



DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Hydrological Analysis of the Inglis-Flowerdale Catchment

A report forming part of the requirements for State of Rivers reporting

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Hydrological Analysis of the Inglis-Flowerdale River Catchment

1. Historical Background

1.1 Catchments and Drainage Systems

The Inglis-Flowerdale River catchment is located in the northeast of the state and occupies an area of approximately 616 km². The Black-Detention River catchment lies in the west, the Cam River catchment in the east, and the Arthur River catchment in the south. A catchment map is shown in Figure 1.1 and shows the type and distribution of hydrological monitoring stations.

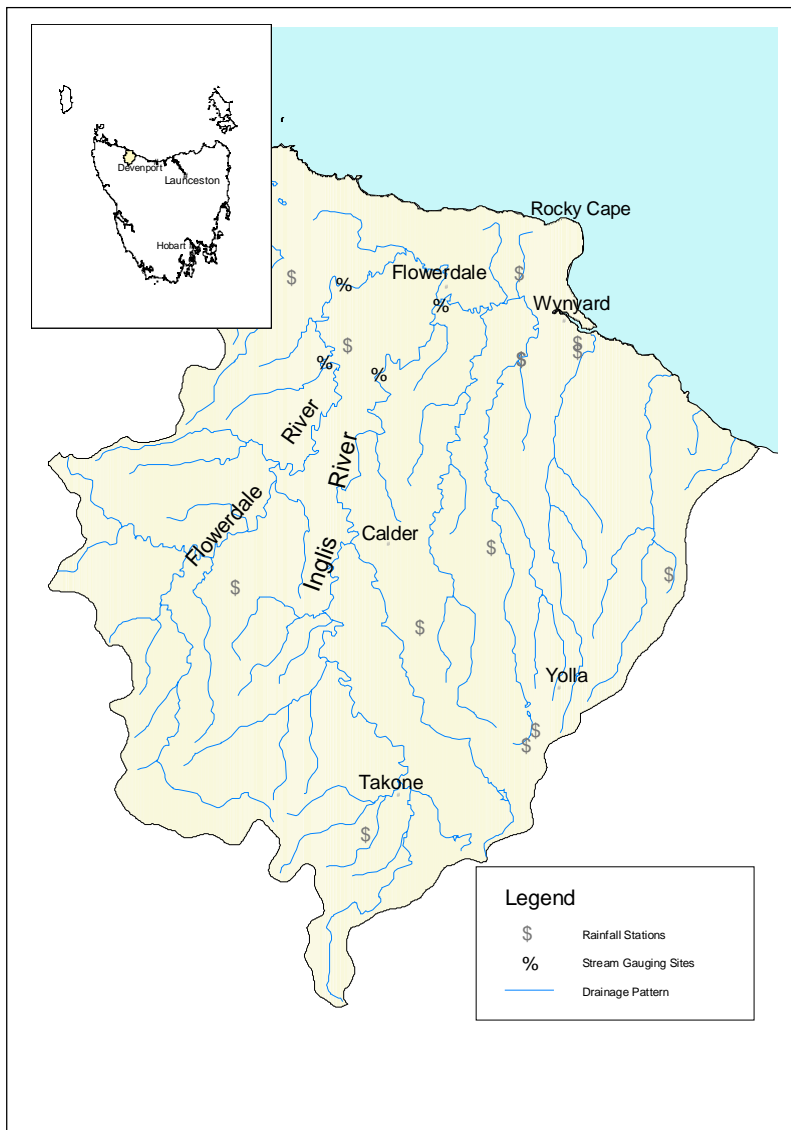


Figure 1.1 Hydrological set up of Inglis-Flowerdale River catchment.

The Inglis River originates southeast of the Campbell Range. Flowing north, the Inglis River passes through the townships of Takone, Calder and Moorleah before joining with Flowerdale River north of Flowerdale township. From here, the Inglis River flows roughly east into the sea at Wynyard. Major tributaries of the Inglis River upstream of the Flowerdale River include the Rattler, Jessie and Calder Rivers. Major tributaries of the Inglis River downstream of the Flowerdale River are Big Creek and Blackfish Creek.

