Report on Macleay Flood of March, 2001
River Levels, Rainfall and Recovery.

Introduction

Macleay Catchment Characteristics

The Macleay River catchment is situated on the mid-north coast of New South Wales and has an area of 11,500 square kilometres, including a large portion in the upper New England tablelands. The upper and lower ends of the catchment are relatively flat, while the central two-thirds are extremely mountainous and rugged. From the base of the mountains the Macleay River meanders over 140km through Kempsey and the river valley to the ocean at South West Rocks.

The catchment is funnel-shaped, so that high intensity rainfall in the upper catchment, combined with steep grades and contributing side streams, can produce dramatic stream rises in a short period. The main tributaries include the Apsley, Muddy and Chandler Rivers, fed by numerous smaller streams from very steep gorge country. (Laurie Montgomery & Pettit, 1980)

Rainfall Data

The first rain gauge in the catchment was installed at Kempsey in 1857. Since that time over 140 different gauges have functioned at one time or another. Mostly, a local resident manually reads these gauges once per day and reports the data to the Bureau of Meteorology (BOM). The first automatic pluviograph was installed at Armidale in 1947. There are now over 30 of these in the catchment.

Average annual rainfall in the Macleay catchment ranges from about 800mm per year at Armidale, to 1500mm around Point Lookout, to 1200mm at Kempsey and 1500mm per year on the coast. Seasonal patterns of rainfall typically show an increase in mean monthly rain in late summer. However, high intensity rain for short periods can occur in late winter. See Fig 2.

Storm Patterns

The Mid-North Coast of New South Wales and the Macleay River catchment lie within the sub-tropical belt of atmospheric high pressure. Normal weather patterns in this zone flow from west to east across the Australian continent, and rain can come from weather fronts crossing the Great Divide throughout the year or from summer thunderstorms. These events tend to cause only relatively minor to moderate rainfall, which can lead to small river rises, and local flooding.

Interaction between the tropical and monsoonal systems and the sub-tropical high-pressure systems can create low-pressure systems, depressions and tropical cyclones along the coast. These may form over the Coral or Tasman Sea and threaten the coast with strong winds, rain and elevated sea levels. Such storms, which predominantly occur in the autumn and winter months, and travel south or southeast, are usually the cause of major flood events in the Macleay River.

Much of the climate variability between years in NSW is related to the El-Nino Southern Oscillation (ENSO), which is a natural cycle of the ocean-atmosphere system that leads to substantial changes in atmospheric circulation in the Asia–Pacific region. These cycles occur every 2 to 7 years and can be monitored by observing the Southern Oscillation Index (SOI). Generally, a negative SOI indicates that an El-Nino, or drought, is likely to occur, and a strong positive index indicates possibility of above average rainfall. (Bureau of Meteorology, 1995)

While these relationships have been fairly recent discoveries, as far back as 1963, in discussing the events leading up to the 1949 Kempsey flood, the Bureau of Meteorology mentioned higher than average ocean temperatures off the NSW coast (up by 3 to 4 degrees C). Indeed, an article in the Sydney Morning Herald of early August 1949 reported an unusual number of people swimming at Sydney beaches in winter.

Development of Macleay Flood Mitigation System

In 1949 and again in 1950, floods approaching a 1 in 100 year recurrence interval occurred, causing significant damage and loss of life. In 1963 a 1 in 15 year flood occurred.

Following those major floods, there was significant pressure to provide some flood protection for the major towns in the flood plain, and the Lower Macleay rural area. A flood mitigation scheme was commenced in the 1950's, and completed in the 1970's, with the aim of:

- protecting the Kempsey township in a 1 in 10 year flood,
- protecting the lower Macleay agricultural areas from a 1 in 2.5 year flood,
- allowing rapid drainage of flood waters from inundated farmland.
- providing some erosion protection to some streams and banks
- improving flood mapping, proofing and data
- providing a flood warning system for residents and landholders.

The scheme, for which Kempsey Shire is now responsible, consists of 182 floodgated structures with 352 floodgates (including three major control structures), 147 km of drains and 34 km of levees and 37 km of bank protection. The levees have had the effect of reducing nuisance flooding over most of the lower Macleay. Land previously affected by a 2.5m AHD flood is now unaffected up to 5.2m on the Kempsey Traffic Bridge (KTB) gauge. To achieve this protection, during a minor flood (between 4.1m and 5.2m at the KTB gauge), it is necessary to discharge flood water through control gates into natural swamp depressions at Belmore River and Kinchela Creek. This sacrifices some poor agricultural land to protect more valuable upper-levee land. These measures, however, have no effect in a flood of over 6m at KTB gauge.

