River at Devon Hills



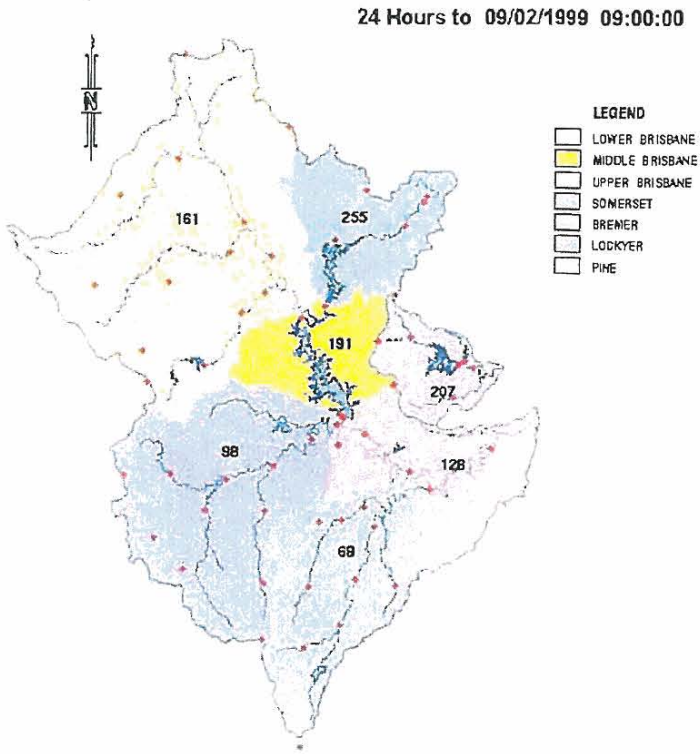
APPENDIX C

CATCHMENT RAINFALLS FOR FEBRUARY 1999 EVENT

APPENDIX C
Sub-Catchment 24 hour Total Rainfall for February 1999 Event

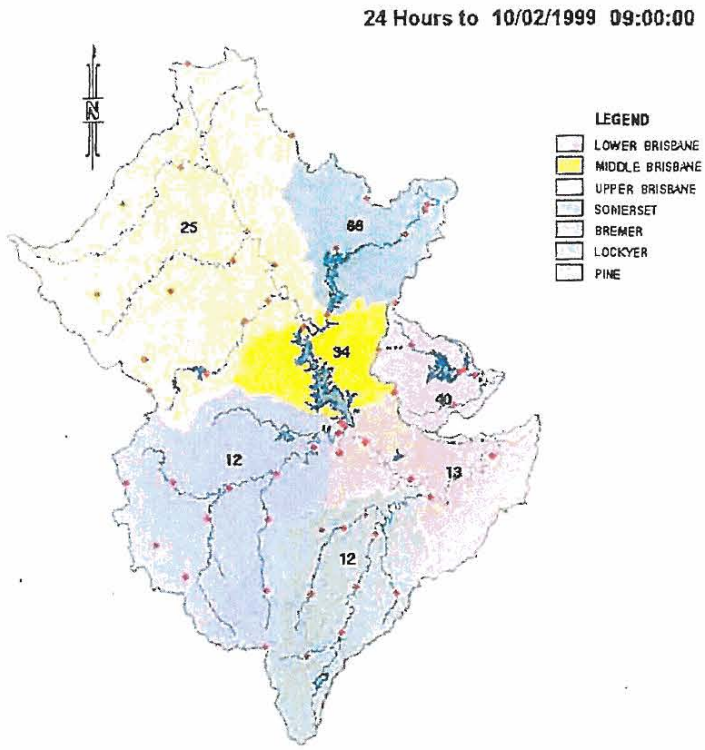


Sub-Catchment 24hr Total Rainfall to 9:00am 8/2/99

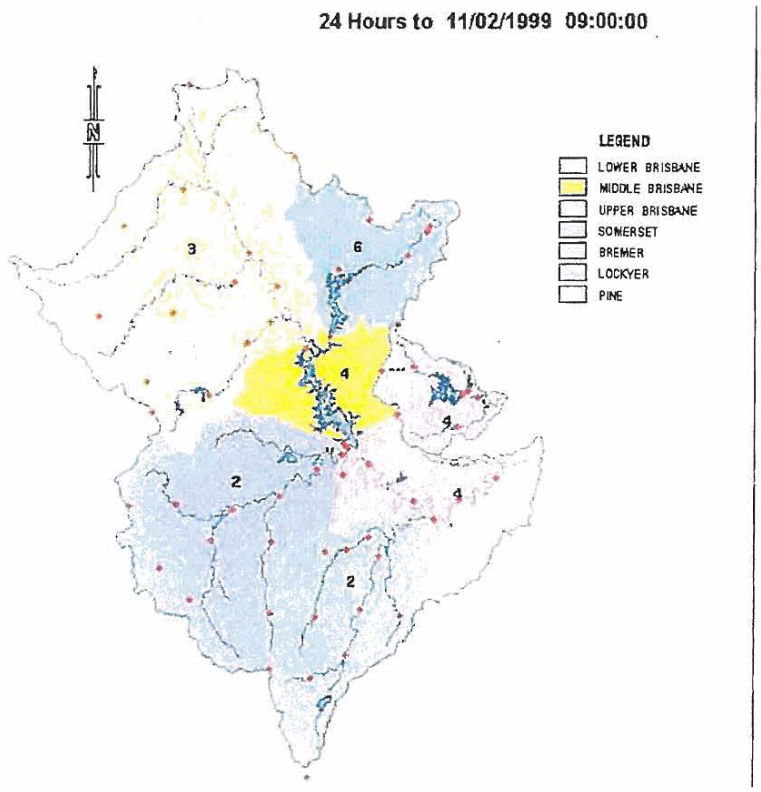


Sub-Catchment 24hr Total Rainfall to 9:00am 9/2/99

APPENDIX C
Sub-Catchment 24 hour Total Rainfall for February 1999 Event



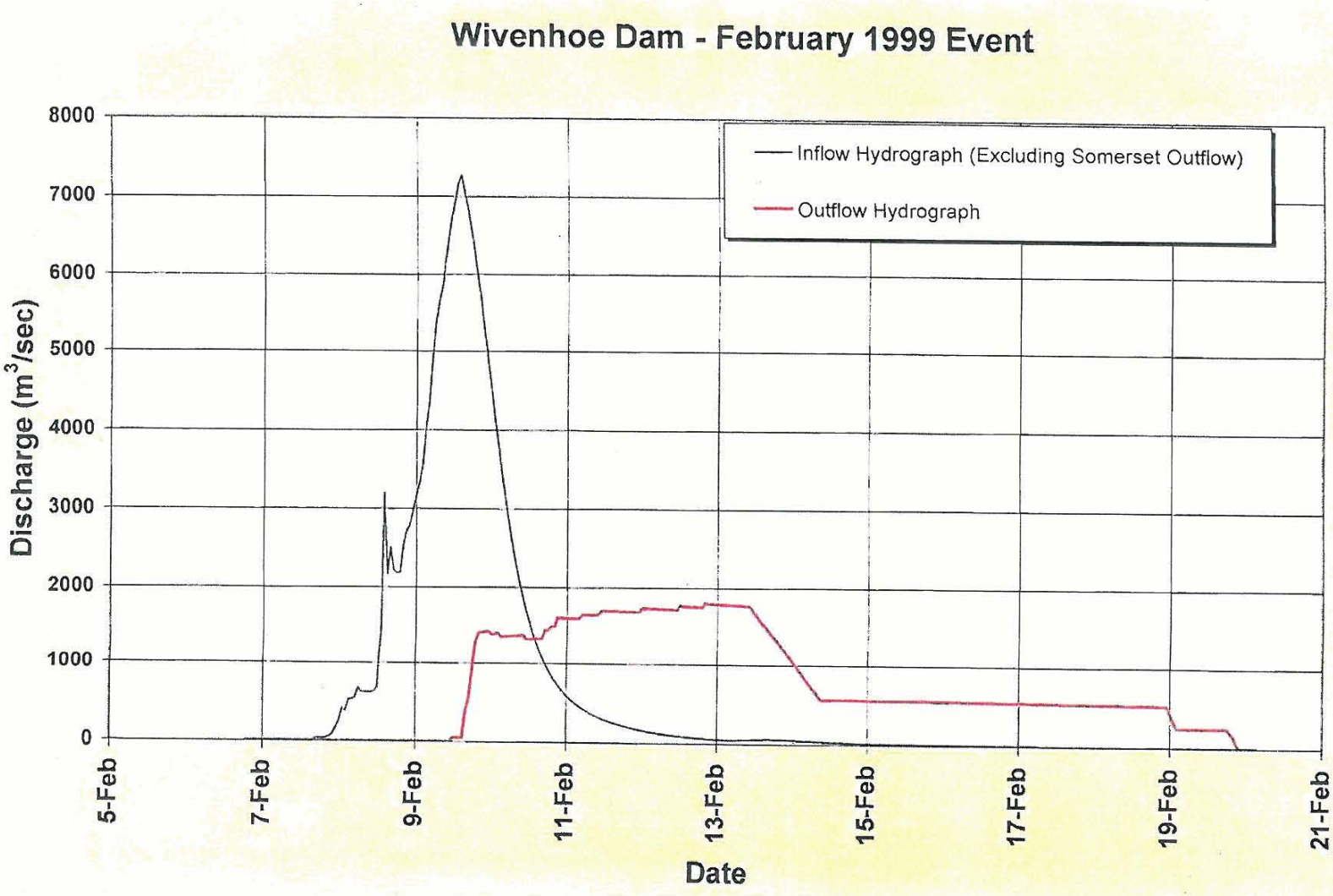
Sub-Catchment 24hr Total Rainfall to 9:00am 10/2/99



Sub-Catchment 24hr Total Rainfall to 9:00am 11/2/99

APPENDIX D

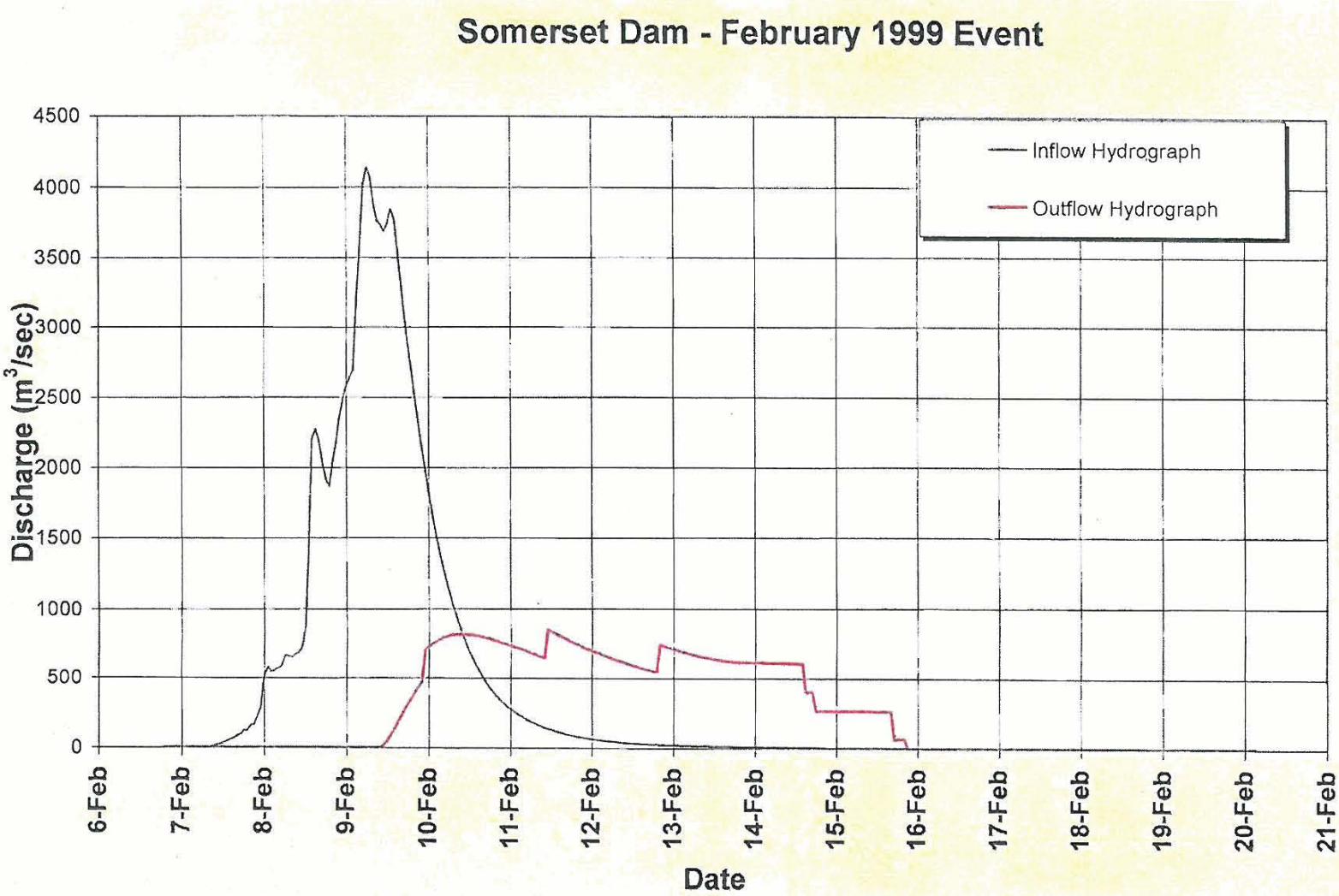
INFLOW and OUTFLOW HYDROGRAPHS FOR FEBRUARY 1999 EVENT



SOMFLOW11b.xls

FIGURE D1

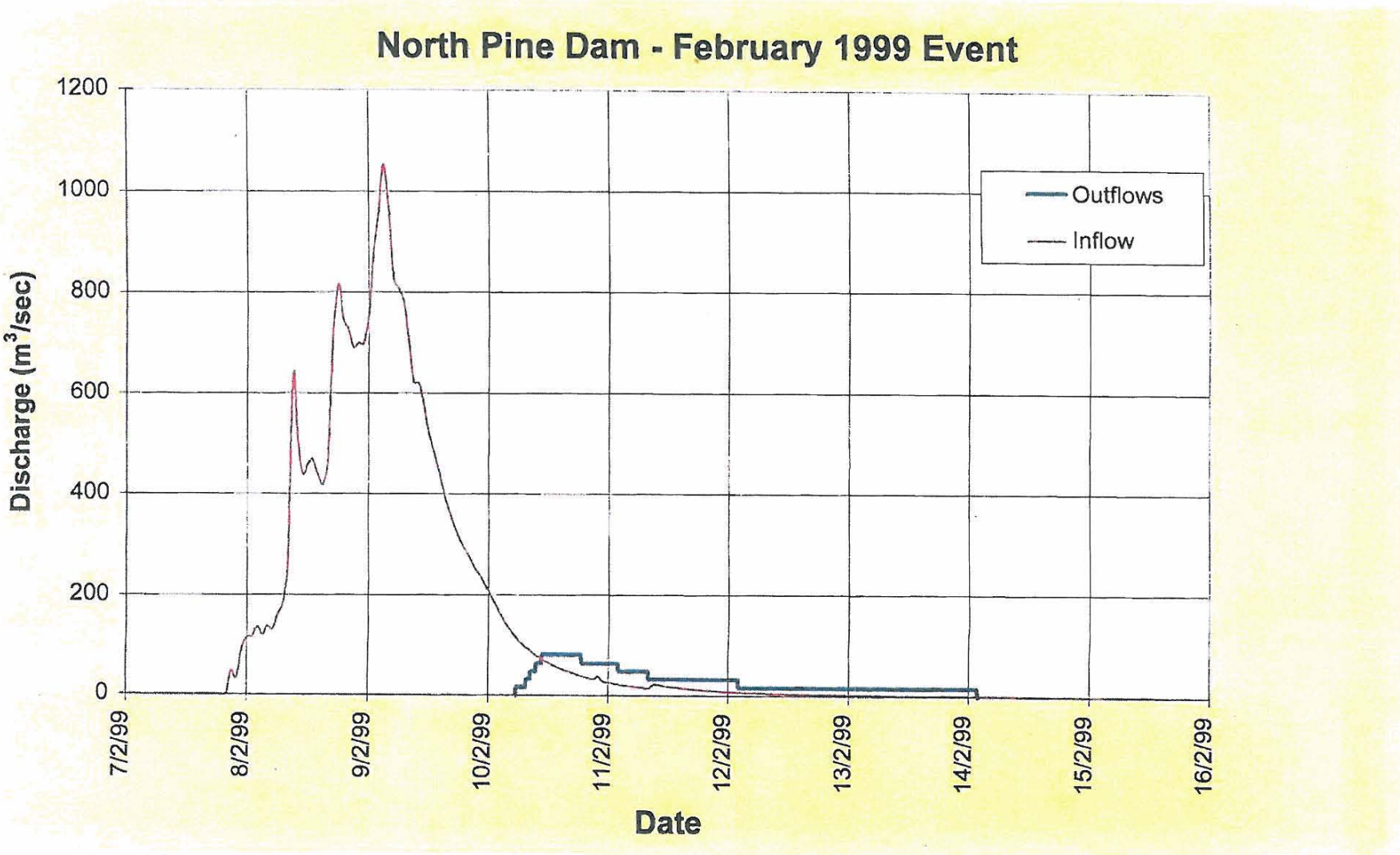
SOQ.002.001.0758



SOMFLOW11b.xls

FIGURE D2

NP Q Graph



np outflowsfeb.xls

FIGURE D3

SOQ.002.001.0760

APPENDIX E

ABRIDGED FCC EVENT LOGS FOR MARCH 1999 EVENT

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
01-Mar-99	6:30	Mobilise skeleton Crew for Flood Control Centre
	6:30	J Ruffini takes over as Duty Flood Engineer (relieving Peter Allen)
	6:30	Contact made with Malcolm Lane @ North Pine advising of proposal to release for approx. 30 hrs.
	6:30	Malcolm Lane advised to contact Pine Shire regarding closing Young's Crossing and Grant Street as releases will commence sometime after 7:30
	7:15	BOM predict local rainfall over next 3 hrs as influence moves from Fraser Island south. Falls of 140mm recorded in Sunshine Coast Hinterland
	7:30	Malcolm Lane at North Pine Dam contacted. Young's Crossing not yet closed.
	7:30	Gary Grant rung at home. Informed him that North Pine to open with the potential to open Somerset later.
	7:45	Dave Gill from SEQWB rang requesting situation report. Informed briefly on what was happening. Advised we would contact him after North Pine Dam had opened.
	7:50	Doug Grigg @ Wivenhoe Dam checked in. Lake level EL 67.08 and Splityard @ EL 165.7
	8:00	Rob Titmarsh @ Somerset checked in. Confirmed roster contact. Condition of Sluice 'L' discussed.
	8:13	North Pine Fax: GB 39.67; BCC 39.67; Digital 39.673. Gate 'C' opened.
	8:25	Malcolm Lane @ North Pine Dam confirmed by 'phone that he had opened Gate 'C' to opening 1.
	8:30	E-mail sent to all Flood Duty Engineers & Data Collectors to confirm availability.
	8:45	Jeff Watson (SEQWB) requests opportunity to visit FCC.
	9:00	North Pine Fax: GB 39.67; BCC 39.677; Digital 39.684. Rain in last hour = 18mm.
	10:00	North Pine Fax: GB 39.67; BCC 39.679; Digital 39.684. Rain in last hour = 0.6mm.
	11:00	North Pine Fax: GB 39.67; BCC 39.679; Digital 39.684. Rain in last hour = 0.1mm.
01-Mar-99	12:00	Somerset Dam operators instructed to raise crest gates and report when completed.
	12:00	North Pine Fax: GB 39.67; BCC 39.682; Digital 39.684.
	12:39	Fax from Somerset confirming opening of crest gates.
	13:00	J Ruffini supplied Gary Grant with a status report. Advised we would open one regulator at Somerset and two regulators at Wivenhoe.
	13:00	Rob Titmarsh @ Somerset checked in. Lake level EL 99.17. Will now report every hour.
		North Pine (Rob Gorian) Fax: @ 13:00:- GB 39.68; BCC 39.683; Digital 39.684.
	13:08	Rain in last hour = 0.1mm.
	13:30	Fax sent to Doug Grigg, operator @ Wivenhoe: Open two (2) regulators to 50%
	13:45	Fax sent to Rob Titmarsh, operator @ Somerset: Open Regulators 3 & 12 to 50% capacity
	14:00	Fax to Somerset: Open 2 regulators to 50%
		Doug Grigg @ Wivenhoe Dam: Lake level EL 67.14m. Regulator 1 to 50% @ 13:30 & Regulator 2 to 50%
	14:18	@ 14:00.
	14:22	Rob Titmarsh @ Somerset: 2 regulators 50% opened O/C
		Doug Grigg @ Wivenhoe Dam checked in. Splityard @ EL 159.8 Campers in 4 vans @ Twin Bridges
	14:55	warned
	15:00	North Pine @ EL 39.696 Dark cloud approaching.
	15:02	Somerset @ EL 99.20 Heavy rains to the north.
	15:30	John tibaldi rang: Discussed O/time claims of Data Collectors
		John Ruffini discussed situation with Peter Allen regarding current flood. Decided on 12 hr. shifts for Data
	15:45	Collectors.
	15:50	Malcolm Lane @ North Pine Dam rang. Reported Lake Level having reached 39.65 - 39.70 (Rob Gorian)
	16:00	Rob Titmarsh @ Somerset: Lake level EL 99.21
		Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. Tailwater checked. Twin Bridges checked again. No
	16:15	problems.
	17:00	Rob Gorian @ North Pine Dam rang. Lake Level 39.704
	17:00	North Pine Fax: GB 39.7; BCC 39.701; Digital 39.701.
	17:00	Rob Titmarsh @ Somerset Dam: Lake level EL 99.24
	17:30	Fax from North Pine Dam: Open Gate 'E'
	17:45	Fax sent to North Pine Dam operator: Open Gate 'E' to setting 1. Spoke to Malcolm on the 'phone.
	18:00	QPF of 4:18 10 - 20 mm to 3pm Tuesday
	18:00	Fax from North Pine: GB 39.71; BCC 39.702; Digital 39.7.
	18:30	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. @ 18 00 hrs.
		At Twin Bridges: 800mm from bottom of bridge to water. Water has risen 45mm in last 2 hrs.
	18:35	John Ruffini spoke to Peter Allen. Informed him that Somerset would need to release for approx. 7 days. North Pine until 6pm Tuesday. Wivenhoe: 10 days plus.
	19:10	Rob Titmarsh .....
	20:00	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.27
	20:15	
		Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. @ 20 00 hrs.
		River @ Twin Bridges has risen 9cm. i.e. water is 71cm below bottom of bridge deck.
		Duty Eng. advised Doug to stand down tonight, & to check Twin Bridges & Savages first thing in the morning.
	20:15	(Will increase Wivenhoe releases to 50 cumecs in the morning)
	21:00	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.28