The Flowerdale River originates at West Takone (northern flank of Campbell Range) and winds its way north joining the Inglis River at Flowerdale township. The Hebe River, Hardmans Creek, Borradale Creek and Sisters Creek are the main tributaries flowing into the Flowerdale River.

1.2 Rainfall

Annual average rainfall in the Inglis-Flowerdale catchment varies between about 1000 mm and 1600 mm. There is a general trend for increasing rainfall from the coastal north to the higher elevation of the Campbell Range in the south. The annual average rainfall in the Campbell Range area (500m AHD) is over 1500 mm. The pattern of average monthly rainfall from three locations in the catchment is shown in Figure 1.2, and shows that all sites show a similar seasonal pattern of change in rainfall. Rainfall increases markedly during the autumn months, peaking in about June or July, and then declining more gradually thereafter. Thunderstorms can occur in the catchments at any time of year, however they are most prevalent during late summer and autumn when climatic conditions are more conducive. The main rain producing storms in these areas are characterised by an initial feed of moist warm air from the Tasman Sea.

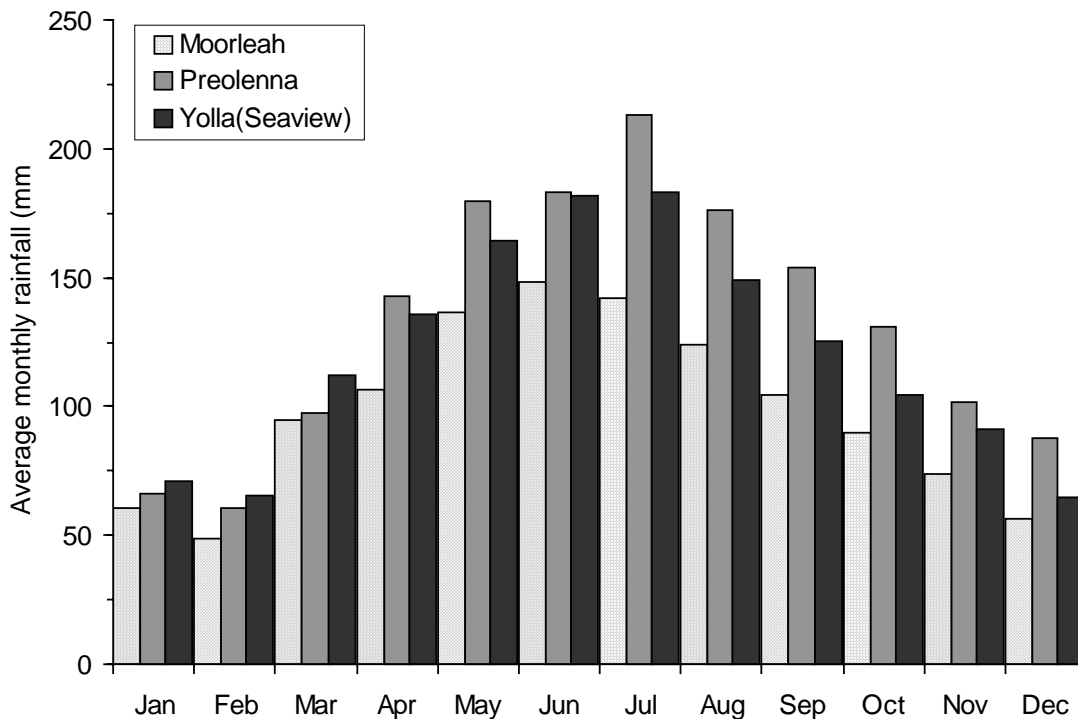


Figure 1. 2 Average monthly rainfall at selected sites in the Inglis-Flowerdale River catchment

1.3 Water Usage and Diversions

Land use practices in the catchment include pasture, irrigated cropland, forestry, and rural residential development. Direct offtake and farm dams have traditionally provided the major irrigation and stock water supply over dry summers in the Inglis-Flowerdale River catchment. The bulk of the licensed water allocation is for irrigation purpose and therefore water demand in the catchment is highest during the summer irrigation season. A summary of the licensed water allocation for the Inglis-Flowerdale River catchment is presented in Table 1.1.