Around the Kempsey township, flood levees were constructed to provide general protection to around the 1 in 10 year level in the CBD and to remove some other hazards. Main physical measures implemented were:-

- Eden Street levee raised (4.1m in 1930, 6.1m in 1955) to 7.5m AHD in 1976.
- First Lane (Cochrane Street) levee constructed to 6.15m AHD in 1976.
- Concrete levee wall constructed near RSL Club to 7.3m- 7.2mAHD in 1976
- Dock Flat, East Kempsey set at 6.7m AHD.
- Concrete levee wall at Cooks Lane completed to RL 11.0m AHD (100 year level)

Council also undertook extensive voluntary purchase and clearing of properties in the Central Kempsey floodway, implementation of floodway zonings and development restrictions in all flood prone areas.

Fresh of 2nd–4th February, 2001.

Following moderate rain on the northern edge of the upper Macleay catchment on 27th & 28th January, 2001, there was a rise in tributaries, especially Five Day Creek and Nulla Nulla Creek. A fall of 44mm of rain was recorded at Point Lookout on 28th January. There were falls of 25mm at Guyra, 33mm at Walcha and light rain over the rest of the upper area on that day. Heavier rain fell from 30th January until the 3rd February, with 124mm recorded at Point Lookout on 1st February and 132.5mm at Mount Boonanghi on that day. Most upper river rain stations received 30 to 50mm on both 31st January and the 1st February, with mid and lower catchment stations receiving 50 to 100mm on those two days. Heaviest rainfalls were along the northern edge of the catchment.

Due to inflow from the northern areas, Nulla Nulla Creek and Five Day Creek and the Macleay at Bellbrook began to rise on Thursday the 1st February and by 2pm had exceeded a level of 3m, closing the Bellbrook bridge. Toorooka Bridge was closed at 10:30am by a level there of 2m and Temagog and Turners Flat followed. The Sherwood Bridge was closed by Friday evening.

The Bureau of Meteorology (BoM) issued a preliminary flood alert for most of the North Coast, including the Macleay, on Wednesday morning (31st Jan) and updated with other general alerts on Thursday and Friday. At 8:23am, Friday the 2nd, the BoM issued a Final Alert which stated that "more rain is expected … but much less than in the past 24 hours and will not produce higher flood peaks in this area".

Council staff made preparations for a river rise by closing the headworks and control gates at Belmore River and Kinchela Creek and checking all tidal flaps and equipment. The Kempsey State Emergency Service became operational on Thursday evening (1st Feb) and remained active until Wednesday 7th February. There was regular liaison between Council's Flood Controller and the SES.

Council eventually opened both the Kinchela Creek Control gates half-way for a period of 5 hours on the evening of Saturday 3rd February to relieve flooding over low level roads. The Belmore River gates were not opened in this event. The fresh peaked at 4.22m at Kempsey Traffic Bridge (KTB) gauge at 1:30pm on Saturday 3rd and caused some minor flooding to lower Macleay properties.

The Weather Events of 5th to 12th March, 2001

Following the development of a low-pressure system off the NSW North Coast, the Bureau of Meteorology began issuing preliminary warnings for wet weather on Monday 5th March (at 4pm). Further preliminary warnings (Flood Alerts) were issued on Tuesday and Wednesday when rain intensified, especially on the northern edge of the catchment.

The catchment was already very wet from heavy rain in early February, when a level of 4.22m at Kempsey Traffic Bridge gauge was recorded on February 3rd. The rainfall received over the catchment between the 5th and 11th March is summarised below.

Rainfall Recorded at Major Sites

Location	Mon 5th	Tues 6th	Wed 7th	Thurs 8th	Fri 9th	Sat 10th	Sun 11th	TOTAL
Pt Lookout	15	84	71	233	170	78	23	674
Guyra	12	4	15	42	8	1	8	90
Blue Nobby	8	13	25	86	8	2	9	151
Walcha	1	4	1	4	21	4	2	37
Wollomombi	2	21	12	57	43	11	1	147
Tia	0	14	97	30	5	11	0	157
Boonanghi	1	66	31	72	105	72	25	372
Millbank	2	65	26	108	151	50	8	410
Bellbrook	2	52	22	104	144	27	8	359
Turners Flat	1	72	14	79	93	45	13	317
Wittitrin	1	3	3	2	9	5	4	27
Kempsey	4	122	30	80	42	11	3	292
Seven Oaks	1	24	4	31	18	2	1	81
Seale Road	12	81	12	49	25	7	1	187

On Friday 9th March, at 5:32am, a Flood Warning (#1) was issued, which predicted a minor flood level (4.0m) at KTB gauge by noon Friday. This warning stated the level at Georges Ck at 5:09am as 6.28m.
Warning #2 at 8:58am Friday, predicted a moderate level 5.2m at KTB gauge by 6pm, and higher if further rain.
Warning #3 at 12:27pm, Friday, predicted 5.18m at KTB gauge at 4pm, with a possibility of a level of 6.1m with further rain – a Major flood warning.
Warning #4 at 4:25pm, Friday, predicted 6m around midnight, 6.2m by 6am Saturday.
Warning #5 at 7:02pm, Friday, predicted peak near 6.0m with moderate flooding. Not expected to exceed 6m at Kempsey.
Warning #6 at 9.05pm, Friday, predicted to reach 6.2m on late Saturday afternoon with moderate to major flooding.
Warning #7 at 9.49pm, Friday, predicted peak to reach 6.5m at noon Saturday with major flooding.
Warning #8 at 1:08am Saturday, predicted peak of 6.5m on Saturday afternoon with major flooding.
Warning #9 at 4.18am, Saturday, predicted peak of 6.5m on Saturday afternoon with major flooding.
Warning # 10 at 7:20am Saturday, predicted 6.7m at 8pm Saturday, major flooding
Warning #11 at 10:52am predicted, 6.9m at 11pm.
Warning # 12 at 12:55pm predicted, 7.1m at 9pm.