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
	21:45	Somerset: Two scenarios run. One 50mm extra over 48 hrs and 0mm over the next 48 hrs. Both are within operational bands of regulators. If continue on this path send Rob T. 11:30 at (?????) of an track.
	22:10	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.29 Rain: 1.6mm in last hour. Don Cock advised Rob to go home and call in when he (Rob) goes on duty in the morning.
	22:00	Fax from North Pine: GB 39.70; BCC 39.699; Digital 39.70. Rain: 0.5 hr = 19mm
	22:30	Fax from North Pine: GB 39.705; BCC 39.704; Digital 39.706. Rain: 0.5 hr = 13mm
	23:00	Fax from North Pine: GB 39.710; BCC 39.707; Digital 39.709. Rain: 0.5 hr = 5mm
02-Mar-99	0:00	Rang North Pine to discuss next Gate opening.
	0:05	Brett Schultz from North Pine Dam 'phoned: Young's Crossing is closed with barricades etc.
	0:15	Fax to North Pine: Open Gate 'A' to setting 1 when level reaches 39.715
	1:10	Fax from North Pine: GB 39.71; BCC 39.711; Digital 39.711.
	2:00	Fax from North Pine: GB 39.710; BCC 39.713; Digital 39.714.
	3:10	Fax from North Pine: GB 39.710; BCC 39.713; Digital 39.714.
	4:20	Fax from North Pine: GB 39.710; BCC 39.714; Digital 39.715. Gate 'A' opened at 4:10am. Lake EL 39.716
	5:12	Fax from North Pine: GB 39.710; BCC 39.715; Digital 39.714.
	6:10	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.35 @ 06 00. 1.0mm of rain since 22:00 last night.
	6:22	Fax from North Pine: Gate setting & Lake Level log. Readings @ 06 00:- GB 39.710; BCC 39.713; Digital 39.712
	6:32	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.16m. @ 06 00 hrs. Little/no rain. Brisbane River @ Twin Bridges is 45cm below bridge deck. Savage's Crossing is 92cm below the deck level (Most of the decking @ Savages was washed away during February event).
	6:32	Splityard still pumping out of Wivenhoe Dam with about 2m to go. Water level in Splityard = 164.2
	7:12	J.Tibaldi requested advice on mobilising dams to 24hr rosters
	7:14	Fax from North Pine: GB 39.710; BCC 39.711; Digital 39.710 @ 7:00
	7:19	M.Lane Nth Pine - requested permission to exercise to exercise cone valve regulators - OK given - just open & close
	7:37	David Gill - SEQWB - update on storages & releases - unknown projections for Wed weather
	8:00	R.Titmarsh @ Somerset - WL 99.37 & no rain for last 2 hrs
	8:27	Fax from North Pine: GB 39.70; BCC 39.703; Digital 39.704. - 0.2mm hourly rain @ 8:00
	9:07	R.Titmarsh @ Somerset - WL 99.38 - mist only
	9:15	Fax from North Pine: GB 39.70; BCC 39.699; Digital 39.702. - 0.2mm hourly rain
	9:57	Malcolm Lane - North Pine: WL 39.968 - request to shut Gate 'A'
	10:00	Somerset EL 99.39 - No rain
	10:00	Fax from North Pine: GB 39.69; BCC 39.695; Digital 39.698. - 0.2mm hourly rain @ 8:00 - Closed Gate 'A'
	10:03	Fax to North Pine - Instruction to shut Gate 'A'
	10:05	Doug Grigg - Wivenhoe EL 67.17 - Twin Bridges 43cm below culvert
	11:00	Fax from North Pine: GB 39.68; BCC 39.691; Digital 39.692. - nil rain
	11:00	Doug Grigg - Wivenhoe EL 67.175 - Twin Bridges 43cm below top of culvert
	11:04	R.Titmarsh @ Somerset - WL 99.40 - nil rain past hour
	11:15	Fax to Wivenhoe - open regulators to release 50 cumecs
	11:35	Doug Grigg - Wivenhoe Dam regulators were opened at 11:30am to 50 cumecs. (#1 fully + #2 = 20 cumecs)
	12:00	R.Titmarsh @ Somerset - WL 99.42
	12:00	Fax from North Pine: GB 39.68; BCC 39.69; Digital 39.688. - nil rain
	12:25	Doug Grigg - Wivenhoe at 12:00 EL 67.20 - Tailwater 28.12 - requires peak check
	13:00	R.Titmarsh @ Somerset - WL 99.43
	13:00	Fax from North Pine: GB 39.68; BCC 39.687; Digital 39.685. - 1 hour rainfall 1.4mm
	13:15	Doug Grigg - Wivenhoe EL 67.20 - Twin Bridges 41.5cm below top of culvert
	14:00	R.Titmarsh @ Somerset - WL 99.44 - no rain
	14:00	Fax from North Pine: GB 39.70; BCC 39.712; Digital 39.712. - 1 hour rainfall 41mm
	14:30	Doug Grigg - Wivenhoe EL 67.201 @ 14:00 - no problems with regulators - no cavitation
	15:00	R.Titmarsh @ Somerset - WL 99.46 - 1 hour rainfall 4.2mm
	15:00	Fax from North Pine: GB 39.74; BCC 39.732; Digital 39.732. - 1 hour rainfall 17mm
	15:00	Doug Grigg - Wivenhoe EL 67.22 - Twin Bridges 34cm below top of culvert
	16:00	R.Titmarsh @ Somerset - WL 99.47 - no rain
	16:00	Fax from North Pine: GB 39.74; BCC 39.739; Digital 39.739. - 1 hour rainfall 0.1mm
	16:00	Doug Grigg - Wivenhoe EL 67.24

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

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Date	Time	Action/Comment
	16:25	Fax to North Pine - Instruction to open Gate 'A'
	16:30	Fax from North Pine: GB 39.74; BCC 39.739; Digital 39.738. confirmation of Gate 'A' opening
	17:00	R.Titmarsh @ Somerset - WL 99.49 - no rain - no further readings reqd
	17:00	Fax from North Pine: GB 39.74; BCC 39.74; Digital 39.737 - no rain
	17:25	Sensor Invest. Request form faxed to Seqwb - 6591 - Somerset Dam Headwater (B) no longer agrees with 5m Druck or manual readings
	17:30	Doug Grigg - Wivenhoe EL 67.25 - Twin Bridges 23cm below top of culvert
	18:00	Fax to North Pine - Instruction to open Gate 'D' one setting
	18:00	Fax from North Pine: GB 39.74; BCC 39.739; Digital 39.738 - no rain confirmation of Gate 'D' opening
	18:45	Fax to North Pine - Instruction to open Gate 'B' one setting as a precaution
	18:53	Fax from North Pine: confirmation of Gate 'B' opening
	20:00	Fax from North Pine: GB 39.73; BCC 39.730; Digital 39.728 - 1/2 hr rain 0.6mm
	20:20	Fax to North Pine - Instruction to close Gate 'B'
	20:25	Brett Schultz from North Pine Dam phoned: Gate 'B' closed
	21:00	Fax from North Pine: GB 39.725; BCC 39.726; Digital 39.723 - no rain
	22:00	Fax from North Pine: GB 39.720; BCC 39.722; Digital 39.718 - no rain
	23:10	Fax from North Pine: GB 39.715; BCC 39.716; Digital 39.712 - no rain
	23:15	Gate 'D' shut - confirmed by Brett Schultz
03-Mar-99	0:00	Fax from North Pine: GB 39.710; BCC 39.710; Digital 39.708
	1:00	Fax from North Pine: GB 39.700; BCC 39.707; Digital 39.703
	2:00	Fax from North Pine: GB 39.700; BCC 39.705; Digital 39.700
	2:00	P.Allen gave verbal approval to shut Gate 'A'
	2:05	Fax from North Pine - Log confirming Gate 'A' closed
	3:00	Fax from North Pine: GB 39.700; BCC 39.701; Digital 39.697
	4:00	Fax from North Pine: GB 39.700; BCC 39.700; Digital 39.695
	5:00	Fax from North Pine: GB 39.700; BCC 39.696; Digital 39.693
	6:00	Somerset EL 99.63 - 0.6mm rain since 2/3/99 15:00
	6:00	Fax from North Pine: GB 39.695; BCC 39.695; Digital 39.692
	7:00	Fax from North Pine: GB 39.690; BCC 39.693; Digital 39.690
	7:00	Wivenhoe 67.24, Splityard 164.00, Twin Bridges 8cm clear
	7:52	PA discussed draining options for Wivenhoe with J.Tibaldi. JT is keen not to have the dams staffed if we open a gate 1-1.5m. PA will discuss with G.Grant before decision.
	8:00	Fax from North Pine: GB 39.680; BCC 39.691; Digital 39.686
	8:04	Somerset EL 99.64 - 0.6mm rain since 2/3/99 15:00
	8:40	Splityard 164.00 @ 7:00, 162.4 @ 8:00 (generating) Storage 164.00=26200ML 162.40=24712ML - implies Q = 410 cumecs
	9:00	Somerset EL 99.65
	9:00	Wivenhoe 67.27 Doug Grigg reported that Splityard Creek Levels for last 3 days were 1/3/99 8:00 165.7 2/3/99 8:00 164.7 3/3/99 8:00 162.4
	9:00	Fax from North Pine: GB 39.680; BCC 39.686; Digital 39.684
	9:00	Discussions between: David Gill, Garry Grant, John Mulheron, PA, JR & DC about proposed operations for Somerset/Wivenhoe. Agreed to keep as is rather than reduce Wivenhoe Drainage time and put Twin Bridges out
	11:00	Fax from North Pine: GB 39.670; BCC 39.68; Digital 39.677
	12:00	Somerset EL 99.67
	12:00	Wivenhoe EL 67.30
	15:00	Somerset Dam EL 99.69 @ 15:00, 99.69 @ 14:00, 99.67 @ 13:00
	15:20	Wivenhoe 67.33 @ 15:00
	16:10	Splityard 156.7m, Somerset Dam HW 99.71
	16:30	Instructed North Pine to open Gate 'A' one setting
	16:45	North Pine 39.686, Gate 'A' opened to setting 1
	17:00	Somerset 99.72, O'Shea's Bridge 67.38
	17:00	North Pine 39.672
	18:00	North Pine EL 39.677. The reading 30min prior was 39.682, 30 min prior 39.673, 30 min prior 39.684 - possible swell in storage
	18:05	Somerset Dam 99.72
	18:05	Fax from North Pine: GB 39.67; BCC 39.677; Digital 39.677
	18:30	Wivenhoe 67.40 - 33mm rain since 9:00
	18:37	Twin Bridges - water is 70mm deep on the Fernvale side - Doug Grigg to advise Esk Shire

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

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Date	Time	Action/Comment
	19:00	Somerset 99.73
	19:15	Fax from North Pine: GB 39.67; BCC 39.678; Digital 39.682
	20:00	Fax from North Pine: GB 39.675; Digital 39.679
	20:30	Somerset @ 8:30 EL 99.75
	21:00	Somerset EL 99.76
	21:30	Advised North Pine to keep 3 gates open as more flow in system
	21:45	Flows in Lockyer Creek have taken out twin bridges
	22:00	Somerset 99.77
	22:00	North Pine 39.674
	22:30	Wivenhoe 67.41, Splityard 158.00, Doug instructed to check Savage's - 28cm over road at Twin Bridges
	23:00	39.673 North Pine
	23:15	Doug Grigg - Water lapping at deck of Savage's Xing - Bridge closed
04-Mar-99	0:00	Somerset 99.77
	0:00	North Pine 39.672
	1:00	North Pine 39.60
	2:00	North Pine 39.667
	3:00	North Pine 39.665
	4:00	North Pine 39.663
	5:00	North Pine 39.655
	6:00	Wivenhoe 67.37, Splityard 164
	6:00	North Pine 39.655
	7:00	Somerset 99.84
	7:00	North Pine 39.652
	8:00	Wivenhoe 67.38, Splityard 165
	8:00	North Pine 39.650
	8:15	SEQWB rang. JR advised David Gill 1. North Pine to continue with 3 gates open to reduce time that Young's Crossing OOA 2. Yesterday's rainfall caused additional inflow into Wivenhoe Dam. This has extended the drainage of Somerset to 12/3/99 15:00 if current strategy remains in place. Total inflow into Somerset no expected to be 66000ML 3. Lockyer Creek will peak at approx 120 cumecs. Twin Bridges closed 4. Savage's Xing is closed 5. We are examining a strategy which would require Wivenhoe releasing at 150 cumecs.
	9:00	North Pine 39.646
	10:00	North Pine 39.642
	11:00	North Pine - digital 39.636
	13:00	North Pine: GB 39.620; BCC 39.626; Digital 39.624
	14:00	North Pine: GB 39.620; BCC 39.620; Digital 39.620
	15:30	Advised Esk SC of Wivenhoe release
	15:40	Advised Ipswich SC of Wivenhoe release
	15:45	Advised Police Communications of Wivenhoe release
	15:50	Advised BOM of Wivenhoe release
	16:15	Somerset 99.87
	16:30	Faxed Wivenhoe instructions to close reg @ 17:00 and open Gate 1 to 0.5m
	17:10	Doug Grigg advised regulator at Wivenhoe closed, Gate 3 open 0.5m
	17:30	North Pine 39.601
	17:32	Advised Malcolm Lane @ North Pine to close Gate 1 (A).
	17:47	Fax from North Pine confirming Gate 1 closed
	18:00	Wivenhoe 67.46, Splityard 158.00
	20:10	Directed Doug Grigg to close Wivenhoe Gate 3 to 0.3m to keep Lowood to 175 cumecs
	20:30	J.Tibaldi confirmed Wivenhoe Gate 3 closed to 0.3m
	21:00	Wivenhoe 67.50, Splityard 158.0 @ 18:00
	21:00	North Pine: GB 39.590; BCC 39.590; Digital 39.592
	22:15	North Pine: GB 39.580; BCC 39.587; Digital 39.589
	23:00	North Pine: GB 39.580; BCC 39.584; Digital 39.585
05-Mar-99	0:00	Wivenhoe 67.52, Splityard 156.3
	0:00	North Pine: GB 39.580; BCC 39.58; Digital 39.581
	1:08	Instructed Wivenhoe to open Gate 3 to 0.5m
	1:15	Wivenhoe confirmed open Gate 3 to 0.5m
	1:24	North Pine: GB 39.570; BCC 39.575; Digital 39.576
	2:00	North Pine: GB 39.570; BCC 39.571; Digital 39.570
	2:30	Wivenhoe 67.51
	3:00	Advised Police of expectation that Colleges will submerge between 10am and 12 noon today.
	3:10	North Pine Digital 39.568

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
	4:00	North Pine: GB 39.560; BCC 39.561; Digital 39.565
	5:00	Wivenhoe 67.475
	5:22	North Pine Gate E shut at 5:15, Lake EL 39.561
	6:00	North Pine: GB 39.550; BCC 39.557; Digital 39.561
	7:00	Wivenhoe 67.460
	7:00	Somerset 99.89, 2 regs at 50%
	7:00	North Pine: GB 39.550; BCC 39.557; Digital 39.560
	8:00	North Pine: GB 39.550; BCC 39.557; Digital 39.557
	9:00	Wivenhoe 67.47
	9:00	North Pine: GB 39.550; BCC 39.55; Digital 39.556
	10:00	North Pine: GB 39.550; BCC 39.553; Digital 39.554
	11:00	North Pine: GB 39.550; BCC 39.552; Digital 39.552
	11:48	Instructed North Pine to close gate
	12:00	Malcolm Lane - North Pine: closed Gate 'C' at 11:45
	12:00	North Pine: GB 39.550; BCC 39.550; Digital 39.551
	14:00	North Pine 39.55
	14:45	Faxed Wivenhoe instructions to open Gate 3 from 0.5m to 1.0m
	15:00	Wivenhoe confirmed open Gate 3 to1.0m
	15:00	Wivenhoe 67.50
	15:00	North Pine 39.55
	15:45	Requested SEQWB to bring Crosby 6752 River Sensor back on line ASAP
	16:00	North Pine 39.551 - confirmed operation ceased 16:00
	16:00	Somerset 99.88
	17:00	Wivenhoe 67.51
	17:17	Fax from SEQWB - Mt Crosby back in action
	18:45	J.Tibaldi reported water 400mm below Colleges
	19:00	Wivenhoe 67.51
	20:00	Splityard 165.8
	21:00	Wivenhoe 67.53
	23:00	Wivenhoe 67.53
06-Mar-99	1:00	Wivenhoe 67.54
	1:30	Splityard 165.80
	5:15	Wivenhoe 67.54
	7:00	Wivenhoe 67.53
	8:00	Somerset 99.78, Regulator at 50%
	9:00	Wivenhoe 67.54
	11:00	Wivenhoe 67.55, Splityard 165.7
	13:00	Wivenhoe 67.55, Splityard 165.1, TW 28.45
	15:00	Wivenhoe 67.54, Splityard 165.7, TW 28.45
	16:00	Somerset 99.74
	17:00	Wivenhoe 67.54
	19:00	Wivenhoe 67.56
	20:00	Wivenhoe 67.56
	20:00	Faxed Wivenhoe to open Gate 3 to 1.5m
	20:10	Wivenhoe confirmed open Gate 3 to 1.5m
	23:00	Wivenhoe 67.57
07-Mar-99	0:00	Wivenhoe 67.57
	6:00	Wivenhoe 67.57
	8:00	Wivenhoe 67.56
	8:30	Somerset 99.65
	10:10	Wivenhoe 67.55, Splityard 165.00 Fernvale Bridge 300mm Higher than that recorded 12:30 6/3 300mm of water over O'Reilly's Weir
	11:05	Downloaded Savages Crossing - Flattened out @ 3.36m
	12:15	Wivenhoe 67.56, Splityard 165.0
	14:10	Wivenhoe 67.55, Splityard 165.00
	15:20	J Ruffini @ College's Crossing - Approx 5cm clearance to lower part of R/B Bridge sections Flow @ Crosby of 168cumecs - Approx 0.6m over @ Twin Bridges
	15:30	Somerset 99.61
	16:00	Wivenhoe 67.55
	18:00	Wivenhoe 67.54
	20:05	J. Tibaldi @ Wivenhoe. He read gauge board @ 67.57 - does not see how day shift have recorded 67.5
	20:07	J Tibaldi advised Wivenhoe level has been @ 67.53 - 67.54 for the last 24 hrs.
	21:00	300mm of water over O'Reilly's Weir, Splityard 165.0
	22:00	Wivenhoe 67.57

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
08-Mar-99	0:00	Wivenhoe 67.57
	2:00	Wivenhoe 67.57
	4:00	Wivenhoe 67.57
	6:00	Wivenhoe 67.54
	6:30	Splityard 165.60
	7:00	Somerset 99.52 - No Rain
	8:00	Wivenhoe 67.54
	10:20	Wivenhoe 67.54, Splityard 164.6
	12:15	Wivenhoe 67.54, Mt Crosby Weir 7.77m AHD Colleges Crossing 300mm from road surface in middle
	12:45	Discharge @ O'Reillys 31.5m=>13.6cumecs
	14:00	Wivenhoe 67.54, Splityard 162.2
	15:00	Somerset 99.47 (wind affected)
	15:45	No signal @ Mt Crosby Weir gauge - requested SEQWB fix immediately
	16:00	Wivenhoe 67.57, Splityard 161.0 (15mm rain)
	18:00	Wivenhoe 67.59, Splityard 159.5
	19:50	Wivenhoe directed to open Gate 3 to 1.7m
	20:00	Wivenhoe 67.59, Confirmed gate opened to 1.7m
	20:45	Splityard 158.4
	22:00	Wivenhoe 67.59
09-Mar-99	0:00	Wivenhoe 67.59, Splityard 158.4
	3:00	Wivenhoe 67.56
	6:00	Wivenhoe 67.51
	6:30	Splityard 165.6 & pumping
	7:00	Somerset 99.38 - Hydro releasing 1170Ml per day (13.54 cumecs)
	8:00	Wivenhoe 67.51
	8:20	Splityard 165.00 - Hydro operating
	9:30	Wivenhoe requested to close Gate 3 to 1.5m
	9:35	Confirmation from Wivenhoe - Gate 3 closed to 1.5m
	11:00	Wivenhoe 67.53, Splityard 163.0
TM	12:00	Somerset 99.35, 9mm Rain overnight
	14:00	Wivenhoe 67.53, Splityard 162.0
	15:00	Somerset 99.33
	16:00	Somerset 99.32
	17:00	Wivenhoe 67.52, Splityard 161.6
	20:00	Wivenhoe 67.52
	20:23	Faxed Wivenhoe directing Gate 3 be opened to 1.7m
	20:40	Wivenhoe advised Gate 3 opened to 1.7m @ 20:35
10-Mar-99	0:00	Wivenhoe 67.52, Splityard 161.2
DR	6:00	Wivenhoe 67.48, Splityard 165.60 Effective Lake Level 67.455, Simulated Drawdown 67.458
	7:00	Somerset 99.24
	9:15	Wivenhoe 67.47 Mr T Fenwick approved holding Somerset at current level & allowing Hydro to draw it down - confirmation fax
	9:40	to follow
	9:47	Received fax from SEQWB (G Grant) re closure of Somerset
	9:55	Fax sent to Somerset re direction to close regulators
	10:50	Somerset confirmed regulators closed - Fax to follow
	10:50	QPF from BOM to 9:00 Thu (11/01/1999) = 2mm
	11:17	Confirmation fax received from Somerset
AL	12:00	at 12:00 Wivenhoe Lake level 67.47; Splityard level 165.4 College's Crossing - Peter Myatt. They have installed a temporary benchmark @ Colleges 0.61m =m
PA	12:50	underside of bridge deck; currently at 0.48m maximum overnight was 0.56m (0.05m below bridge deck)
PA	15:10	Andrew Maughan - Wivenhoe 67.47 (cf Alert:67.44)
AL	16:30	QPF for 24h to 3pm Thu is less than 2mm rainfall for Somerset/Wivenhoe and less than 2mm rainfall for North Pine catchments
AL	18:00	Wivenhoe W.L. 67.45 @ 18:00 (A. Maughan) (cf Alert 67.40 (#6640) @ 18:00), Splityard W.L. 165.5 at 17:30. Andrew took measurement at O'Reilly's Weir @ 17:00 of 0.265m on temporary gauge board, a drop of 40mm since last reading 0.305m @ 16:30 on 9/3/99. Advised that we may want Doug Grigg to take another reading at about 2-3am on 11/3/99 if we see another dip in flow similar to dips on 9/3/99 & 10/3/99. Andrew estimated that W.L. was about 0.08m above weir crest @ 17:00. Alert #6569 at 17:00 approx 24.60 CTF on current rating curve would be 24.60-(24.0+0.08) = 0.52m reduction to levels in rating curve. Need more data before such change to rating curve is made