Table 1.1 A summary of water allocations in the greater Inglis-Flowerdale catchment.

Source	Intended Use	License Volume (ML)
Inglis-Flowerdale catchment	Irrigation	8242
	Stock & Domestic	1088
	Commercial & Industrial	21
	Total	9361

Data source: Water Information Management System, <http://wims.dpiwe.tas.gov.au>

2. Hydrological Monitoring in the Catchment

2.1 Rainfall Monitoring

As part of the statewide rainfall-monitoring network, the federal Bureau of Meteorology currently operates 5 stations in the Inglis-Flowerdale catchment. They also have records for a number of stations that are no longer operational (Table 2.1). The data from these sites can be accessed from the Internet site <http://www.bom.gov.au> or from the regional Bureau of Meteorology office at Hobart.

Table 2.1 Bureau of Meteorology rainfall stations in the Inglis-Flowerdale River catchment.

Station	Station Name	AHD(m)	Start Record	End Record
91030	Elliot(Research Station)	130	31/08/1914	Current
91047	Lapoinya(Myalla)		31/12/1916	27/06/1956
91066	Moorleah(Preolenna Rd)	150	31/12/1915	Current
91079	Preolenna	260	09/01/1952	Current
91097	Takone	340	31/07/1927	26/02/1985
91107	Wynyard Airport	12	30/04/1947	Current
91108	Wynyard State Scholl	19	31/12/1906	26/01/1950
91109	Yolla(Seaview)	343	31/12/1906	Current
91112	Wynyard(Jackson St)	9	31/05/1960	08/10/1992
91125	Kellatier	260	31/01/1962	19/12/1995
91143	Wynyard Post Office		10/11/1938	30/06/1948
91212	Preolinna(Maweena)	366	31/12/1924	26/02/1926
91214	Flowerdale		31/12/1903	29/09/1911
91297	Oldine(Locketts Rd)	185	31/08/1996	28/12/1997

AHD: Australian Height Datum in metres.

2.2 River Flow Monitoring

Table 2.2 lists the past and current stream flow monitoring sites in the Inglis-Flowerdale River catchment. There is currently one stream gauging site operating in the catchment. Flow data from other monitoring sites are discontinuous or are daily measurements for short periods.

Table 2.2 Stream flow monitoring sites in the Inglis-Flowerdale River catchment.

Site	Site Name	Area (km ²)	Start Record	End Record
14210	Inglis u/s Flowerdale	172	06/06/1967	07/02/1989
14260	Inglis at Railway Bridge [#]		11/02/1999	12/04/2002
14215	Flowerdale at Moorleah	152	21/03/1966	Current

[#]Short-term Water Quality monitoring site.

3. Catchment Yields and Distribution of Flows

3.1 Catchment Yields

The historical total annual discharge volumes at Inglis River u/s of Flowerdale River (site 14210) and Flowerdale River at Moorleah (site 14215) are shown in Figure 3.1a&b. Blank sections in the figures indicate periods for which there was no data recorded. Annual discharge from the Inglis River u/s Flowerdale River is in the range from 72,000 to 230,000 ML with an annual average of 132,000 ML. The annual discharge volume at the Flowerdale River at Moorleah is similar to that of the Inglis River site, ranging from 64,000 to 200,000 ML with an annual average of 118,000 ML. The relative contribution to the overall catchment yield by the Inglis and Flowerdale Rivers is 53% and 47% respectively.