At about 7am Saturday, water began to flow over the Eden Street levee (level on the KTB gauge at that time was 6.15m) and at about 8am the First Lane levee was just overtopped when the KTB gauge was reading 6.2m. Water then flowed into the Kempsey CBD basin from north and south. Forth St was closed to traffic by 11am and Belgrave St by around 1pm Saturday. The peak ponded level in the Kempsey CBD appears to be about 6.6m AHD.

Recorded Peak levels in the Macleay were:

- Georges Creek peaked at 12.06m at 7am on Sat 10th
- Bellbrook peaked at 12.85m at 10am on Sat 10th
- Toorooka peaked at 12.45m at noon on Sat 10th
- Turners Flat peaked at 12.09 at 6:45pm on Sat 10th
- Aldavilla peaked at 12.40m at 9pm on Sat 10th
- Kempsey Bridge reached 4.0m at 10am Friday 9th
- reached 5.2m at 4pm Friday 9th
- reached 6m at 5am Sat 10th
- peaked at 6.9m, 10pm on Sat 10th
- Seven Oaks peaked at 2.82m at 12noon on Sat 10th
- Belmore River peaked at 3.30m AHD at 1pm on Mon 12th
- Upper Kinchela Ck peaked at 2.94m AHD at 2am on Mon 12th
- Kinchela Ck Entrance peaked at 3.44m AHD at 10pm on Sat 10th
- Killick Creek peaked at 2.66m at 8pm on Sun 11th
- Jerseyville peaked at 2.1m
- Clybucca Ck, peaked at 3.1m

Gladstone, Smithtown, South West Rocks, Hat Head, Crescent Head and many upstream and downstream rural areas were isolated. Many food drops, or evacuation for medical reasons, were organised.

The sewerage treatment system at Smithtown/ Gladstone was overloaded by floodwaters and surcharging occurred. Council staff were unable to bring the system back on line until late Tuesday. Both villages were voluntarily evacuated of some residents until the sewer was fully functional.

Apart from short periods, during power failures at Bellbrook and Stuarts Point, there were no problems with, or disruptions to, water supply in any area.

The Kempsey Traffic Bridge Gauge malfunctioned from about mid-day Saturday, causing much higher predictions by the Bureau of Meteorology than the actual levels. A manual read was finally able to be made at 10:55pm confirming a level of 6.7m at that time. It appears the flood peaked at 6.9m between 9pm and 10pm Saturday evening (the 10th). Overtopping of all the town levees and inundation of the Kempsey CBD did occur. Belgrave Street and Forth Street were impassable for about 24 hours. Water slowly receded in the river, and below the top of all the levee banks, but was unable to drain from the town until the river receded at First Lane.

This flood now appears to be about a 1 in 12 year event, and the highest to occur since 1963. The 1963 flood reached a level of 7.14m on the Kempsey gauge, and was classed as a 1 in 15 year The computer modelled 1 in 10 year flood was predicted to reach 6.95m at the KTB gauge. There have been 8 floods higher than this on record since 1838.

The 1949 flood reached a level of 7.92m on the Kempsey gauge, and was classed as a 1 in 90 year event. The computer modelled 100year flood was predicted to reach 8.2m at Kempsey Traffic Bridge gauge.

The town levee system worked well in delaying inundation until personnel, stock and equipment could be moved. Without these levees, very rapid inundation on Friday night

would have occurred. Failure of the key Kempsey gauge, at the critical time, was disappointing, as it had only been serviced one week earlier. However, adequate information was available from other gauges (Aldavilla, etc). In all other facets, the flood warning system and liaison with emergency groups worked well.

Over 200 State Emergency Services (SES) and volunteer personnel were used, including 19 SES, Rural Fire Services and NSW Fire Brigade units. Almost 13,000 volunteer hours were worked. 12 flood boats and 11 helicopters were used and 150 people were evacuated.

Cleaning up proceeded for two-weeks after the event with spoilt food, carpets, paper, etc being collected by Council and taken to Council's landfill. At least 200 tonnes of flood damage material was taken to the landfill. Normal garbage collection in the isolated villages recommenced after one week.

Damage to roads and bridges has been assessed to be in the order of $3 Million. At least one major bridge at Turners Flat was severely damaged, as were many roads. Damage to Water & Sewer infrastructure is estimated at about $500,000.

Figure 6 : KEY FLOOD WARNINGS - KEMPSEY MARCH 2001