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
AL	21:00	Wivenhoe Dam W.L. 67.44 (Doug Grigg). Asked Doug to take another measurement of height at O'Reilly's Weir. He will try to do it at 23:00
DC	23:09	Doug Grigg rang re O'Reilly's Weir - gauge board now reads 0.260m (prev 0.265m at 17:00). Also flow over O'Reilly's Weir crest 0.12m over the crest - this measurement made by a staff on the weir crest - more accurate than Andrew's measurement) - FCC to contact Doug when mesurement required. Note: Sensor in FCC dropped 0.1m - supports theory of power surge.
11-Mar-99	0:00	Doug Grigg Wivenhoe EL 67.42m, Spiltyard 165.2m
KN	6:00	Wivenhoe 67.40 (Don asked Doug Grigg to visit O'Reilly Weir)
	7:00	Doug Grigg reported O'Reilly's Weir gauge board reading of 0.25m, flow depth over weir measured at 0.10m
	7:45	Rob Titmarsh report Somerset lake level reading at 6:00am = 99.20
	8:30	David Gill SEQWB rang. Wanted confirmation that Wivenhoe will be closed off on Sunday & that Somerset was closed too
KN	9:00	Wivenhoe lake level 67.39
JR	9:00	Discussed with Senior Flood Duty Engineer that we will draw Wivenhoe down below Full Supply Level to accommodate trickle from Somerset hydro
DC	9:50	Splityard 164.7m - phone call
KN	10:30	QPF to 9am Friday approx 5mm
JR	11:00	SEQWB. Spoke to David Gill requesting problems with O'Reilly's Weir gauge oscillations be examined. Also asked for a confirmation level at Mt Crosby
JR	11:15	Mt Crosby gauge BCC 7.81 and constant. BCC currently using between 400-450 ML/day
JR	11:30	7 day forecasts checked. Possible +60mm on Sunday. Radar confirms weather in the North.
DT	12:00	Wivenhoe EL 67.39 (Peter Myatt)
DT	15:50	Peter Myatt rang. Wivenhoe EL 67.40, Splityard EL 160.90, O'Reilly's Weir 95mm over crest at approx 14:40
DT	15:50	Faxom Wivenhoe Dam showing event log
DT	18:00	Wivenhoe EL 67.41
DT	19:00	Peter Myatt phoned. Level at College's Crossing 0.56m on gauge board, 0.61m below bridge, 130mm top of road to water level in middle.
DT	21:00	Wivenhoe EL 67.41, Splityard EL 157.6 (Doug Grigg) (deficit = 7442ML, corrected 67.342m AHD)
12-Mar-99	0:00	Wivenhoe EL 67.39, Splityard EL 157.6 (no change) (corrected 67.322)
AN	6:00	Wivenhoe EL 67.30, Splityard EL 165.7
AN	9:00	Peter Myatt phoned. Wivenhoe EL 67.28
PA	9:05	Peter Myatt - Wivenhoe - requested levels at Splityard about 3 times per day am, midday and pm. They will also check out O'Reilly's today. I have not asked for a College's Crossing level at this stage, but indicated we might ask for one if we get rain.
AN	11:30	Phoned Somerset. Lake Level 99.20
AN	12:00	Peter Myatt phoned. Wivenhoe EL 67.29, Splityard EL 163.2
DC	12:27	David Gill SEQWB rang requesting info on close down on Sunday
NA	15:00	Andrew Maughan - Wivenhoe EL 67.28, will read Wivenhoe and Splityard again at 18:00
NA	15:20	Colin Rockett, Pine Shire rang back - the preferable time for a release for them is Sunday & please provide a minimum of three hours prior notice
NA	16:50	John Tibaldi rang from Ipswich (home). Queried whether current downpour was affecting North Pine Dam (No)
DC	16:53	Rang M. Lane, North Pine. Digital reading 39.602. Gauge board just over 39.60.
DC	18:00	Andrew Maughan rang. Wivenhoe EL 67.27, Splityard Ck 163.3m - Colleges Crossing 0.49m on temp gauge board. 90mm going over Mt Crosby Weir.
NA	18:30	Wivenhoe event log fax received
JR	21:00	Wivenhoe Dam EL 67.26, Splityard Ck Dam 163.10
13-Mar-99	0:10	Doug Grigg phoned. Wivenhoe Dam EL 67.25, Splityard Ck Dam EL 163.10
RD	6:00	Doug Grigg phoned. Wivenhoe Dam EL 67.22, Splityard Ck Dam EL 163.10
PA	9:00	Andrew Maughan. Wivenhoe Dam EL 67.20
PA	12:30	Andrew Maughan. Wivenhoe Dam EL 67.191 @ 12:00, Splityard EL 163.10, Adjusted level 67.
TM	15:20	Andrew Maughan. Wivenhoe Dam EL 67.18 @ 15:00, Splityard 163.10 @ 15:00
PA	18:00	Andrew Maughan. Wivenhoe Dam EL 67.17 @ 18:00, Splityard 163.10, Mt Crosby @ 7.81m (cf Alert @ 7.80) & Colleges Crossing at 0.47m on temporary gauge board (down from 0.49 yesterday & 14cm under deck)
PA	21:00	Doug Grigg Wivenhoe 67.16, Splityard 162.6, Somerset report @ 6.00am - 90.19m
14-Mar-99	0:00	Doug Grigg. Wivenhoe 67.15, Splityard 162.6. He will report again at 6am
KN	6:00	Doug Grigg. Wivenhoe 67.12, Splityard 162.6
KN	6:50	Received fax of Wivenhoe Dam Event Log
KN, DC	8:00	Don Cock has sent a fax to Rob Titmarsh @ Somerset Dam requesting closure of all crest gates. Rob Titmarsh had rung - water level 99.19 steady. Power station generating 24 hours per day. Rob will ring again about 3-4pm.

APPENDIX E **ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS**

MARCH 1999 Event

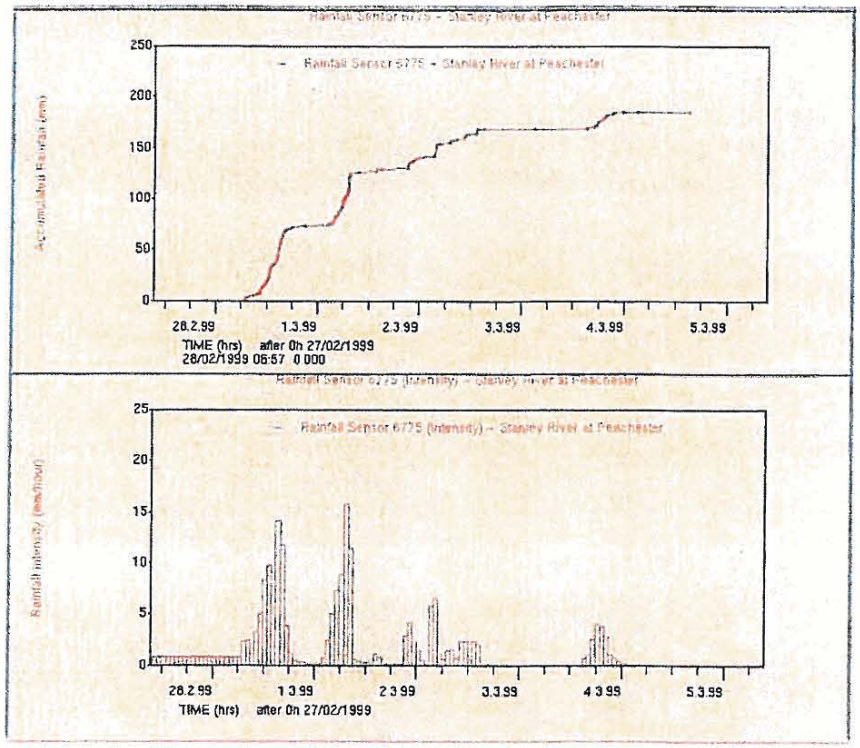
NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
DC	9:00	Wivenhoe EL 67.10, Splityard 162.6
KN	9:30	Confirm fax from Rob Titmarsh regarding closure of all crest gates on Somerset Dam
KN	10:00	Malcolm Lane phoned from North Pine Dam. Gauge Board 39.60, BCC 39.603, Digital 39.605
KN	10:30	QPF for North Pine, Somerset and Wivenhoe 0mm to 3pm Monday
JR	10:45	Discussed with Peter Allen the need to provide baseflow after final closedown
JR	12:00	Wivenhoe Dam EL 67.09, Splityard 162.6
JR	12:30	Rang Power Station at Somerset. Still releasing continuously (about 13.5 cumecs) and will be until Somerset reaches EL 99.00
AL	14:00	John Tibaldi rang. Wivenhoe Dam EL 67.085, Splityard Ck Dam EL 162.6

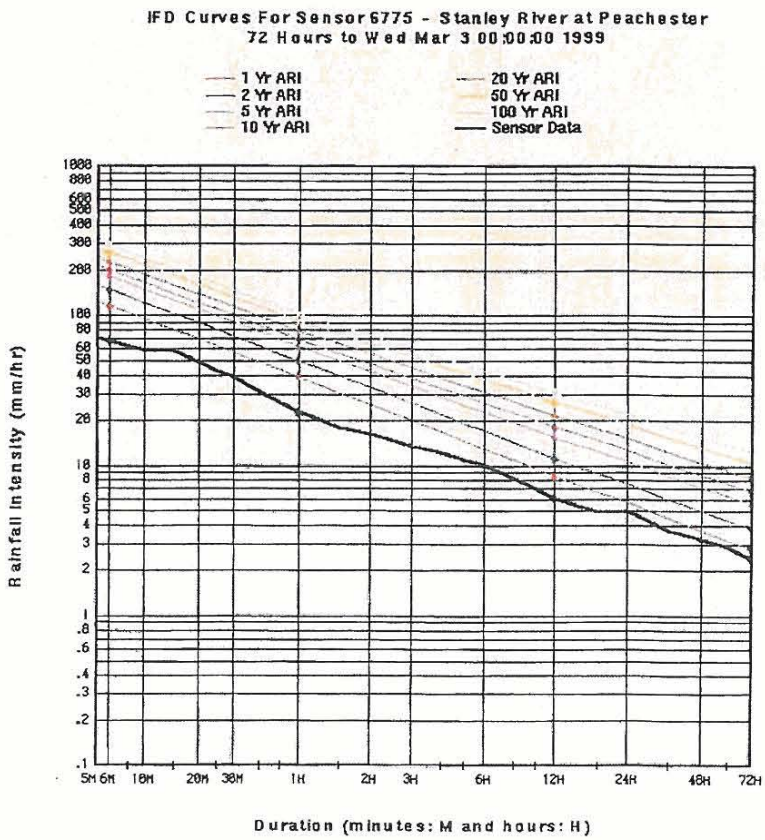
APPENDIX F

REPRESENTATIVE CUMULATIVE RAINFALL AND IFD CURVES FOR MARCH 1999 EVENT

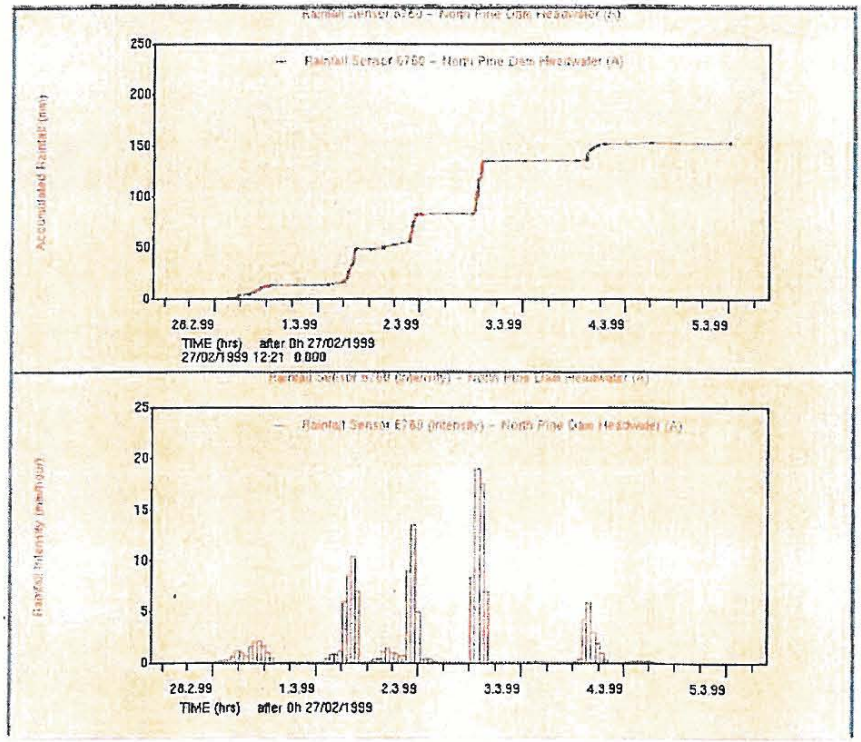
APPENDIX F- Cumulative Rainfalls & IFD Curves for March 1999 Event



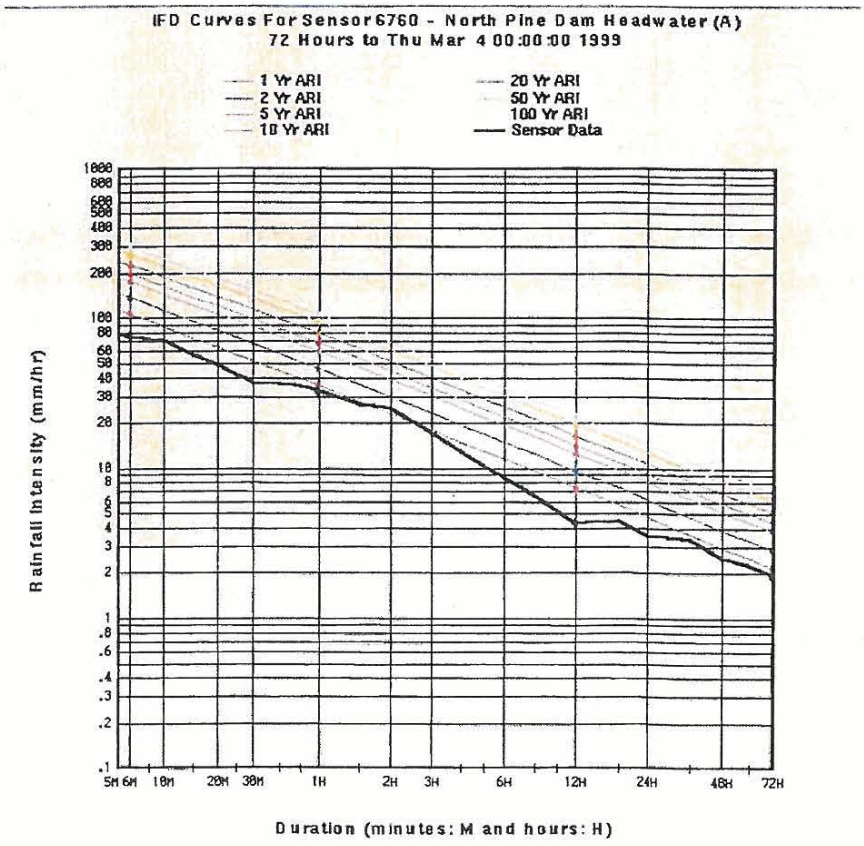
Somerset Catchment Rainfall Sensor 6775 - Stanley River at Peachester



APPENDIX F- Cumulative Rainfalls & IFD Curves for March 1999 Event



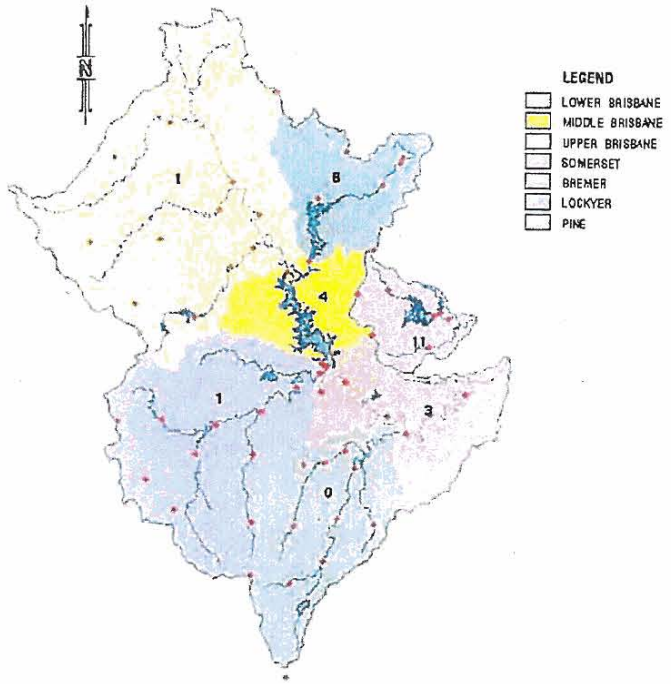
Pine Catchment Rainfall Sensor 6760 - North Pine Dam Headwater



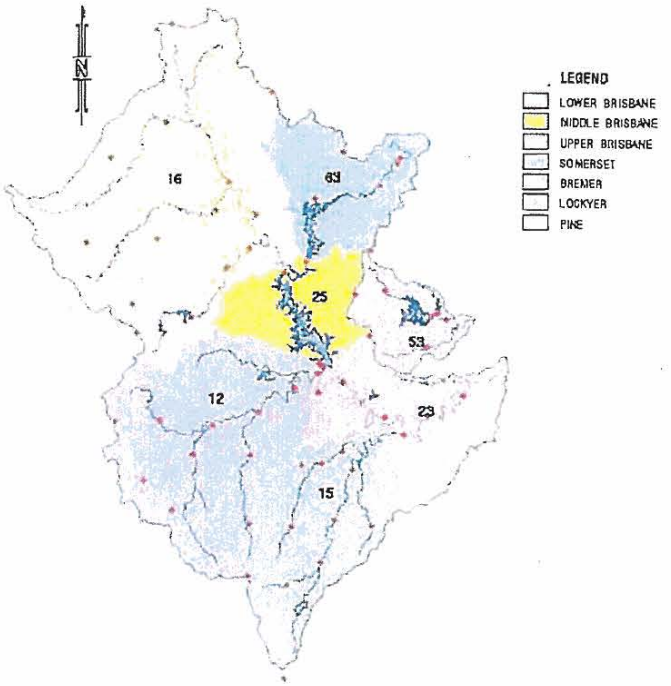
APPENDIX G

CATCHMENT RAINFALLS FOR MARCH 1999 EVENT

APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event



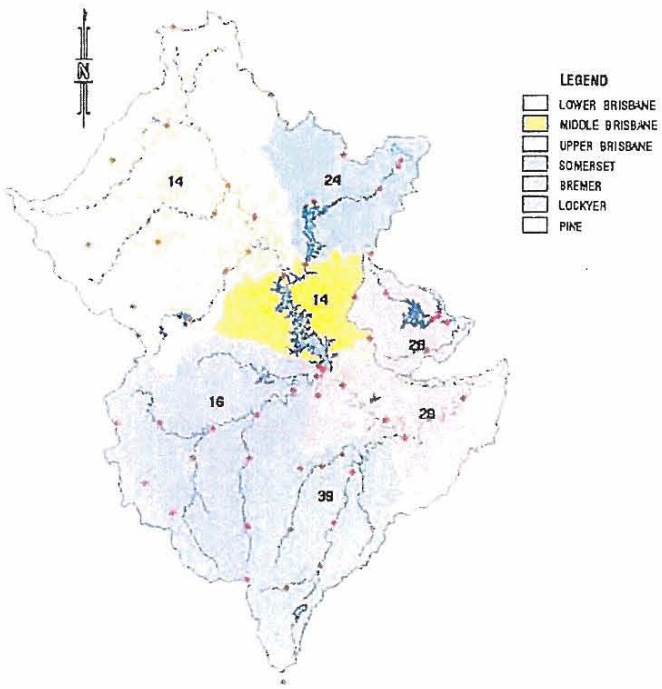
Sub-Catchment 24hr Total Rainfall to 9:00am 28/2/99



Sub-Catchment 24hr Total Rainfall to 9:00am 1/3/99

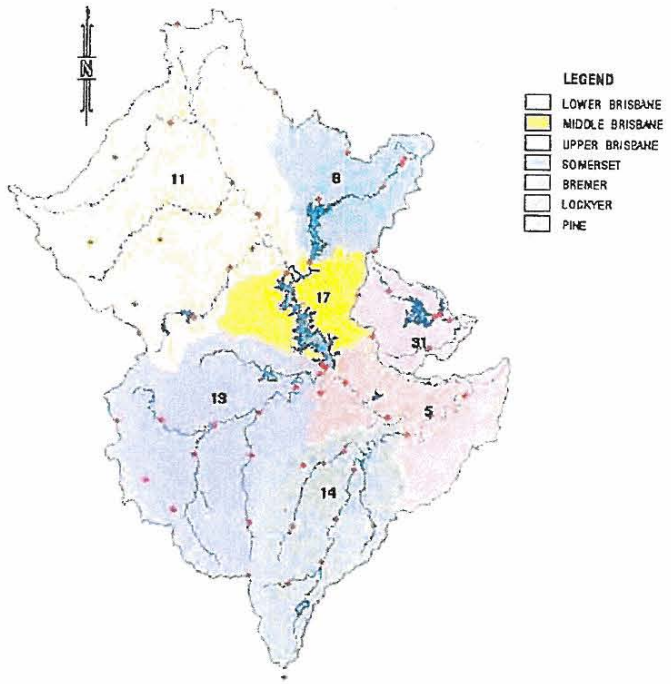
APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event