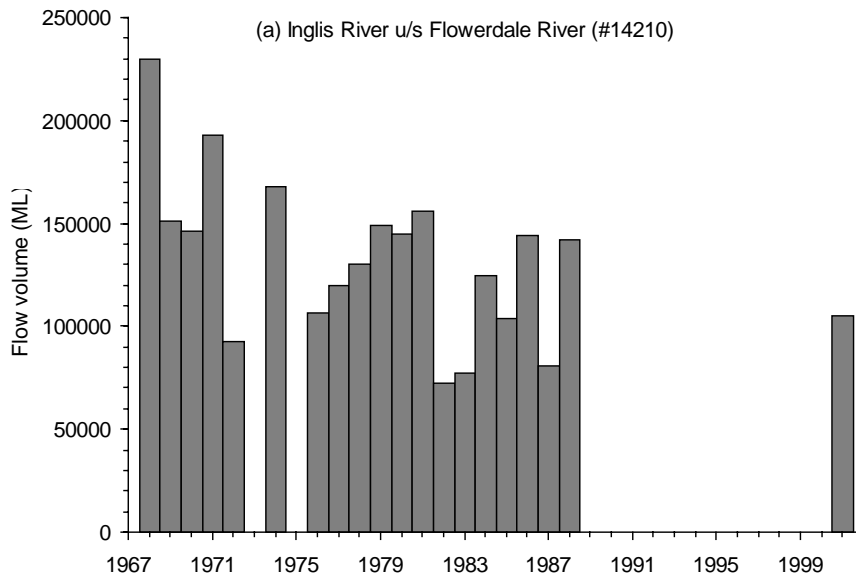


Figure 3.1a Annual discharge volumes recorded at the Inglis River at Railway Bridge.

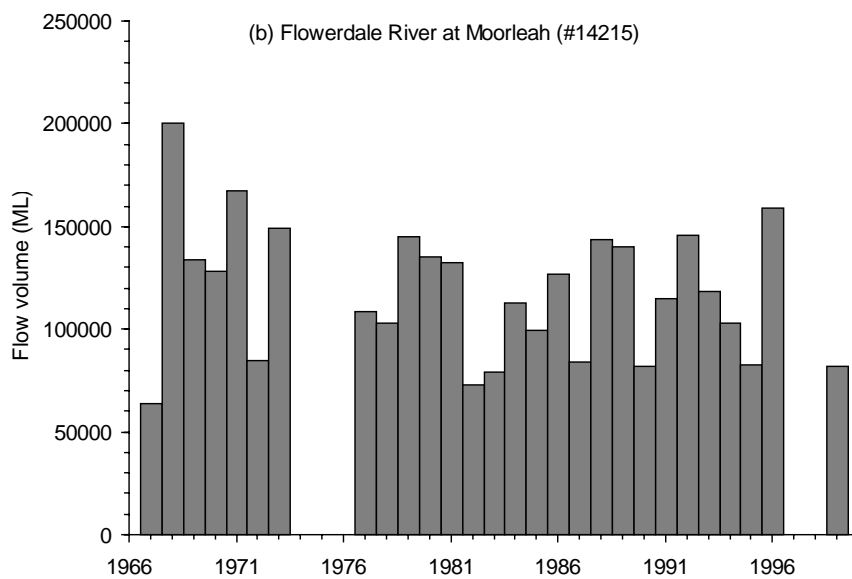


Figure 3.1b Annual discharge volumes recorded at the Flowerdale River at Moorleah..

The variability of seasonal flow patterns in the Inglis and Flowerdale Rivers is shown in Figure 3.2a&b. For these two rivers, the winter discharge volumes range from 6,100 to 175,000 ML and are significantly higher than the summer flows. The summer flows are in the range from 0 to 60,800 ML (mean discharge of 24,500 ML) and 3,100 to 49,500 ML (mean discharge of 24,600 ML) for the Inglis and Flowerdale Rivers respectively.

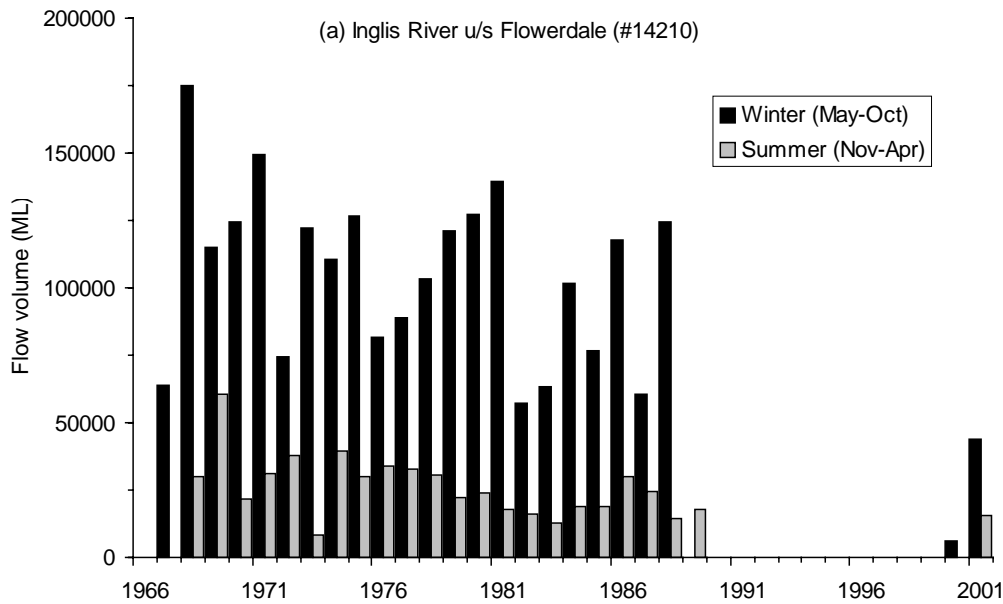


Figure 3.2a Seasonal flow volumes at the Inglis River at Railway.

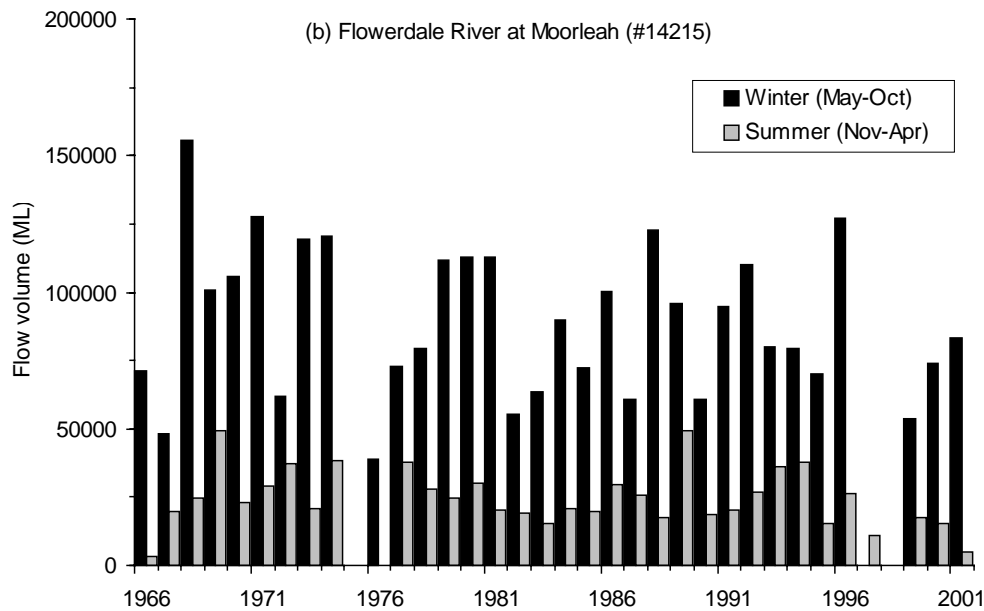


Figure 3.2b Seasonal flow volumes at the Flowerdale River at Moorleah.

3.2 Monthly Yields

The variability of monthly flows in the Inglis-Flowerdale River catchment is shown in Figure 3.3a&b, which provide box and whisker plots of monthly average flow data. The horizontal line across the box represents the median flow whereas the bottom and top edges of the box mark the first and third quartiles respectively. The ends of the whiskers show the spread of 95% of the data. The crosses beyond the whiskers indicate high and low outliers.