Sub-Catchment 24hr Total Rainfall to 9:00am 2/3/99

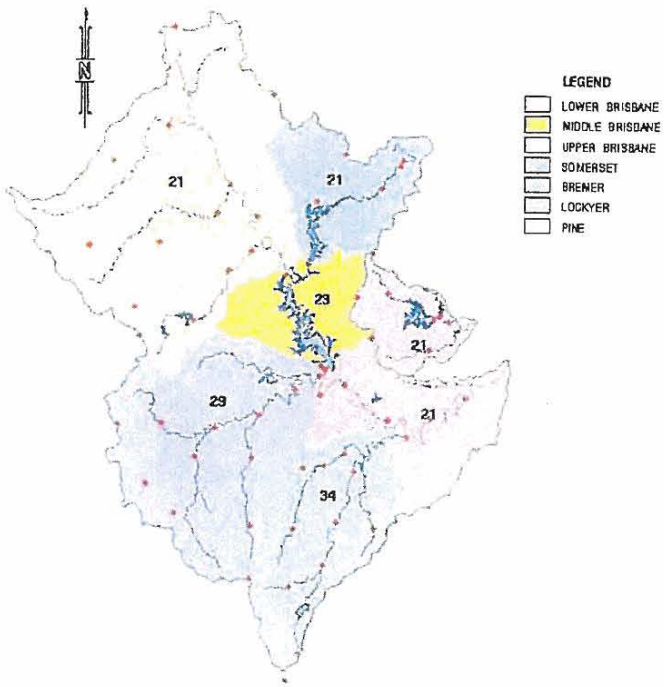


Sub-Catchment 24hr Total Rainfall to 9:00am 3/3/99

APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event



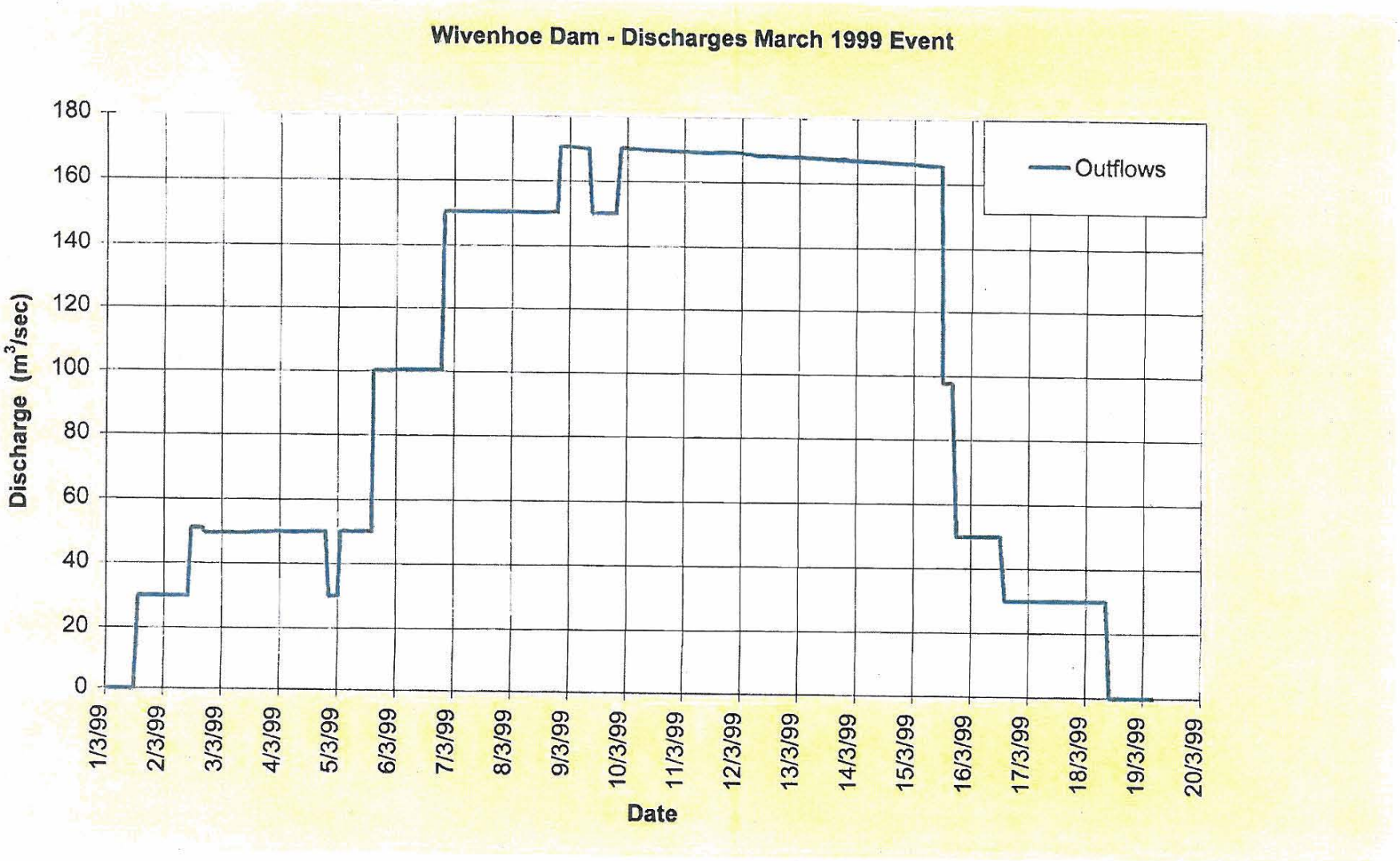
Sub-Catchment 24hr Total Rainfall to 9:00am 4/3/99



APPENDIX H

INFLOW and OUTFLOW HYDROGRAPHS MARCH 1999 EVENT

Wiv Q Graph



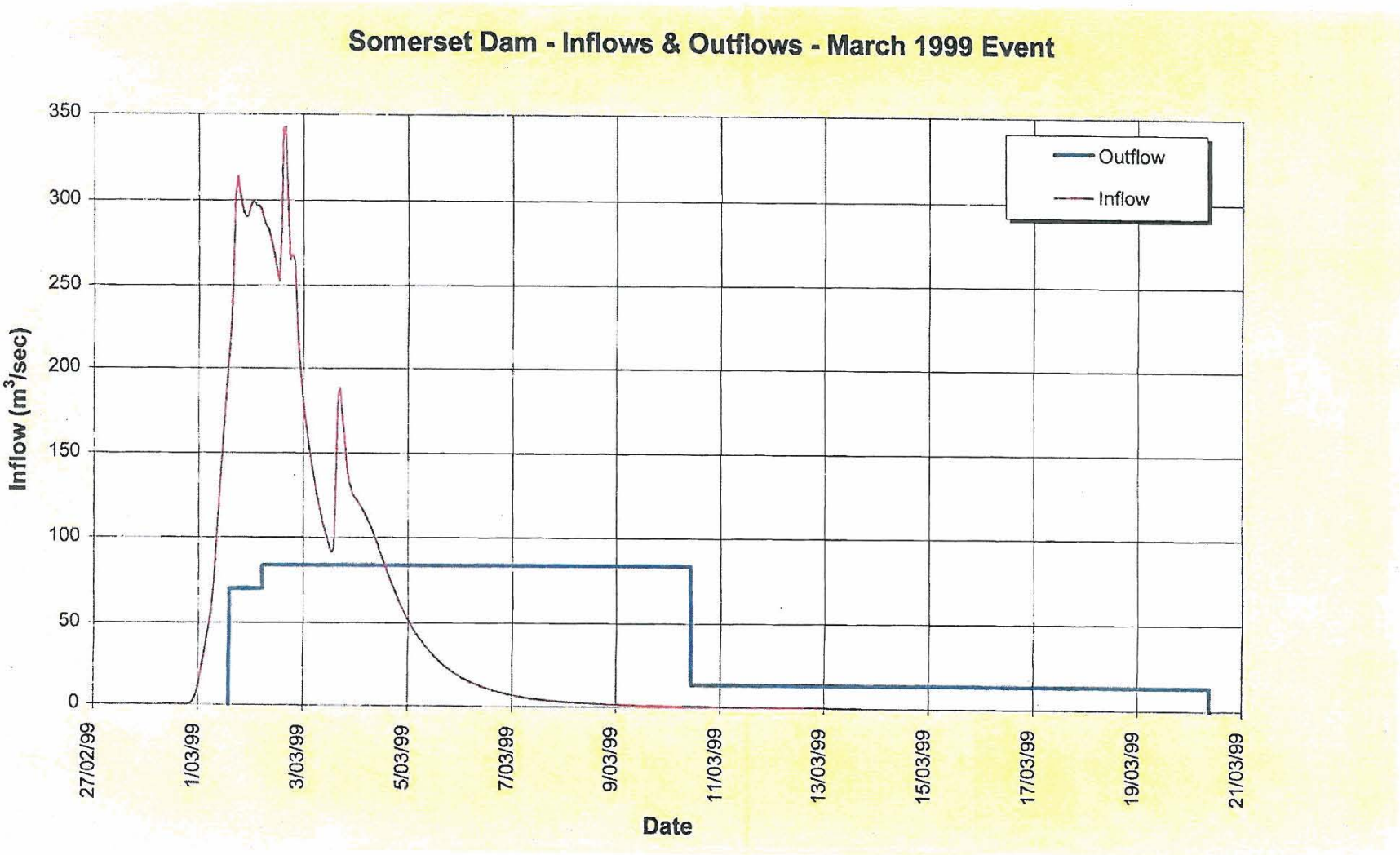
wivenhoe outflows.xls

31/08/99

FIGURE H1

SOQ.002.001.0778

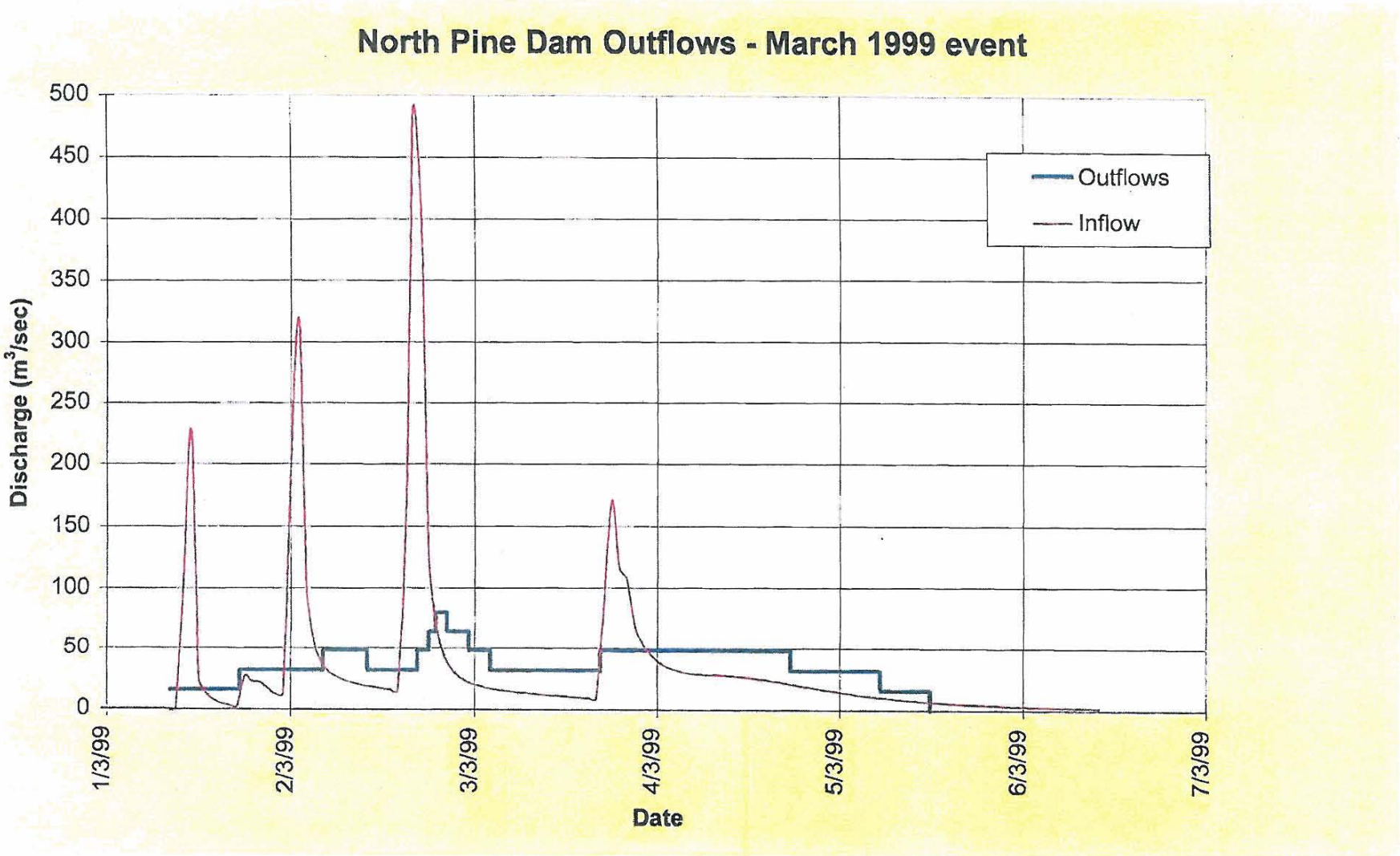
Somerset



wivenhoe outflows.xls

FIGURE H2

NP Q Graph



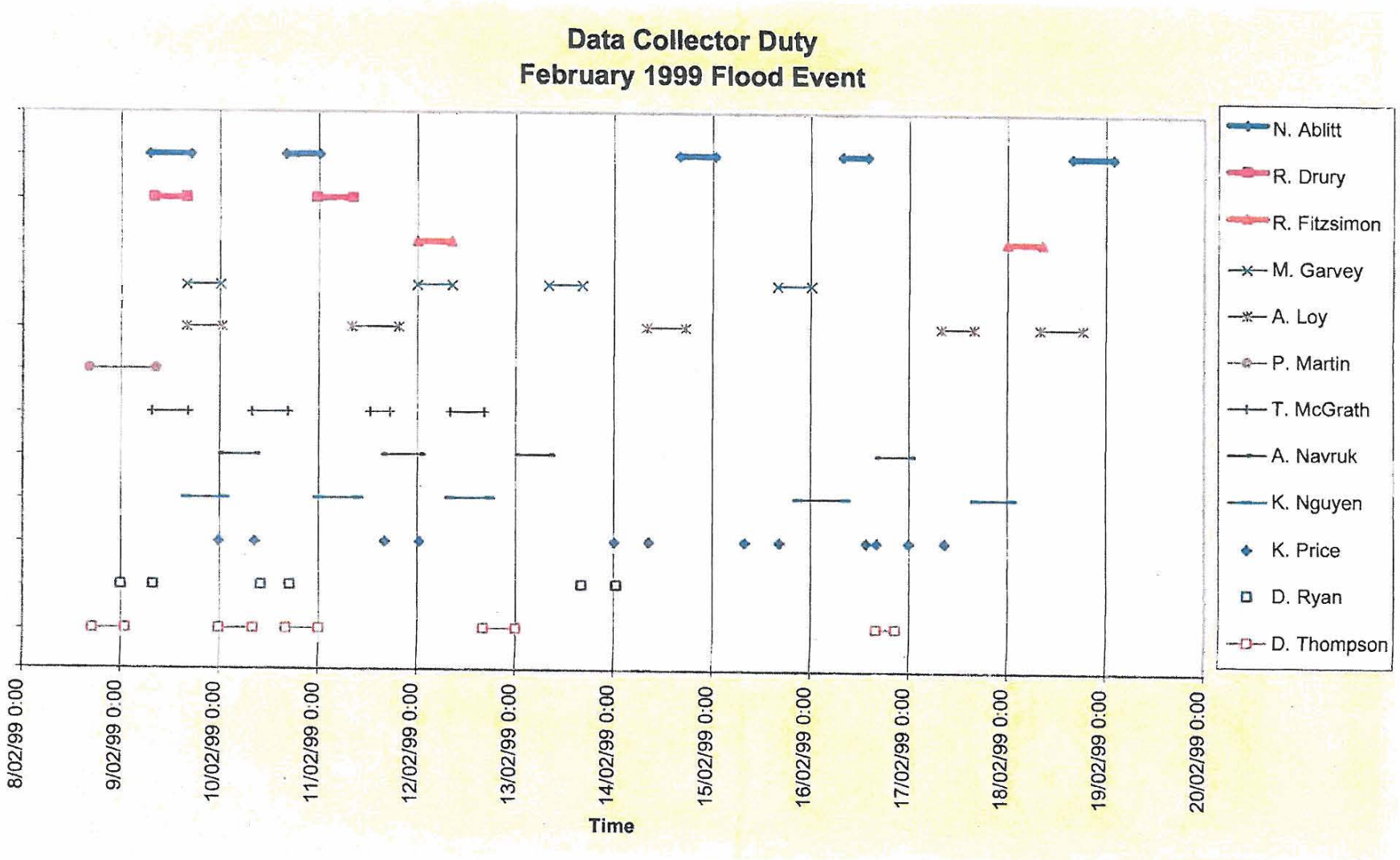
np outflowsmar.xls

FIGURE H3

APPENDIX I

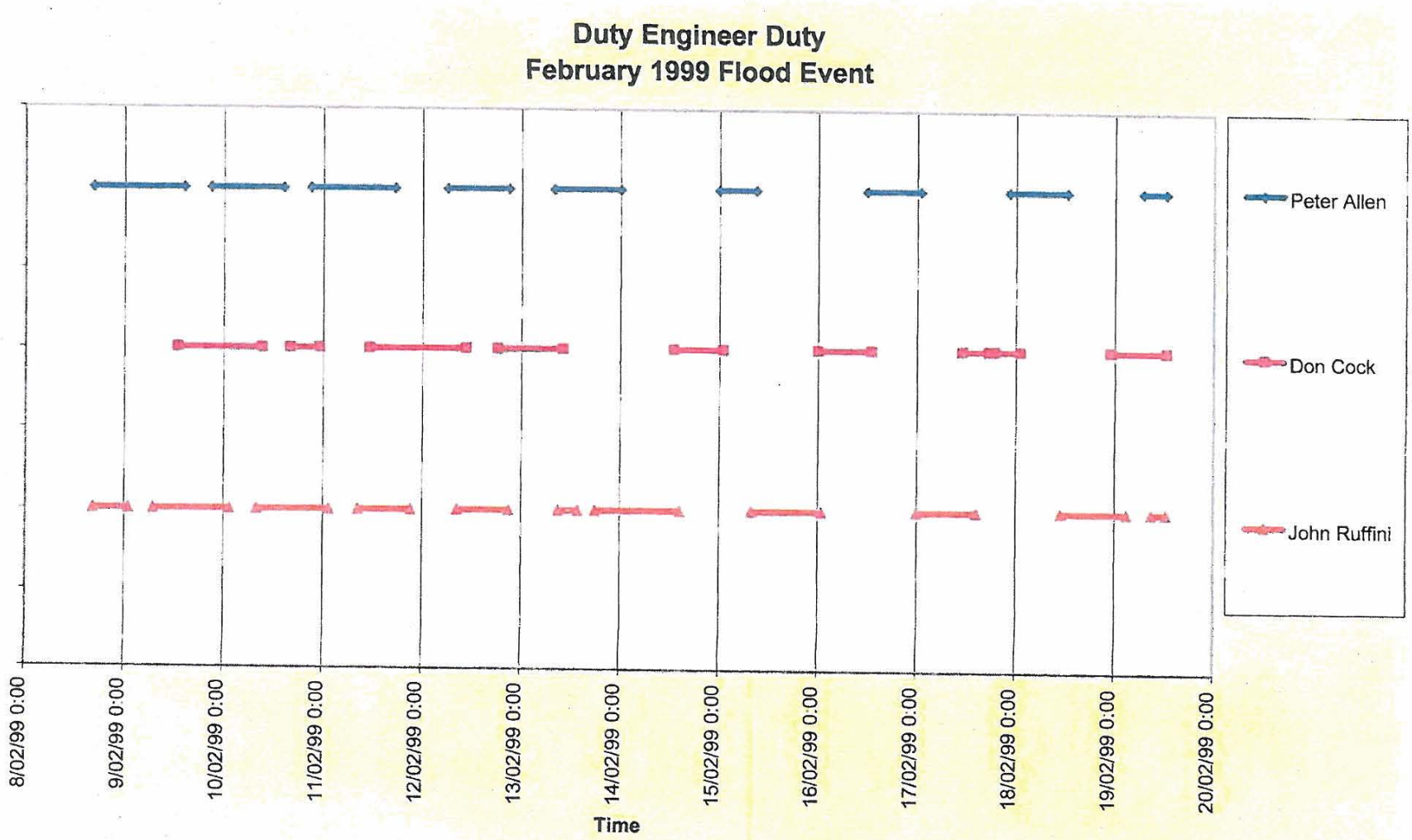
RECORD OF DUTY ENGINEERS and DATA COLLECTORS FOR FEBRUARY and MARCH 1999 EVENT

APPENDIX I



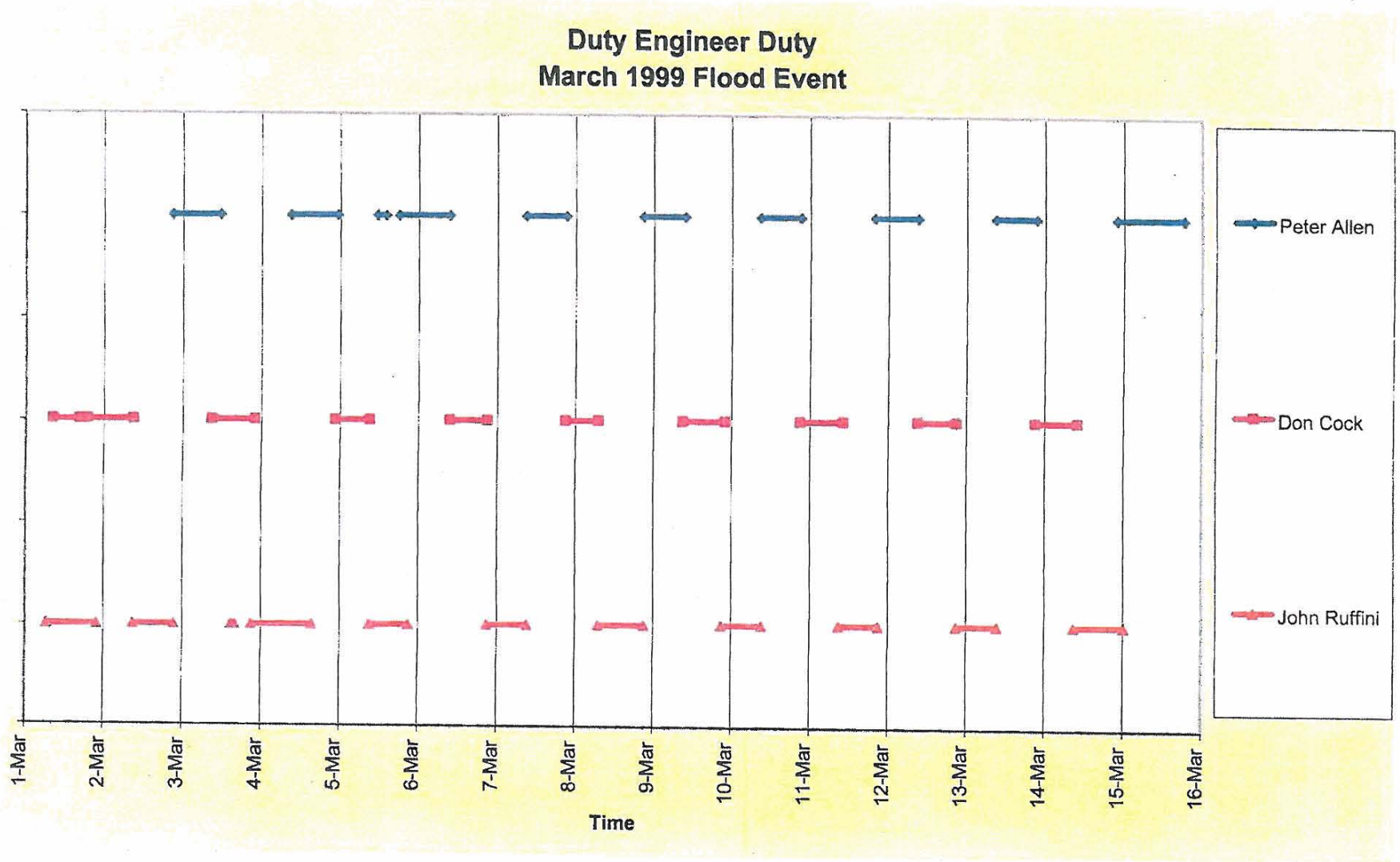
Duty_Feb99.xls

APPENDIX I



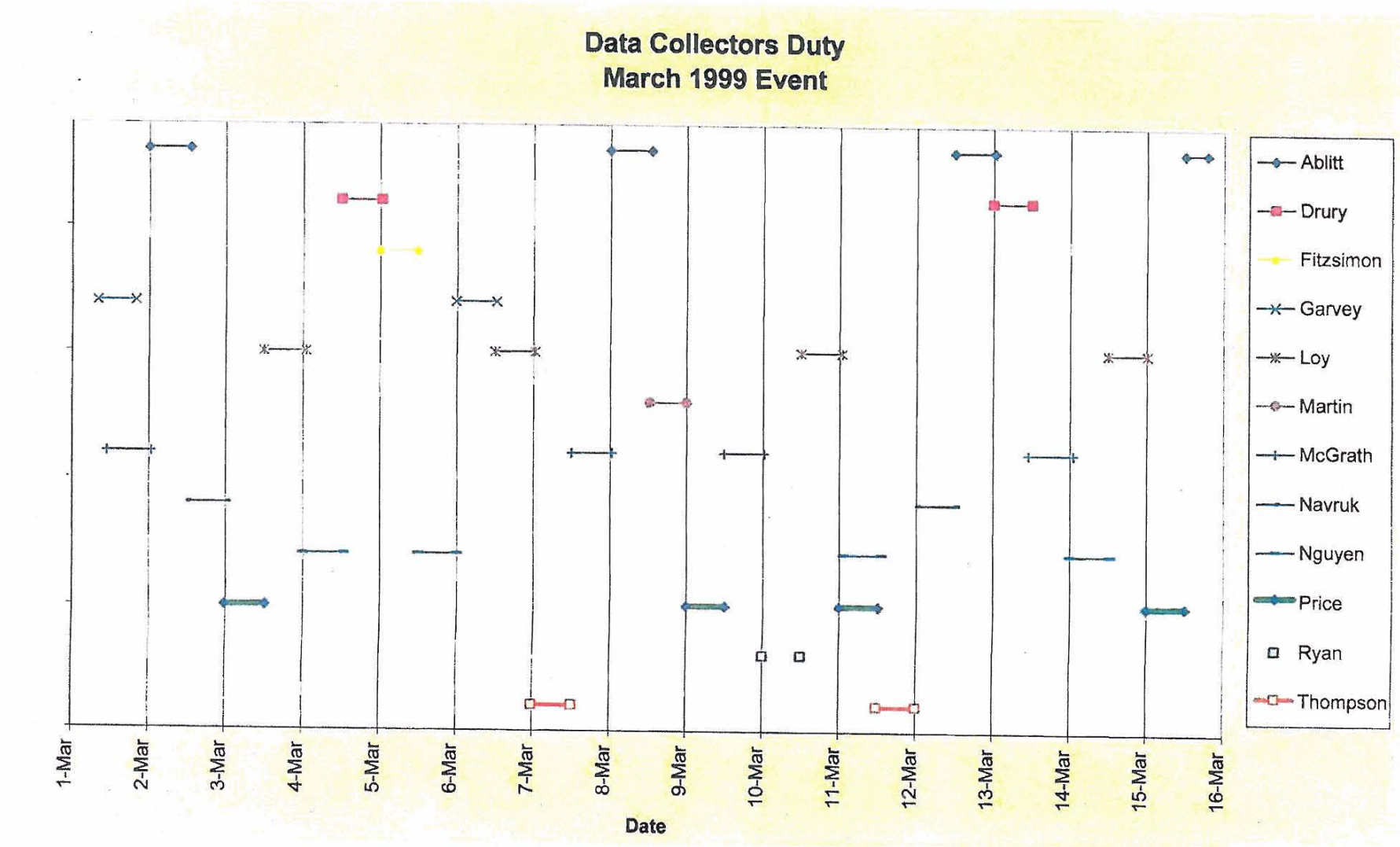
Duty_Feb99.xls

APPENDIX I



Duty_Mar99.xls

APPENDIX I



Duty_Mar99.xls

'DERM-19'

seqwater
WATER FOR LIFE

REPORT ON FLOOD EVENTS AT WIVENHOE, SOMERSET AND NORTH PINE DAMS

MAY 2009 TO JULY 2009

July 2009

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1 INTRODUCTION

Between 14 April 2009 and 8 July 2009, four separate flood events impacted on Wivenhoe, Somerset and North Pine dams. This report contains details of those events and is prepared in accordance with the requirements of the following Flood Operations Manuals:

- Manual of Operational Procedures for Flood Mitigation for Wivenhoe Dam and Somerset Dam, Revision No 6, December 2004.
- Manual of Operational Procedures for Flood Releases from North Pine Dam, Revision No 4, September 2007.

Section 2.9 of both of these Manuals requires the preparation of a suitable report at the completion of a flood event. The *'report shall contain details of the procedures used, the reasons therefore and other pertinent information'*. This document contains a combined report covering the four separate flood events across all three dams.

2 FLOOD EVENT SUMMARY

A series of flood events occurred in South-East Queensland between 14 April 2009 and 8 July 2009. These events resulted in significant water releases (including gate operations) being required at Somerset and North Pine Dams. These water releases were necessary to prevent the dam overtopping and subsequent failure. All water releases were made in accordance with the Manuals of Flood Operations and the Water Supply Act 2008. Details of the flood events are as follows:

EVENT DATES	DAMS REQUIRING FLOOD RELEASES
April Event (14 April to 17 April 2009)	Somerset Dam
May Event (19 May to 22 May 2009)	North Pine Dam and Somerset Dam
Early June Event (4 June 2009)	North Pine Dam
Late June Event (22 June to 8 July 2009)	North Pine Dam

The April Event was not strictly a flood event as defined by the Manual of Flood Operations as the event did not require mobilisation of the Flood Operations Centre, even though Somerset Dam attained Full Supply Level. This event was treated as an operational release on the basis that the catchment rainfall was just sufficient to fill the reservoir and there was no significant corresponding inflow into Wivenhoe Dam. This event is mentioned as it contributed to the elevated lake levels for the later events.

The May Event was the most significant in terms of releases from the dams. This event resulted in the full mobilization of the Flood Operations Centre and both Somerset Dam and North Pine Dam.

The Early June Event was as a result of base-flow into North Pine Dam causing the lake level to exceed gate trigger level. The Flood Operations Centre and North Pine Dam were mobilized for this drainage activity.

The Late June Event involved the mobilization of the Flood Operations Centre and North Pine Dam. This event featured a trial drainage release involving the use of the cone valves to minimise as much as possible adverse impacts on both fish and the closure of downstream crossings. The event was relatively small in nature and slightly higher rainfalls would have necessitated operation of the radial gates to protect the structural safety of the dam.

3 MOBILISATION AND STAFFING DETAILS

3.1 April Event (14 April to 17 April 2009)

Heavy rain in the catchment on the 14 April 2009 caused Somerset Dam to attain its full supply level. The event did not require mobilization of the Flood Operations Centre or dam staff because significant rises above the Somerset Dam Full Supply Level did not eventuate. This event was treated as an operational release on the basis that the catchment rainfall was just sufficient to fill the reservoir and there was no significant corresponding inflow into Wivenhoe Dam.

3.2 May Event (19 May to 22 May 2009)

Heavy rain started falling over the catchments of the dams on the afternoon of 19 May 2009. The catchments of the dams had a low antecedent moisture store and there was a sizable storage deficit in all three dams prior to the onset of the event. As a consequence runoff did not commence until the afternoon of Wednesday 20th May 2009.

The SunWater Flood Response Team was formally mobilized on 20 May 2009 at 09:00.

Heavy rain continued throughout 20 May 2009 and into 21 May 2009. The Duty Flood Operations Engineer monitored the event by downloading data through FLOODPC from his home during the evening of the 19 May 2009. Rainfall and river heights were then monitored continuously throughout the day from around 09:00 on the 20 May 2009 in the Flood Operations Centre.

The Duty Flood Operations Engineer advised Seqwater at 21:00 on 19 May 2009 that flood operations were likely at Somerset Dam and North Pine Dam sometime late on the following day. The Dam Supervisors were then placed upon high alert, but formal mobilisation was delayed until gate operations were expected.

Once mobilized, the following staffing arrangements applied:

a) Duty Flood Operations Engineers: Two Duty Engineers were on duty until midnight on 20 May 2009 when this role reverted to the use of a single Duty Engineer. Shifts then reverted to a single Duty Engineer until the end of the event.

b) Data Collectors: A team of three Data Collectors were mobilised to the Flood Operations Centre on the morning of 20 May 2009. Subsequent Data Collectors were then mobilized in groups of three and then two for the remainder of the event.

c) Seqwater Dam Operators: Operators were formally mobilized during the early phase of the event. As noted above, Dam Supervisors were placed upon alert during the early phases of the event. Formal mobilization of the dam operators took place on 20 May 2009, when gate

operations were considered likely. Two Dam Operations staff remained on duty at each dam for the duration of the event.

The event was declared over at 17:30 hours on Friday 22 May 2009. At this stage it was considered that further significant runoff into the storages was unlikely and the probability of further operation of the gates at each of the dams was low. Following this declaration, monitoring of the dams and the continuing weather situation reverted to the Duty Flood Operations Engineer on close call.

3.3 Early June Event (4 June 2009)

The Flood Operations Centre was mobilized at 08:30 am on 4 June 2009. Although light rainfall had occurred over the catchment of North Pine Dam on the proceeding night, the lake levels in the reservoir exceeded gate trigger levels due to continued base flows from the May event. This event was effectively a drainage activity to return the lake level back to Full Supply Level. The Flood Operations Centre was staffed by a Duty Engineer and two Data Collectors for the duration of the event.

The event was declared over at 19:00 on 4 June 2009. Following this declaration, monitoring of the dams and the continuing weather situation reverted to the Duty Flood Operations Engineer on close call.

Two Dam Operations staff remained on duty at North Pine Dam for the duration of the event.

3.4 Late June Event (22 June to 8 July 2009)

The Flood Operations Centre was mobilized at 09:00 on 22 June 2009 in response to moderate to heavy rainfall over the catchments of the Stanley River and North Pine River.

Four shifts were effectively conducted during this event which lasted until 21:30 on 23 June 2009. The Flood Operations Centre was staffed by a Duty Engineer and two Data Collectors for the duration of the event.

The event was declared over at 21:30 on 23 June 2009. Following this declaration, monitoring of the dams and the continuing weather situation reverted to the Duty Flood Operations Engineer on close call.

Two Dam Operations staff remained on duty at North Pine Dam for the duration of the event.

Further drain down of North Pine Dam was undertaken using the cone valves to minimise as much as possible adverse impacts on both fish and the closure of downstream crossings. The Flood Operations Centre was not mobilised for these releases as no rain was forecast in the catchment and dam inflows were minimal.

4 EVENT RAINFALL

A summary of the average catchment rainfall for each event is contained in the table below.

EVENT DATES	CATCHMENT	AVERAGE CATCHMENT RAINFALL (mm)
April Event	Wivenhoe Dam	45
	Somerset Dam	88
	North Pine Dam	157
May Event	Wivenhoe Dam	114
	Somerset Dam	175
	North Pine Dam	336
Early June Event	Wivenhoe Dam	6
	Somerset Dam	10
	North Pine Dam	18
Late June Event	Wivenhoe Dam	26
	Somerset Dam	43
	North Pine Dam	72

The table above shows that the May Event was significant, with the remaining events being relatively minor. Event Magnitude is further discussed in Section 4.2 below.

4.1 Rainfall Forecasts

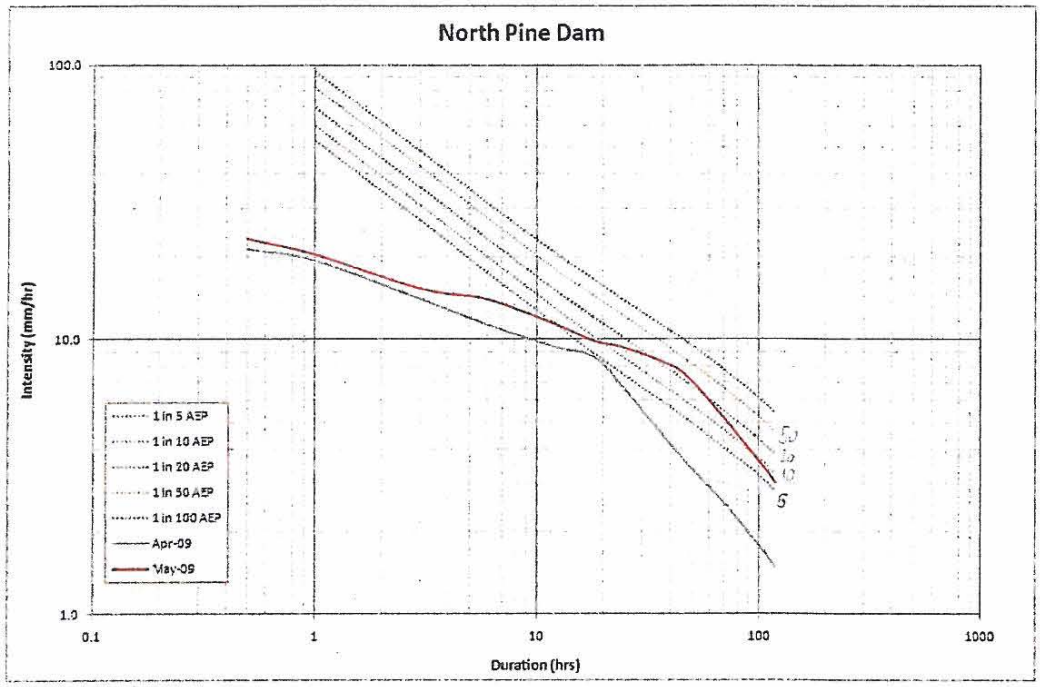
The Bureau of Meteorology provides Seqwater with Quantitative Precipitation Forecasts on a twice daily basis. This forecast provides an estimate of the likely rainfall within the next 24 hour period. These forecasts proved useful in encouraging a state of alert prior to each event. Seqwater intends to continue with this service.

The Flood Response Team also subscribes to the SILO Meteogram medium duration forecast (up to seven days) service. Four day outlooks are also available via the Water and the Land site on the Bureau of Meteorology webpage. These services were also useful in raising the state of alert prior to the event.

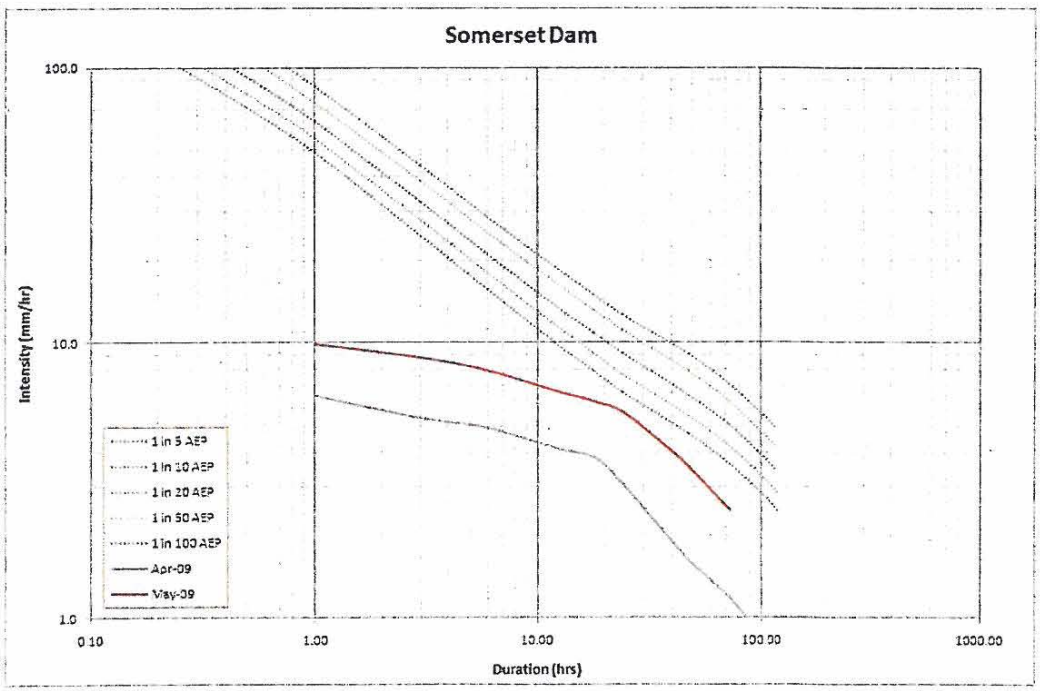
4.2 Event Magnitude

As shown in the table above, the rainfall in the April and May events is significantly higher in all three catchments than the Early and Late June events.

Only the April and May 2009 events were significant rainfall events in the North Pine catchment. The graph below shows that the April event was about 1 in 5 AEP for a duration of 18 to 24 hours. The May event was more significant just exceeding the 1 in 20 AEP for a 48 hour duration storm.



Similar to North Pine the May event in the Somerset catchment was statistically more significant than any of the other events. However, the rainfall in both the April and May events was below a 1 in 5 AEP for all durations.



The rainfall in the Wivenhoe catchment during all four events is not considered to be statistically significant.

5 INFLOW AND WATER RELEASE DETAILS

The tables below summarise dam inflows, dam outflows and water levels for each event.

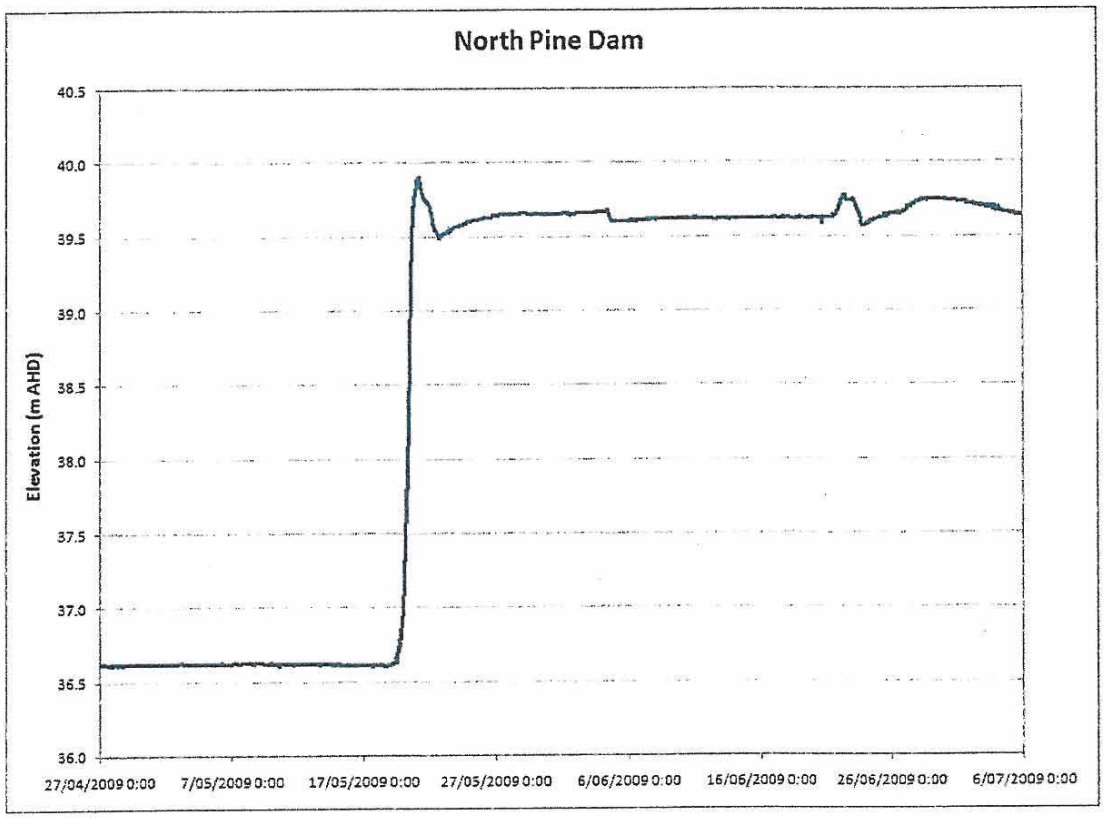
APRIL EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	74900	101200	45200
Release (ML)	78300	0	0
Peak Outflow (m^3/s)	276	0	0
Peak Water Level (mAHD)	99.06	59.04	36.61

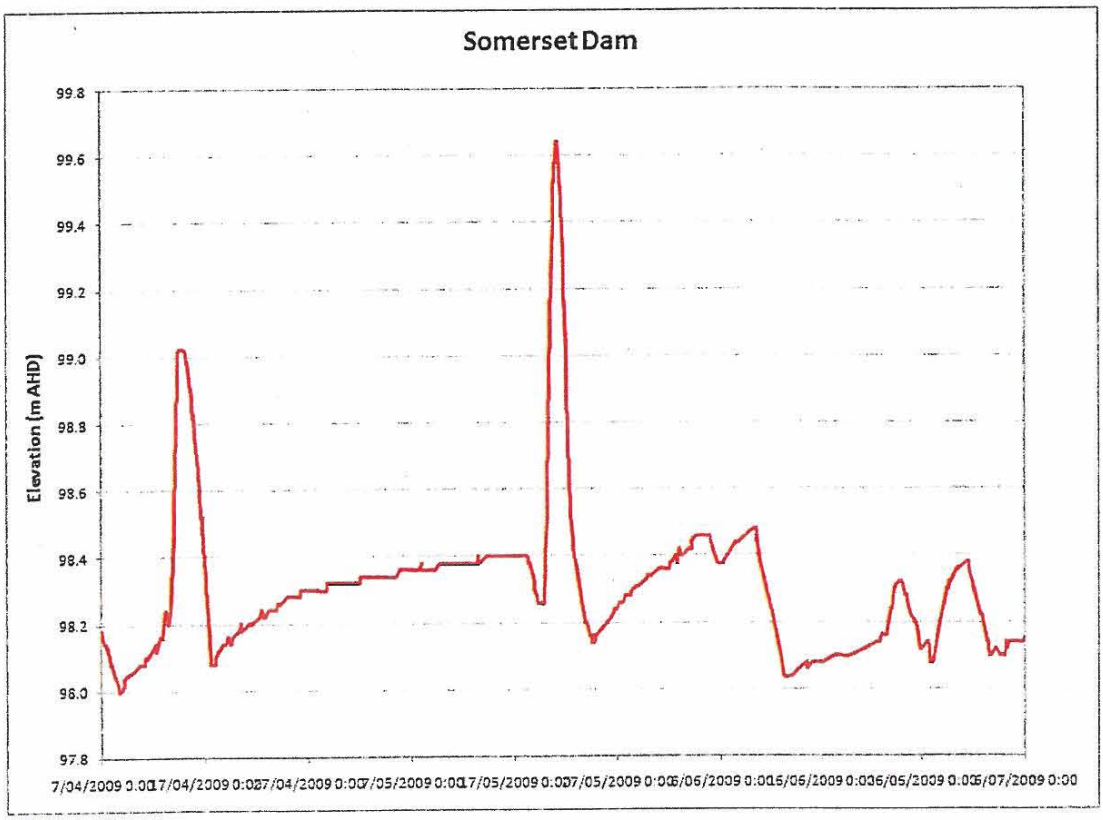
MAY EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	111200	302600	84400
Release (ML)	87400	0	26000
Peak Outflow (m^3/s)	875	0	336
Peak Water Level (mAHD)	99.68	62.54	39.90

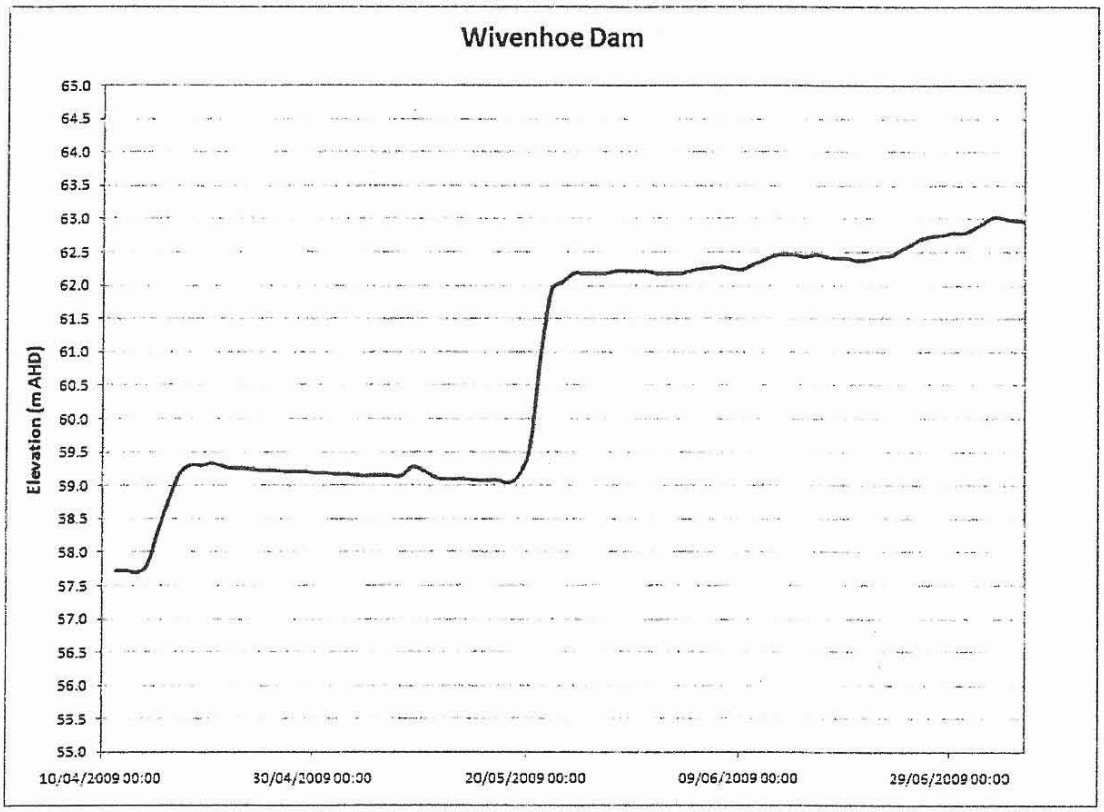
EARLY JUNE EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	Nil significant	Nil significant	Nil significant
Release (ML)	Nil significant	Nil significant	3630
Peak Outflow (m^3/s)	Nil significant	Nil significant	65
Peak Water Level (mAHD)	-	-	39.68

LATE JUNE EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	Nil significant	Nil significant	11200
Release (ML)	Nil significant	Nil significant	11900
Peak Outflow (m^3/s)	67	Nil significant	105
Peak Water Level (mAHD)	98.32	-	39.78

The following graphs show the behaviour of the storages over the duration of the four events.


North Pine Dam
Elevation (m AHD)
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
36.0
27/04/2009 0:00
7/05/2009 0:00
17/05/2009 0:00
27/05/2009 0:00
6/06/2009 0:00
16/06/2009 0:00
26/06/2009 0:00
6/07/2009 0:00


Somerset Dam
Elevation (m AHD)
99.8
99.6
99.4
99.2
99.0
98.8
98.6
98.4
98.2
98.0
97.8
7/04/2009 0:00
17/04/2009 0:00
27/04/2009 0:00
7/05/2009 0:00
17/05/2009 0:00
27/05/2009 0:00
6/06/2009 0:00
16/06/2009 0:00
26/06/2009 0:00
6/07/2009 0:00



The events were relatively minor at Somerset and Wivenhoe Dams; however the May Event was quite significant at North Pine Dam being one of the biggest events experienced since construction was completed. In terms of classification of the flood magnitude for the May Event, the Bureau of Meteorology assessed the flood flows in the Stanley River as 'Minor' and those in the Bremer River and Warrill Creek as "Moderate". No classification is available for the Pine River as this catchment is categorized as a flash flood situation. All other streams were categorized as below minor flood levels.

Maximum gate openings were in accordance with the Manuals of Flood operations. A summary of the gate openings for the significant May Event are contained in the table below:

North Pine Gate Openings							
Calendar Time	A	B	C	D	E	North Pine Discharge	Dam Lake Levels (m AHD)
20/5/09 17:00	0	0	0	0	0	0	39.638
20/5/09 18:00	0	0	1	0	0	16	39.733
20/5/09 19:00	0	0	1	0	1	32	39.814
20/5/09 20:00	1	1	1	1	1	81	39.879
20/5/09 21:00	1	1	2	1	2	129	39.928
20/5/09 22:00	2	1	2	1	2	154	39.965
20/5/09 23:00	2	2	3	2	2	230	39.986
21/5/09 0:00	2	2	3	2	3	256	39.994
21/5/09 1:00	2	2	3	2	3	256	39.994
21/5/09 2:00	3	3	3	3	3	336	39.983
21/5/09 3:00	3	3	3	3	3	336	39.961
21/5/09 4:00	3	3	3	3	3	335	39.936
21/5/09 5:00	3	3	3	2	3	308	39.910
21/5/09 6:00	3	2	3	2	3	282	39.885
21/5/09 7:00	3	2	3	2	3	281	39.860
21/5/09 8:00	2	2	3	2	3	254	39.835
21/5/09 9:00	2	2	2	2	2	202	39.815
21/5/09 10:00	2	1	2	2	2	177	39.801
21/5/09 11:00	2	1	2	1	2	153	39.789
21/5/09 12:00	1	1	2	1	2	129	39.781
21/5/09 13:00	1	1	2	1	2	129	39.772
21/5/09 14:00	1	1	2	1	1	105	39.765
21/5/09 15:00	1	1	2	1	1	105	39.758
21/5/09 16:00	1	1	2	1	1	104	39.750
21/5/09 17:00	1	1	1	1	1	80	39.744
21/5/09 18:00	1	1	1	1	1	80	39.738
21/5/09 19:00	1	1	1	1	1	80	39.732
21/5/09 20:00	1	1	1	1	1	80	39.725
21/5/09 21:00	1	1	1	1	1	80	39.717
21/5/09 22:00	1	1	1	1	1	80	39.709
21/5/09 23:00	1	1	1	1	1	80	39.700
22/5/09 0:00	1	1	1	1	1	80	39.691
22/5/09 1:00	2	1	2	2	2	176	39.674
22/5/09 2:00	2	1	2	2	2	176	39.648
22/5/09 3:00	2	1	2	2	2	175	39.623
22/5/09 4:00	1	1	2	1	2	127	39.601
22/5/09 5:00	1	1	1	1	1	80	39.586
22/5/09 6:00	1	1	1	1	1	80	39.575
22/5/09 7:00	1	1	1	1	1	80	39.564
22/5/09 8:00	1	1	1	1	1	80	39.553
22/5/09 9:00	1	1	1	1	1	80	39.542
22/5/09 10:00	1	1	1	1	1	79	39.530
22/5/09 11:00	1	1	1	1	1	79	39.518
22/5/09 12:00	0	0	1	0	1	32	39.511
22/5/09 13:00	0	0	1	0	1	32	39.507
22/5/09 14:00	0	0	1	0	1	32	39.503
22/5/09 15:00	0	0	0	0	0	0	39.501

No issues, including equipment or infrastructure issues were encountered during the flood operations across all four events.

6 PERFORMANCE OF THE DATA COLLECTION SYSTEM

A range of data systems was used by the Flood Response Team during these events. These data systems were:

- Seqwater ALERT rainfall and river height network
- The Department of Environment and Resource Management's Hydromet Telephone Telemetry System
- Bureau of Meteorology Weather Radar Imagery
- Bureau of Meteorology Weather Forecasts and Warnings
- Bureau of Meteorology Quantitative Precipitation Forecasts
- Manually Observed Storage Levels

The Seqwater ALERT Network is the primary source of data used by the Flood Response Team. The network consists of 71 rainfall sensors and 58 river height sensors spread throughout the Pine River and Brisbane River catchments. The general performance of the network over the events is summarised in the table below.

Sensor Group	No of Sensors	Overall Sensor Availability (%)
Main Rain	60	85
Main River	45	71
Back-up Rain	11	82
Back-up River	13	69

As can be seen from the percentage available, the back-up rain and river sensor groups are lower than desirable. A percentage available of in excess of 85 percent is regarded as the target for normal operation, provided that the unavailable sites are not congregated in a specific part of the network. However, it should be noted that the majority of the main rain sensors that were out of action were located downstream of the dams and so this was not regarded as crucial.

All of the critical sites or key locations have full back-up in the network, with only one site (Lyons Bridge) not having either the main or back-up sensor operational during the events. Overall the performance of the system was judged acceptable. It should be noted however that Seqwater are committed to the improvement of the system and have recently appointed two full time Hydrographers to support this objective. Accordingly it is expected that the performance of the data collection system will show further improvement in the short term.

The Department of Environment and Resource Management's Hydromet Telephone Telemetry System was used to check data being received by the ALERT network. In particular, the stations located in the Upper Brisbane River were checked. These sites include:

- Cooyar Creek at Dam Site
- Emu Creek at Boat Mountain

- Brisbane River at Gregors Creek

The data was found to be consistent. The Flood Operations Centre also received the weather radar images from the Bureau of Meteorology for the entire duration of the event from the Bureau's web page on the internet. These images again proved to be very useful in understanding the development and movement of the weather system.

7 PERFORMANCE OF FLOOD MODELS

The Real Time Flood Models generally performed satisfactorily over the flood events. The data collection module Flood-COL performed well throughout the event and the data analysis module also provided useful outcomes. However the following issues should be noted. These issues will be further considered by the Expert Panel currently reviewing the Flood Models prior to their expect upgrade in 2010.

- In order to minimise road closures and associated impacts on the urban population downstream of the dams, some gate operations undertaken were different to those contained in the standard gate operation spreadsheets. These spreadsheets do not account for flood objectives associated with minimising impacts on urban populations downstream of the dams. Accordingly the flood operations team needed to modify the standard spreadsheets to properly model dam outflows.

- The quality of the calibration of the runoff-routing models was varied, with the South Pine River at Drapers Crossing, Lockyer Creek at Helidon and the Bremer River at Adams Bridge providing good fits with both peak flows and overall shape of the hydrograph. The other models and especially those situated above the dams provided an adequate calibration, with the volume of runoff matching well, but some differences in the shape of the hydrographs. This was probably related to the representation of rainfall within certain parts of the catchments in question.

- Due to the unreliability of the data recorded at Woodford, the derived Somerset Dam inflows contained a large amount of uncertainty. This was overcome to some extent by running a range of scenarios to provide upper and lower bound estimates.

8 COMMUNICATIONS

No issues were encountered with communications during the events and the communications systems performed satisfactorily. Notification of mobilisation was by phone, whilst flood advice issued by the Flood Operations Centre was by facsimile.

As a precaution, the two way radio was tested to ensure communication with both Somerset Dam and North Pine Dam. A satellite telephone is also available at Somerset Dam.

Communications with Emergency Response Agencies over the course of the events was undertaken in accordance with the Dam Emergency Action Plans. All communications worked well, particularly in terms of coordinating road closures. Follow-up meetings have been held with all agencies since the events to allow procedures to be reviewed and where necessary improved for future events.

9 FLOOD MANAGEMENT STRATEGIES

9.1 Wivenhoe and Somerset Dams

No gate operations were required (or at any time appeared likely) for Wivenhoe Dam during the flood events and accordingly the primary strategy was to ensure that the Somerset Dam Full Supply level was not excessively exceeded.

The situation was encountered where Somerset Dam was rising and above full supply level, with no significant inflows into Wivenhoe Dam. Although a low risk, this scenario is not fully considered in the current Manuals of Flood Operation and will be the subject of further discussion with the Dam Safety Regulator prior to the next revision of the Manuals due in September 2009.

9.2 North Pine Dam

Because of the relatively small nature of these events, the following strategies were employed in the operation of North Pine Dam during the course of the events.

- When the dam level was rising and significant rain was forecast or the dam level exceeded 39.75 metres, North Pine Dam was operated strictly in accordance with the standard table of gate operations contained in the Manual of Flood Operations.

- When the dam level was falling, consideration was given to the objective in the Manual of Flood Operations associated with minimising the impact to urban populations downstream of the dam. To support this objective, the drain down time of the dam was increased by extending the time of single increment gate openings (see Section 5). The benefits of this strategy were two fold as follows:

    - The closing of Young's Crossing Road was minimised.
    - The adverse impacts on the fish population in the dam caused by gate operations was minimised.

- When no significant rain was forecast and the dam level was below 39.75 metres, use of the cone valves in preference to the gates was maximised within a flow that would not adversely impact on public roads downstream of the dam. The reason for this was to minimise the adverse impacts on both urban populations downstream of the dam and the fish population in the dam that is caused by gate operations.

Again, the strategies and scenarios described above are not fully considered in the current Manual of Flood Operation and will be the subject of further discussion with the Dam Safety Regulator prior to the next revision of the Manuals due in September 2009.

10 IMPACT OF DAM OPERATIONS

10.1 Wivenhoe and Somerset Dams

Because no gate operations were required for Wivenhoe Dam during the flood events, no significant impacts downstream of the dams occurred as a result of flood operations. A number of dead fish were observed downstream of Somerset Dam following flood releases; however it is yet to be determined whether these were fish from the dam or fish swimming upstream from Wivenhoe Dam. This issue is the subject of a separate investigation project currently being undertaken by Seqwater.

10.2 North Pine Dam

On the North Pine River, Young's Crossing was saved from extended periods of inundation by the presence of North Pine Dam. Some closing of the road was unavoidable, however as discussed in the previous section, the release strategy adopted minimised road closure times.

A number of dead fish were discovered as a result of gate operations and this matter is currently the subject of a separate investigation and report. Seqwater minimised adverse impacts on fish by reducing as much as possible the gate operation times and also by maximising the use of the cone valves for water releases. However the structural safety of the dam must always be the primary consideration during flood events as the failure of North Pine Dam would be catastrophic both in terms of loss of life and property and infrastructure damage.

In relation to the fish impacts, Seqwater conducted extensive fish recovery operations following each event. These operations will continue into the future to support the objective of minimising fish impacts from flood releases.

'DERM-20'

Guidance on the Assessment of Tangible Flood Damages

Sep 2002

Queensland Government
Natural Resources and Mines

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1. Guidance on the assessment of flood damages

1.1 Introduction

The impact of flooding on communities is extensive. It typically includes damage to property, community infrastructure, the local economy and the environment, and causes individual and community distress and hardship.

The purpose of this bulletin is to assist applicants to the Regional Flood Mitigation Program to assess tangible flood damages (i.e. those that can be estimated in dollars). The focus is on how to estimate the value of potential[1] physical damage caused to property and infrastructure exposed to flood inundation within an urban environment. The common methods and approaches adopted for estimating flood damages, and the conversion of those estimates to an average annual damage figure necessary for cost/benefit calculations, are explained.

This guidance is consistent with that in broadly accepted methods, including those described in Report 73 of the SCARM Series, *Floodplain Management in Australia: Best Practice Principles and Guidelines* (CSIRO Publishing 2000)

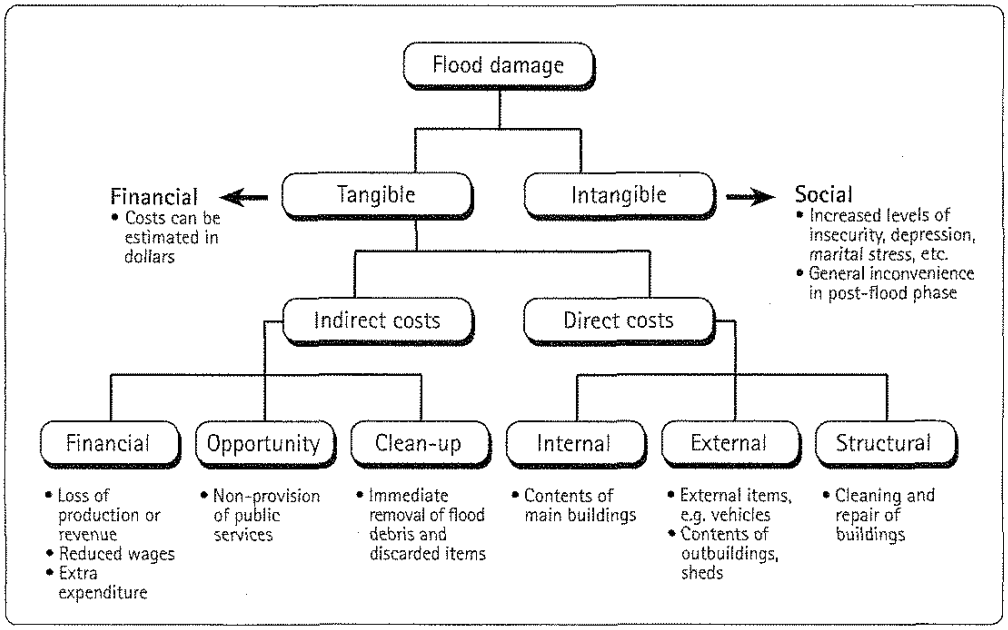
1.2 Types of flood damage

Damage incurred as a result of significant flood events is broadly classified as follows:

- Tangible damages—those that can be estimated directly in dollars.
- Intangible damages—those that cannot be assessed in dollar terms.

The subject of this bulletin is *tangible damages*, which can be further classified as either *direct or indirect*. (See figure 1.)

Figure 1: Types of flood damage



1. Potential damages are discussed further in section 1.3.

Tangible damages are those that can be readily measured in monetary terms. Damage to buildings and contents is considered *tangible* because it can be quantified in terms of replacement or restoration cost. Other damage—such as emotional trauma or loss of life—is considered *intangible* because it cannot be readily expressed in monetary terms.

Direct damages are those that occur immediately and as a direct result of exposure to flood inundation. They include damage to both community infrastructure and private property.

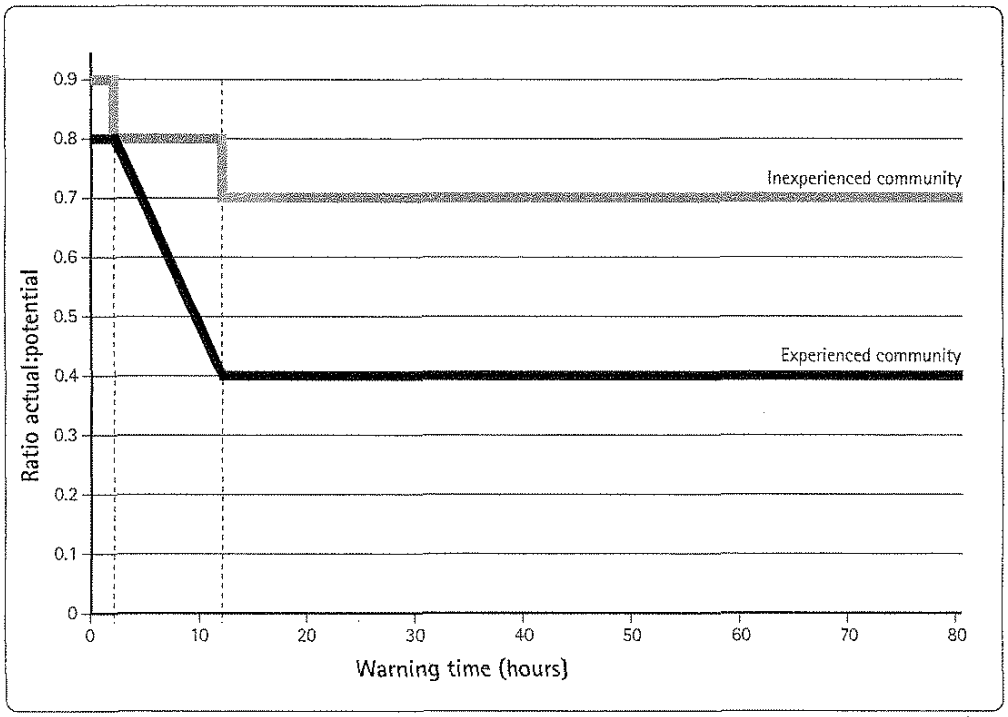
Indirect damages occur as a consequence of direct flood impacts. They include reduced economic activity and individual financial hardship, as well as adverse impacts on the social well-being of a community, and encompass disruptive impacts, including lost trading time and loss of market demand for products.

1.3 Actual and potential damages

The consideration of *potential* versus *actual* damages presents a further complication. Typically, as part of supporting investigations for floodplain management or flood risk reduction measures, damages likely to occur as a result of a given flood are assessed, and particular assumptions are made about what structures and possessions will be affected. Generally, the worst-case assumption is that nothing can or will be done to remove susceptible valuables from the area facing inundation. However, significant reductions in potential damages can be achieved by relocating movable possessions to flood-free areas, where warning times are sufficient (and the affected population is 'flood aware').

When estimating potential flood damages, consider including a reduction based on the possible efforts of residents and volunteers ahead of the flood. Factors such as the warning time, access to flood free refuges and the flood readiness of the community at risk must be taken into account

Figure 2 : The relationship between actual and potential damages



Reproduced from Victorian Department of Natural Resources and Environment 2000, Rapid Appraisal Method (RAM) for Floodplain Management, *prepared by Read Sturgess and Associates, Melbourne.*

As noted earlier, the focus of this bulletin is on the estimation of *tangible direct* and *indirect potential damages* to private and public infrastructure. While not exhaustive, such an assessment is a useful indicator of the level of economic impact.

(It is intended that the assessment of social and environmental impacts will be detailed in other bulletins.)

1.4 Approaches to flood impact assessment

There are a number of approaches that can be used to estimate tangible flood damages. In decreasing order of accuracy they are:

1. Survey of individual properties by a loss assessor to determine potential damages.
2. Application of stage-damage curves to assess potential damages.
3. Adoption of an average damage amount per building.

It is important to adopt an assessment approach that is appropriate for both the level of flood risk and the quality of flood hazard information.

The stage-damage curves provided in this bulletin are suitable for use by applicants under the Regional Flood Mitigation Program. However, it is strongly recommended that, where possible, local authorities develop their own data.

2. Estimating damages to residential and commercial properties

The relationship between the level of inundation by floodwaters and the resulting damage to residential and commercial property is influenced by the value of the building structure, the value of its contents, and the susceptibility of each to damage.

In addition, the local velocity of floodwaters, in combination with their depth, can result in significant structural damage to a building if the forces exceed the capacity of the structure to withstand them.

2.1 Stage–damage relationships

The damage to residential properties and household contents can be assessed using stage–damage curves, which describe the relationship between levels of inundation and damage incurred. Surveyed damage estimates for a range of flood levels are essential to their production.

Where velocities are considered high enough to demolish a structure, the replacement value of the structure and contents should be adopted. Such magnitudes of velocity are usually experienced only in extreme flood events—that is, floods of a magnitude greater than a 100-year average recurrence interval (100-year ARI).

It is strongly recommended, where possible, to develop stage–damage curves that represent local conditions and the types of buildings present. Where this is not possible because locally specific data does not exist, use available stage–damage curves produced as a result of previous flood damage studies.

The Department of Natural Resources and Mines recommends adopting the stage–damage curves developed for ANUFLOOD[2]. The curves for this flood damage model were developed for a range of building types and sizes, and include those that represent:

- residential buildings for a range of property sizes
- commercial buildings for a range of sizes and contents.

2.2 Estimating levels of inundation for affected properties

Property inundation levels are calculated using information on ground heights, flood heights and property floor levels.

- **Ground heights** can be measured by a range of survey techniques and are also required for numerical flood modelling exercises (e.g. a flood study). Where this information is not available from flood modelling studies, estimates of ground heights may be made from sources such as topographic maps, sewerage plans and building approvals.
- **Flood heights** are predicted either by numerical flood modelling or from flood extent maps of previous flood events.
- **Floor levels** can be estimated from building approval records or by traditional survey techniques. Less accurate kerbside estimation techniques can also be used, which involve estimating floor heights above ground levels rather than the survey of actual levels. The level of over-floor inundation is the difference between the flood height and the floor height at each property.

Indirect damages (e.g. clean-up costs) for residential and commercial properties are difficult to estimate and are commonly assessed as a proportion of direct damages.

2. A computer model (developed by ANU) designed to assess flood damages to urban buildings.

2.3 Estimating flood damages

The following steps are involved in estimating flood damages:

1. Identify flood-affected properties and the likely height of inundation.
2. Select appropriate stage–damage curves for determining potential direct damages.
3. Apply stage–damage curves to estimate potential direct damages from flooding.
4. Estimate indirect losses.
5. Calculate total (direct and indirect) damages.

2.3.1 Step 1

Flood hazard mapping exercises predict the extent and depth of floodwaters for varying levels of flood severity. These flood maps provide the information on location of affected buildings, ground levels, flood levels and flow velocities required to calculate a damage estimate.

To use the stage–damage curves in later steps, an estimate must be made of the height of inundation (above floor level) at each of the affected properties.

2.3.2 Step 2

The stage–damage curves provided in this bulletin are separated into residential and commercial categories.

Three residential curves have been developed to cover the range of house sizes (small, medium and large). (See table 1 for further illustration.)

The size categories are as follows:

Small house: < 80m² and/or 1–2 bedrooms

Medium house: 80–140m² and/or 3 bedrooms

Large house: > 140m² and/or 3+ bedrooms

Table 1: Stage–damage relationships for residential properties

Depth over floor level	Small house ($)	Medium house ($)	Large house ($)
0 m	905	2 557	5 873
0.1 m	1 881	5 115	11 743
0.6 m	7 370	13 979	25 351
1.5 m	17 379	18 585	32 276
1.8 m	17 643	18 868	32 768

Reproduced from Centre for Resource and Environmental Studies (Australian National University) 1992, ANUFLOOD: A Field Guide, *prepared by D.I. Smith and M.A. Greenaway, Canberra.*

To account for different building sizes and the varying value of any contents, there are several categories of commercial stage-damage curves (see table 2). First, there are three size categories for commercial properties:

Small property: < 186 m^2

Medium property: 186-650 m^2

Large property*: > 650 m^2

**For large properties, damage estimates are per square metre of floor area and must be multiplied by floor area.*

Within each commercial property size category there are classes to account for the value of any contents and how easily they are damaged by floodwaters. They range from one to five in increasing value of potential damage. (See figure 3 for guidance on the selection of an appropriate value class for commercial property contents.)

Example

Property: Jim's Hardware Store

Floor area: 250 m^2

Contents: hardware supplies

In this example of the selection of an appropriate commercial stage-damage curve, the floor area is greater than 186m^2, therefore a medium-sized commercial property curve with value class 2 contents (see table 2) should be selected.

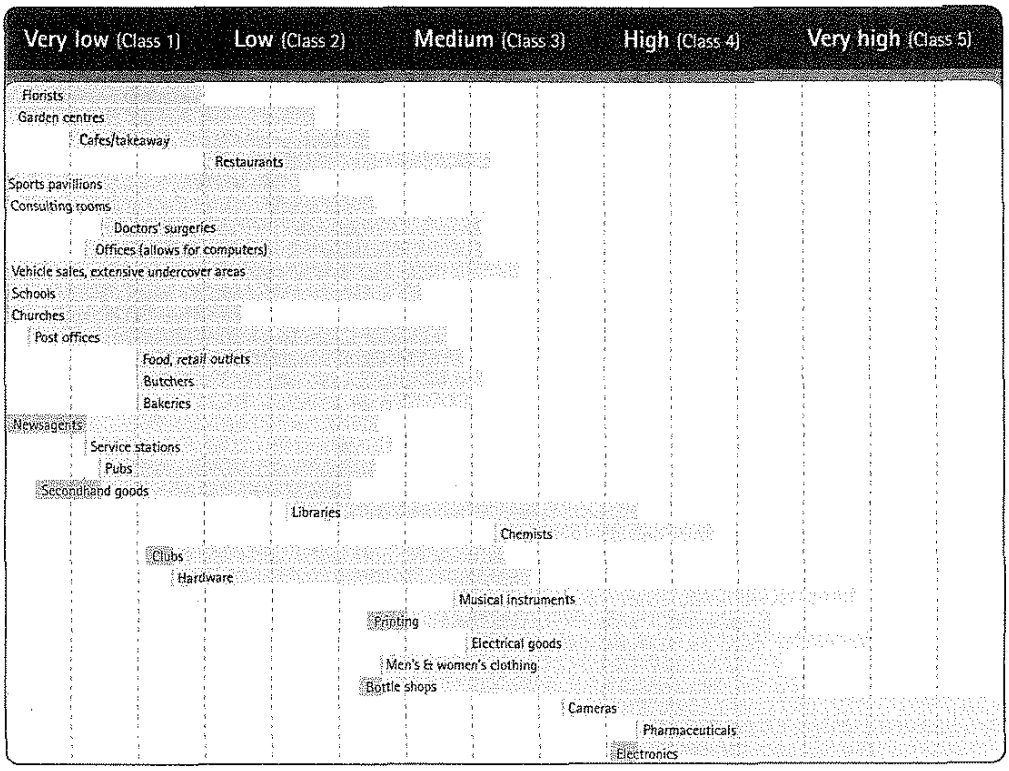
Table 2: Stage–damage relationships for commercial properties

	Small commercial properties (<186m²)					Medium commercial properties (186-650m²)					Large commercial properties (>650m²)*				
Value class	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0.25	$2 202	$4 405	$8 809	$17 618	$35 237	$6 975	$13 948	$27 896	$55 791	$111 583	$7	$15	$32	$61	$122
0.75	$5 506	$11 011	$22 023	$44 046	$88 092	$16 884	$33 768	$67 537	$135 074	$270 147	$39	$78	$154	$308	$619
1.25	$8 258	$16 518	$33 034	$66 069	$132 137	$25 693	$51 387	$102 773	$205 574	$411 094	$81	$162	$326	$649	$1297
1.75	$9 176	$18 352	$36 705	$73 410	$146 819	$28 445	$56 893	$113 785	$227 570	$455 140	$132	$267	$533	$1065	$2129
2	$9 726	$19 454	$38 907	$77 814	$155 628	$30 281	$60 564	$121 126	$242 252	$484 504	$159	$318	$636	$1 272	$2 545

* units of $/m²

Reproduced from the Centre for Resource and Environmental Studies (Australian National University) 1992, ANUFLOOD: A Field Guide, *prepared by D.I. Smith and M.A. Greenaway, Canberra.*

Figure 3: Damage categories for commercial properties



Reproduced from Centre for Resource and Environmental Studies (Australian National University) 1992, ANUFLOOD: A Field Guide, *prepared by D.I. Smith and M.A. Greenaway, Canberra.*

2.3.3 Step 3

An estimate of potential damages can be generated once an appropriate stage-damage curve has been selected for the exposed properties.

The first stage in estimating potential damages is assessing the likelihood of the building structure failing when exposed to flooding. This requires information on flood velocities. If this information is unavailable, an estimate of likely velocities should be used.

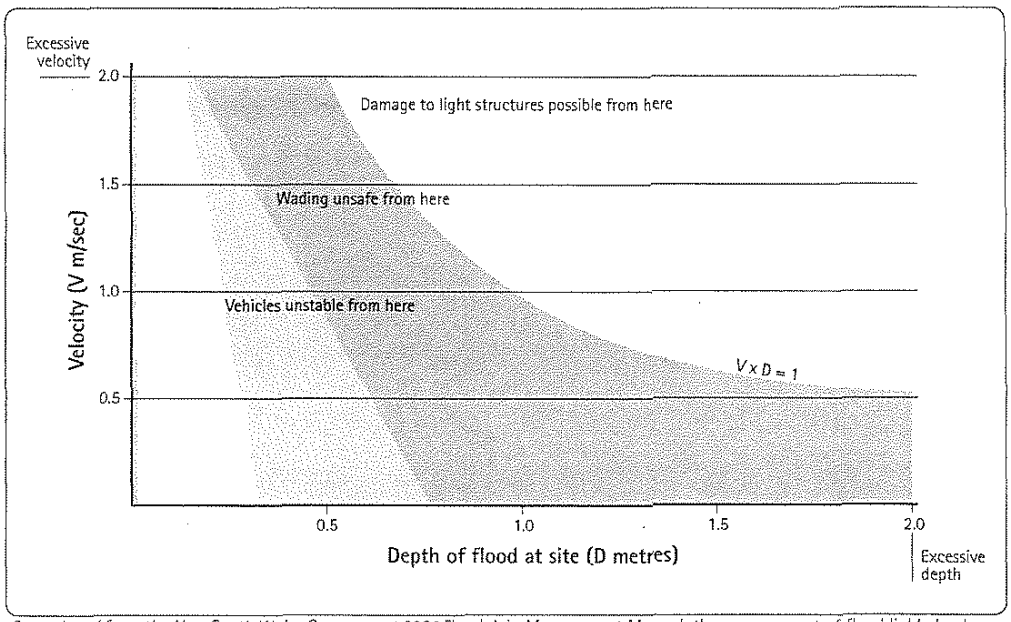
Structural failures can begin at a range of flood depth-velocity combinations. At shallow depths, velocities greater than two metres per second can affect the stability of building foundations through the actions of scour. Even at very low velocities, damage to light-framed buildings from water pressure, flotation and debris loads can be caused by flood inundation depths of greater than two metres. Typically, such damage is considered likely to occur where the product of the depth and velocity is greater than one.

Figure 4 may be used as a guide to assessing whether depth and velocity require consideration in the damage estimate. Where the graph indicates that the depth and velocity experienced by a building are great enough to cause failure, the potential damage estimate should be based on the cost of replacing both the building and its contents.

If depth-velocity figures indicate that structural damage is not likely, the application of stage-damage curves alone is appropriate to estimate potential damage.

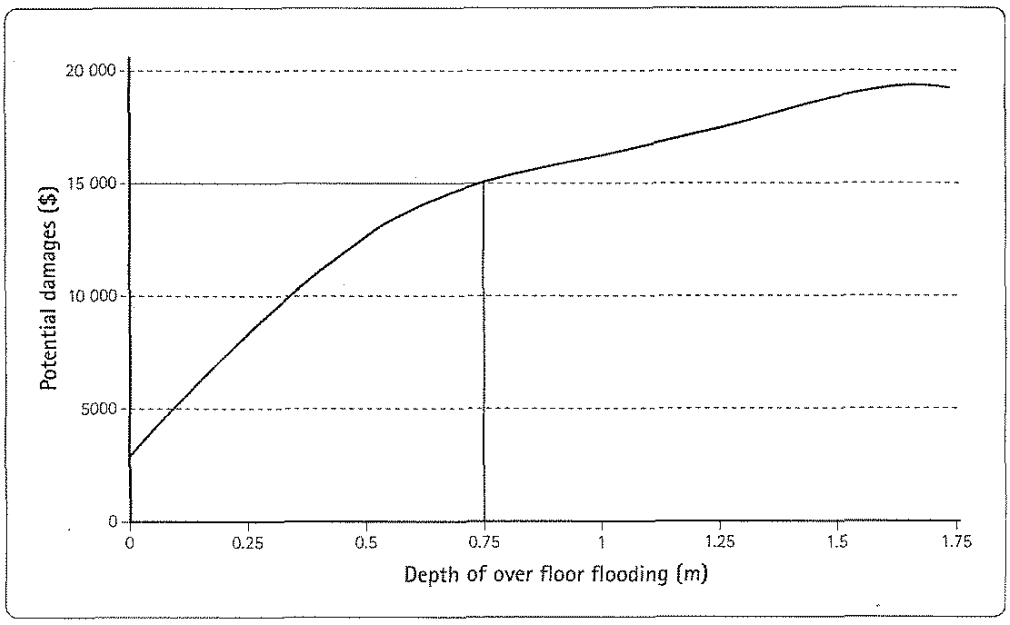
An example of a typical stage-damage curve for a large residential property is provided at figure 5.

Figure 4: Critical depth–velocity relationship



Reproduced from the New South Wales Government 2001, Floodplain Management Manual: the management of flood liable land, *Sydney.*

Figure 5: Residential stage–damage curve for a medium-sized house



Entering this graph on the horizontal axis (height of inundation), a vertical line is drawn to the curve. The value displayed on the *y*-intercept is the potential damage.

As some residential properties may be raised, with storage provided underneath for items such as mowers and washing machines, allowances can be made for damage caused to these items. ANUFLOOD has a maximum under-house damage allowance of $1225. Where the flood height is lower than the habitable floor height, a proportion of this allowance can be included in the damage estimate:

$$\text{Damage} = \frac{\text{Inundation above ground level}}{\text{Habitable floor height above ground}} \times \text{Maximum under-house damages}$$

The total damage for a residential property is the sum of under-house damages and internal damage estimates for over-floor flooding (generated from stage-damage curves), plus structural damage, if applicable.

An example of this process is provided below:

Property: 3-bedroom residential

Flood height: 26.5 m

Ground level: 24.95 m

First floor height: 0.8 m above ground level

Velocity of flow: 0.65 m/s

Depth of over-floor inundation

= 26.5m - 24.95m - 0.8 m

= 0.75 m

Check for structural failure

Depth x Velocity

= 0.75 x 0.65

= 0.49

Therefore, structural failure is not likely. (Refer figure 4.)

Calculate under-house damages

Flood height – ground height is greater than first floor level

Therefore, damage is the allowable maximum of $1225.

Stage-damage curve estimate

Inundation above floor = 0.75 m

Therefore, damage = $14 747*

(Interpolated from figure 4: Residential stage-damage curve for medium-sized house.)*

Calculate total damages

Total damage = under-house damage + stage damage

= $1225 + $14 747

= $15 972

These calculations are then repeated for each affected property.

2.3.4 Step 4

Once an assessment of the potential direct damages to exposed properties has been made, indirect damages are estimated. Commonly, for residential and commercial properties, indirect damages are estimated as a percentage of direct damage.

The following percentages are recommended in the ANUFLOOD model:

Indirect residential damages = 15% of direct residential damages

Indirect commercial damages = 55% of direct commercial damages

2.3.5 Step 5

The total damage cost is the sum of all direct and indirect damages.

Total damages = direct damages + indirect damages

3. Estimating damage to other infrastructure

Other than privately owned property, there are a number of assets that may be exposed to flood damage. For example, direct and indirect damages may be caused to:

- roads and transport infrastructure
- parks and recreational facilities
- hospitals, schools, police and fire stations, and other government buildings
- water, sewerage and drainage systems
- communications networks.

Traditionally, most of these assets were publicly owned; however, the increasing trend towards privatisation of services (e.g. communications) has influenced the costing methodology used to assess damages. This issue will be discussed further in this section.

3.1 Direct damages

Commonly, the repair and replacement of roads and bridges is the largest component of damages to public assets. The amount of damage caused is a result of flood-related factors and the ability of the road to withstand flood conditions. Relevant factors include both the initial repair costs incurred after a flood event and the possibility of a significant reduction in the overall life of the road surface.

Annual maintenance expenditure figures and other documented historical costs can be used to develop locally specific damage costs. Where this information is not available, data from other studies may be used. See table 3 below.

Table 3: Unit damages for roads and bridges (per kilometre of road inundated)

	Initial road repair ($)	Subsequent accelarated deterioration of roads ($)	Initial bridge repair and subsequent increased maintenance ($)	Total cost to be applied per km of road inundated ($)
Major sealed roads	34 860	17 430	11 985	64 275
Minor sealed roads	10 895	5 450	3 815	20 160
Unsealed roads	4 900	2 450	1 740	9 090

Reproduced from the Victorian Department of Natural Resources and Environment 2000, Rapid Appraisal Method (RAM) for Floodplain Management, *prepared by Read Sturgess and Associates, Melbourne.*

The damage estimates presented above are based on studies completed following floods in Victoria and include the following components:

- initial repairs to roads
- subsequent accelerated deterioration of roads (i.e. reduced pavement life)
- initial repairs to bridges (based on one-third of road damages)
- subsequent additional maintenance required by bridges.

Where possible, direct damages to any other affected infrastructure should be included in the overall damage estimate. Information on the magnitude of such damages may be sourced from data collected after historical flood events and extrapolated to the size of flood event being investigated.

Direct damages to publicly owned buildings (e.g. local government offices) must also be considered and can be evaluated using the stage–damage curves for commercial buildings discussed earlier.

3.2 Indirect damages

The indirect damages to services provided by government or community agencies should be based on the lost wages from downtime and disruption to operations. This may be calculated by multiplying lost working hours by wages.

Businesses or activities not provided by government or community agencies are profit driven. Accordingly, the calculation of their damages needs to be based on different assumptions. These indirect losses should be calculated only as the lost profit component.

4. Economic assessment of flood mitigation projects

The purpose of this section is to provide guidance on the economic assessment of flood mitigation projects based on their costs and benefits.

4.1 Average annual damages

The annual average damage (AAD) cost from flooding (expressed in units of dollars per year) is a common performance indicator used to measure the level of potential flood damages. It expresses the costs of flood damage as a uniform annual amount based on the potential damages inflicted by a range of flood magnitudes.

The calculation of an AAD estimate requires potential damage bills for a number of flood sizes—the more, the better. As a bare minimum, an estimate is needed of:

- the size of flood event where damage to property begins
- potential damage for the design event
- potential damages caused from the probable maximum flood (the largest probable flood event, e.g. 10 000-year-average recurrence interval).

As a general rule, the greater the range of flood events investigated, the more accurate the estimate.

To calculate AADs:

1. Estimate potential damage costs from a range of flood sizes.
2. Plot graph of potential damages versus annual exceedance probability.
3. Calculate annual average damage costs from flooding.
4. Calculate potential reduction in annual average damage from flood mitigation activities.

4.1.2 Step 1

To complete this step, it is necessary to have estimates of potential damages for a range of flood sizes.

Following is a simple example of damage costs that illustrates the process used to calculate AADs.

Event where damages begin:

10-year average recurrence interval (ARI)

Potential damages from 100-year ARI flood event:

Total residential damages		$120 000
Total commercial damages	+	$195 000
Total damages	=	$315 000

Damages from probable maximum flood event:

Total residential damages		$200 000
Total commercial damages	+	$320 000
Total damages	=	$520 000

4.1.3 Step 2

Next, a graph of potential damages estimates versus annual exceedance probability (AEP) is plotted.

Potential damages in dollars are plotted on the vertical axis, while annual exceedance probability is plotted horizontally. Like an average recurrence interval, the annual exceedance probability is a measure of the likelihood of a given flood occurring. The chance of a flood event of a given size (or larger) occurring in any one year is measured as a percentage value between zero and one. (Zero indicates that the event is extremely unlikely, while one indicates that it is certain to occur.)

The annual exceedance probability for a given flood event is the inverse of the average recurrence interval:

$$\text{Annual exceedance probability} = \frac{1}{\text{Average recurrence interval}}$$

Using the example damage costs from before:

10-year ARI = 10%, AEP = 0.1

100-year ARI = 1%, AEP = 0.01

For rarer flood events, like the probable maximum flood, the annual exceedance probability (AEP) approaches zero.

For the purpose of the example, the probable maximum flood will be assumed to be a 10 000-year average recurrence interval event, or a 0.01 per cent annual exceedance probability event.

Next, potential damage estimates are plotted against annual exceedance probability.

Table 4. Annual exceedance probability

Average recurrence interval	Annual exceedance probability	Total potential damages
10 year	10%	$0
100 year	1%	$315 000
10 000 year	0.01%	$520 000

4.1.4 Step 3

The annual average damage cost is the area under the line of the graph plotted above. It is expressed in units of dollars per year.

Using the previous examples of flood damages (see figure 6), the area under the plotted line is calculated as follows:

Area total = Area triangle + Area Parallelogram

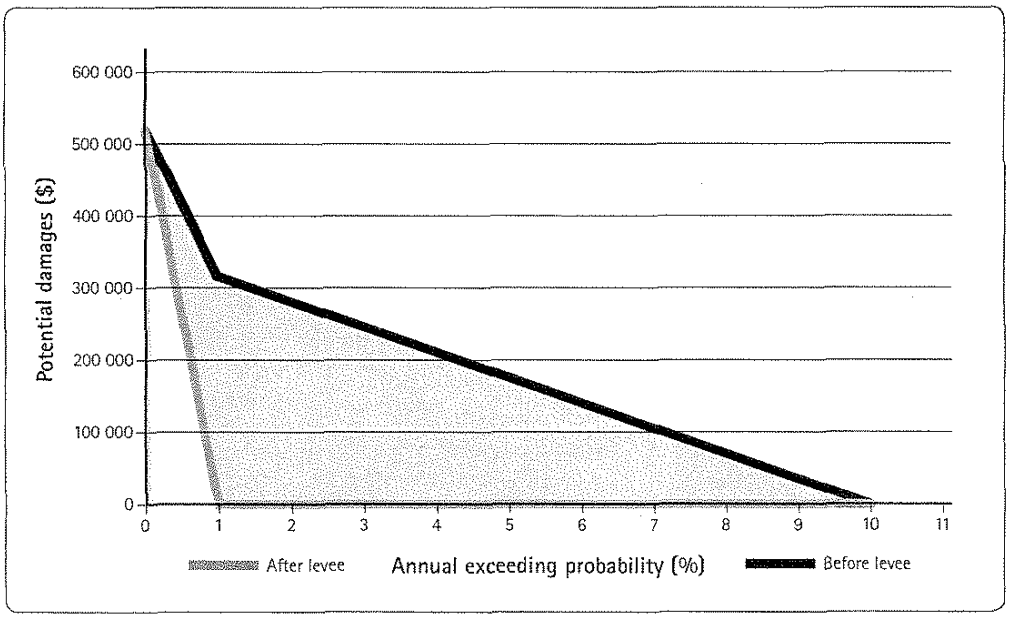
Area = 0.5 x [(0.1-0.01) x 315 000] + 0.5 x [0.5 x (520 000+315 000) x (0.010-0.0001)]

= $ 14 175 + $ 2067

= $ 16 242

Therefore, annual average damage = $16 242.

Figure 6: Plot of potential damages versus annual exceedance probability



4.1.4 Step 4

The reduction in annual average damages (AAD) that can be realised through flood mitigation projects is calculated as:

Reduction in AAD = AAD without project – AAD with project

For example, if a levee bank is proposed to be constructed to provide 100-year average recurrence interval immunity (see figure 6):

Reduction in AAD = AAD without levee – AAD with levee

= $16 242 - $2600

= $13 642

4.2 Future Regional Flood Mitigation Program bulletins

This is the first in a series of bulletins that are currently being developed by the Department of Natural Resources and Mines to provide guidance to Regional Flood Mitigation Program applicants. It is intended that the topics of social and environmental assessment will be covered in future bulletins.

Notes

'DERM-21'

DERM State Interest Checklist

Purpose

This checklist lists all DERM State Interests that are included in Schedule 7 of the *Sustainable Planning Regulation 2009*. *Schedule 7 Referral Agencies and their jurisdictions* explains when a development application needs to be referred to a State Agency for assessment and the role of the agency i.e. concurrence agency or advice agency.

A colloquial term for the matters which require an applicant to refer an application to DERM is "trigger".

Outline of the process

When an application is lodged centrally with Permits and Licensing Management (PALM) in Brisbane, it is checked for being properly made or properly referred. The triggers for DERM are listed on an acknowledgement notice which is lodged with the application. However, this notice is not always correct so PALM staff also use the check list to make sure that there are no other triggers that have been missed by the assessment manager – usually Local Government and the applicant.

If there is only one trigger i.e. only one of DERM's State Interests is affected by the development proposal, it is considered a single issue application. If more than one trigger it is considered multiple and will require a coordinated response from DERM and process managed by the DA Coordination staff or planning staff in the regions. Single issue development applications bypass the DA Coordination centres and go straight to the specialist business units for assessment and direct response back to the assessment manager and applicant.

Most times the initial check by PALM identifies all DERM triggers requiring assessment by the specialist business units such as Vegetation Services, Water Services, Environmental Services, Contaminated Land Unit, Land Resource Officers etc.

Expectation of business units

It is proposed that this checklist be used as a "double check" by specialist business units when assessing a single issue development application. All staff should be diligent and be on the lookout for missed triggers and this check list will assist.

Please note that the check list can be used in conjunction with mapping or GIS tools which access all the natural resource and environment information sources and data bases in DERM. It is not expected that the single issue business units duplicate this mapping exercise that has already been performed by PALM when the applications are received. The checklist is to be used as a guide and a reminder to specialist staff to be on the lookout for other interests of DERM that could also be affected by the development proposal.

Vegetation Management

Assessable Vegetation

Does the site include areas mapped as containing Categories A or B on a Property Map of Assessable Vegetation (PMAV) OR remnant Regional Ecosystem (RE) vegetation OR native woody vegetation on State Land that is not a mangrove?

If **No**, then there is no referral or is Self Assessable Development for regulated regrowth vegetation.

Is the activity exempt for clearing in an urban area (identified in the local government's planning scheme) for an urban purpose and not mapped as containing Category A on a PMAV OR Endangered remnant RE vegetation that is not a mangrove OR clearing for single residence purposes?

If **Yes**, then there is no referral this application is exempt from the *Vegetation Management Act 1999*.

Is the application for a Material Change of Use (MCU)?

If Yes, is the size of the premises 2ha or larger?
If Yes, is the existing use of the premises rural or environmental?
If Yes, is this a preliminary approval OR this has a Property Vegetation Management Plan (PVMP) identifying that clearing of assessable vegetation at the operational works stage will result?
If **all Yes**, this has a Concurrence role and requires IDAS form 11 (SPA) or J (IPA)

Is the application for a Reconfiguration of a Lot (RaL)?

If Yes, are 2 or more lots proposed to be created?
If Yes, is any lot, before reconfiguration, 2ha or larger?
If Yes, is the size of any proposed lot to be created, 25ha or smaller?
If Yes, will this involve clearing of assessable vegetation at the operational works stage or make the clearing of vegetation exempt after reconfiguration (eg. fence lines, firebreaks, roads, houses)?
If **all Yes**, this has a Concurrence role and requires IDAS form 11 (SPA) or J (IPA)

Is the application for Operational Work (OpW) and involving the clearing of assessable vegetation (PMAV Categories A or B OR remnant vegetation OR native vegetation on State Land)?

If Yes, is the proposed clearing a relevant purpose under Section 22A of the *Vegetation Management Act 1999*?

Relevant purposes include: a significant project under the *State Development and Public Works Organisation Act 1971*; necessary to control non-native plants or declared pests; to ensure public safety; for establishing a necessary fence, firebreak, road or vehicle track, or constructing necessary built infrastructure; a natural and ordinary consequence of a previous development approval; for fodder harvesting; for thinning; for clearing of encroachment; for an extractive industry; for clearing regrowth on leases issued under the *Land Act 1994* for agriculture or grazing purposes; for clearing regrowth on freehold land, or indigenous land, in a wild river high preservation area.

If **Yes**, this has a Concurrence role and requires IDAS form 11 (SPA) or J (IPA)

Biodiversity Planning

Is the application exempt from assessment due to clearing for a single residence? (if yes, referral not required)

Referable Wetlands

Is any part of the site situated in a Wetland Management Area? (previously within 100m of a Referrable Wetland)

Is the application for a Material Change of Use?

Is the application for a Reconfiguration of a Lot that results in more than 6 lots, or any lot created is less than 5ha?

If **yes to either/both**, this has an Advice role.
If **yes to either/both**, AND is in a Great Barrier Reef wetland protection area this has a Concurrence role.

Conservation Estate

Is any part of the premises situated in or within 100m of a Conservation Estate?

Conservation Estate includes: a protected area, forest reserve, critical habitat or area of major interest under the *Nature Conservation Act 1992*; a State forest or timber reserve under the *Forestry Act 1959*; a marine park under the *Marine Parks Act 2004*; a recreational area under the *Recreation Areas Management Act 2006*; a world heritage area listed under the World Heritage Convention; and a Brisbane forest park under the *Brisbane Forest Park Act 1977*.

Is the application for a Material Change of Use?

Is the application for a Reconfiguration of a Lot that results in more than 10 lots, or any lot created is less than 5ha?

If **yes to either/both**, this has an Advice role.

Water Services (*Water Act 2000*) or Water Safety and Supply Unit (*Water Supply (Safety and Reliability) Act 2008*)

Taking or Interfering with Water – Operational Works (OpW) only

Is the application for the taking or interference of water in a watercourse, lake or spring?

- If Yes, is the work for a water pump? * requires IDAS form 13 (SPA) or K_2 (IPA)
- If Yes, is the work for water storage? * requires IDAS form 14 (SPA) or K_3 (IPA)
- If Yes, is the work for a gravity diversion from a watercourse? * requires IDAS form 15 (SPA) or K_4 (IPA)
- If Yes, is the work for a watercourse diversion? * requires IDAS form 17 (SPA) or K_6 (IPA)
- If Yes, is the work for other work for taking or interfering with water? * requires IDAS form 21 (SPA) or K_9 (IPA)

If **yes to any** of these, this has a Concurrence role and requires IDAS forms for each (as above)

Is the application for any thing constructed or installed that allows for the taking or interfering with artesian or subartesian water?

If **yes**, this has a Concurrence role and requires IDAS form 12 (SPA) or K_1 (IPA)

Is the application for any thing constructed or installed that allows for the taking or interfering with overland flow water and is regulated under the relevant Water Resource Plan (WRP)?

If **yes**, this has a Concurrence role and requires IDAS form 19 (SPA) or K_8 (IPA) for taking and/or IDAS form 20 (SPA) or K_{10} (IPA) for interfering

Declared Catchment Area (DCA)

Is the application within the SEQ Regional Plan area and an application under SPA?

If **yes**, there is no referral to DERM, this will go to Seqwater (Queensland Bulk Water Supply Authority).

No, is the application within a Declared Catchment Area (DCA)?

If Yes, does the application involve a RaL that results in any lot being less than 16ha?

If Yes, does the application involve the establishment or expansion of a waste water disposal system that is NOT an ERA under the *Environmental Protection Act 1994* (EP Act)?

(if it is an ERA under the EP Act, this will be assessed by Environmental Services)

If **yes to either**, then this has a Concurrence role.

Wild Rivers

Is the application for a Material Change of Use (MCU) and involves agricultural or animal husbandry activities where any part of the premises is not in a High Preservation area AND the proposed use is not in relation to the production of a high risk species?

If **Yes**, then this has a Concurrence role and requires IDAS form 29 (SPA) or Q (IPA) for agriculture and/ or IDAS form 30 (SPA) or R (IPA) for animal husbandry.

Is the application for Operational Works (OpW) and is for residential, commercial or industrial purposes outside a designated urban area OR assessable in a Wild River Declaration?

If **Yes**, then this has a Concurrence role and requires IDAS form 19 (SPA) or K_8 (IPA).

Referable Dam

Is the application for Operational Work (OpW) for the construction of a Referable Dam?

Does the application for Operational Work (OpW) increase the storage capacity of a Referable Dam by more than 10%?

A Referable Dam, as defined under the *Water Supply (Safety and Reliability) Act 2008*, is a dam that: is more than 8m in height at the barrier AND a storage capacity of more than 500ML OR more than 250ML and a catchment area that is more than 3 times its maximum surface area at full supply level; and requires a failure impact assessment (a category 1 or 2 rating) accepted by the Chief Executive.

If **Yes to either/both**, then this has a Concurrence role and requires IDAS form 16 (SPA) or K_5 (IPA)

Surface Water – Material Change of Use (MCU) and/or Reconfiguration of a Lot (RaL) only

Are there any drainage features that may be a watercourse, lake or spring?

If **yes, confirm** if watercourse, lake or spring and this has a 3rd Party Advice role.

Ground Water – Material Change of Use (MCU) and/or Reconfiguration of a Lot (RaL) only

Is there any ground water, artesian or subartesian areas identified?

If **yes, confirm** if regulated under the relevant WRP and this has a 3rd Party Advice role.

Environmental Services

Environmentally Relevant Activity (ERA)

Does the application involve any Environmentally Relevant Activities (ERAs)?

(this is usually on the IDAS forms or Acknowledgement Notice)

If Yes, are any ERAs assessable by DERM (ie. not all ERAs have been devolved to the local Council or Assessment Manager)?

If **both Yes**, this has a Concurrence role and requires IDAS form 8 (SPA) or G (IPA)

Quarry Material

Does the proposal involve removing quarry material from a watercourse, lake or spring, as defined under the *Water Act 2000*?

If **yes**, this has a Concurrence role and requires IDAS form 18 (SPA) or K_7 (IPA)

Does the proposal have a Quarry Material Allocation Notice (QMAN) issued by DERM?(if not, it is not properly made)

Coastal Management

Is any part of the site located in a Coastal Management District (CMD) or seaward of a coastal building line?

If Yes, is the proposal involving a Material Change of Use (MCU)?

If Yes, will the proposal involve operational work completely or partly within the CMD?

If Yes, will the proposal involve building work completely or partly within the CMD –

That is the construction of a new building with Gross Floor Area (GFA) of at least 1000m^2?

That is the enlargement of the GFA of an existing building by more than 1000m^2?

If **Yes to either**, then this has a Concurrence role.

If Yes, does the proposal involve a Reconfiguration of a Lot (RaL)?

If Yes, then this has a Concurrence role.

If Yes, does the proposal involve the construction of a canal?

If **Yes**, then this has a Concurrence role and requires IDAS form 23 (SPA) or M (IPA).

If Yes, does the proposal involve Operational Works (OpW) that is prescribed tidal work?

If **Yes**, then this has a Concurrence role and requires IDAS form 28 (SPA) or P (IPA).

If Yes, does the proposal involve other Operational Works (OpW) activity/s or tidal works?

These activities are: interfering with quarry material on State coastal land above high-water mark; disposing of dredge spoil or other solid waste material in tidal water; draining or allowing drainage or flow water or other matter across State coastal land above the high-water mark; constructing or installing works in a watercourse where the works are not assessable under the *Water Act 2000* or *Water Supply (Safety and Reliability) Act 2008*; reclaiming land under tidal water; constructing an artificial waterway; constructing a bank or bund wall to establish a ponded pasture on land, other than State coastal land, above the high-water mark; and removing or interfering with coastal dunes on land, other than State coastal land, that is an erosion prone area and above the high-water mark.

If **Yes** to any activities, then this has a Concurrence role and requires IDAS form 23 (SPA) or M (IPA).

and Resource Assessment

Acid Sulfate Soils (ASS)

Is the site within a local government area listed in Annex 1 of SPP 2/02?

These councils are: Aurukun, Brisbane, Bundaberg, Burdekin, Burke, Cairns, Carpentaria, Cassowary Coast, Cook, Fraser Coast, Gladstone, Gold Coast, Gympie, Hinchinbrook, Issac, Logan, Mackay, Moreton Bay, Mornington, Redland, Rockhampton, Sunshine Coast, Torres, Townsville, and Whitsunday.

If Yes, is the natural ground level of any part of the premises less than 20m AHD?

If Yes, is the proposal involving either/both:

Excavations of 1000m^3 or more of soil or sediment at or below 5m AHD?

Fill of 1000m^3 or more with an average depth of 0.5m or more of material on land, soil or sediment at or below 5m AHD?

If **Yes to either/both** of the above, then this has an Advice role.

Has an ASS investigation and/or management plan been provided?

If No and triggers met, then ASS investigation and/or management plan is required.

Good Quality Agricultural Land (GQAL)

Is the site within the Regional Landscape Rural Production Area of the SEQ Regional Plan?
Is there any GQAL information and/or investigations provided with the application?
If **yes to either** of these, GQAL may have a 3rd Party Advice role.

Contaminated Land

Is the application for a Material Change of Use / Reconfiguration of a Lot?

Is the site listed on the Contaminated Land Register (CLR) and/or the Environmental Management Register (EMR) OR has a notifiable activity or is zoned industrial and proposing more sensitive development (eg. residential, child care centre) OR has unexploded ordinances present?

If **both Yes**, then may have a Concurrence role and required IDAS form 24 (SPA) or N (IPA).

Cultural Heritage (non-indigenous)

Is there a Heritage Place registered on the property/s part of the application?

If **yes**, this has a Concurrence role.

Is there a Heritage Place registered on property/s adjacent to the application site (sharing a common boundary)?

If **yes**, this has an Advice role.

Indigenous Cultural Heritage

Does the application include information on Indigenous Cultural Heritage?

If yes, send information to a reviewer

Include the Indigenous Cultural Heritage duty of care statement in correspondence. ❑ Done

Koalas

Is the application area outside the Urban Footprint of the SEQ Regional Plan?

If yes, is the application area within the Koala SPRP and/or SPP area?

If yes, is the application area within a Koala Habitat area?

If yes to either/both, then the Koala unit may be involved.

State Land

Does the application area include tenures that are State Land and will they be affected?

(Reserve Land, Lands Lease, Unallocated State Land, Deed of Grant in Trust, Road Reserves, etc.)

Is there any other State Land? (Stock Routes, Floating Road Reserves, Fire Management, Boundary Watercourses, etc.)

Is Resource Entitlement required for any State Land and is it granted? (if required & not granted, it is not properly made)

- If yes to any, please contact the State Land Asset Management team for that Local Government area (council) for advice.

Other interests

Does the application area include threatened species?

Does the application area include National Park/s?

Does the application area include forest products?

If **yes to any** of these, DERM may have a 3rd Party Advice role.

Confirmation of Referral Requirements

I have completed an assessment of the proposal and find that the application is:

Properly Referred / Not Properly Referred

If "Not Properly Referred" specify proposed action to be taken. Consult with Senior Planning Officer if required.

.....

End