As expected from the information presented above, Figures 3.3a&b illustrate that monthly flows in both the Inglis River and Flowerdale Rivers show similar patterns of seasonal variation. Monthly median flows from the Inglis River range from a low of 1 m³/s in March to a high of about 10 m³/s in August. The pattern and scale of seasonal change in discharge in the Flowerdale River is similar to that of the Inglis River, with monthly median flows ranging from 1 m³/s in summer to 8 m³/s in winter.

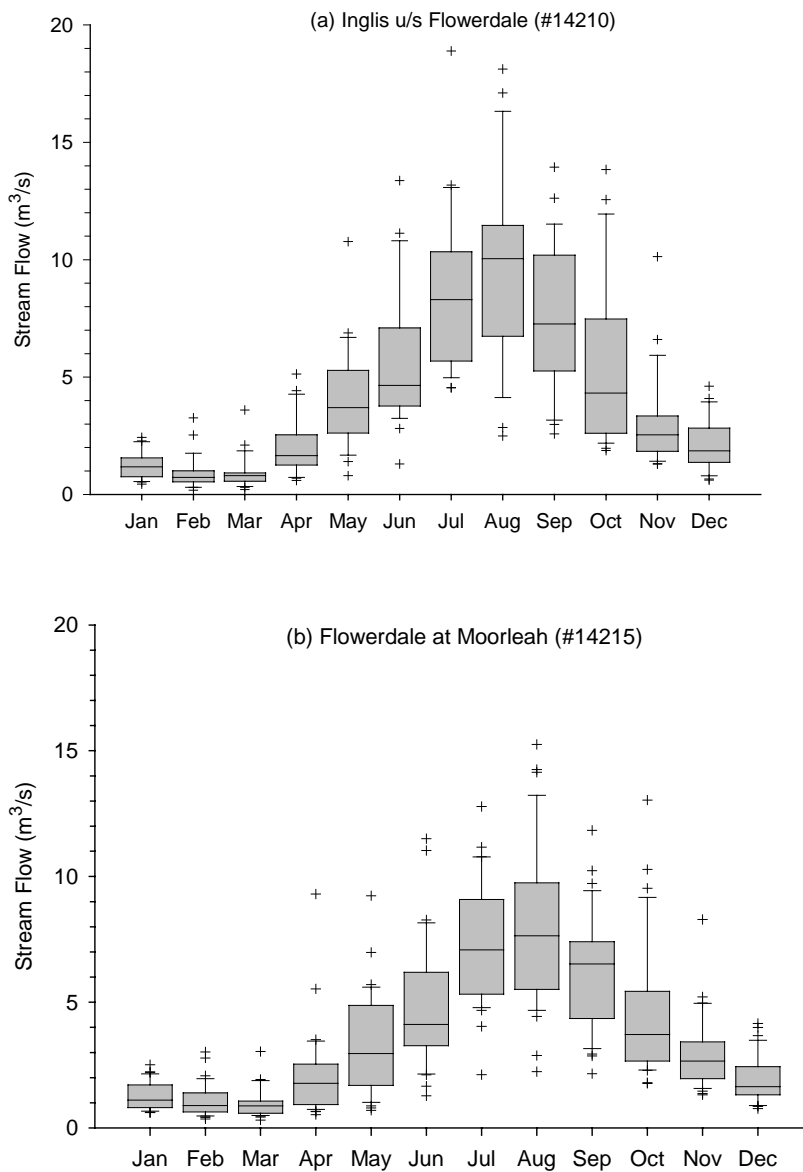


Figure 3.3a&b Monthly flow from (a) Inglis River at Railway Bridge and (b) Flowerdale River at Moorleah.

4. Comparison between Study Period and Historical Data

Figures 4.1a&b show a comparison between the monthly average flows experienced at the Inglis and Flowerdale River during the State of River study period (1999-2001) with the historical flow record. Blank sections in Figure 4.1a indicate missing data at this site following severe flooding that caused damage to the recording station. The bar chart shows that the monthly flows during the winter periods of the study were generally lower than monthly historical flows. There was no significant difference in flows between the study period and historical data during the summer periods. The overall monthly average flows during the study periods were 36% and 13% lower than the historical average flows for the Inglis and Flowerdale Rivers respectively.

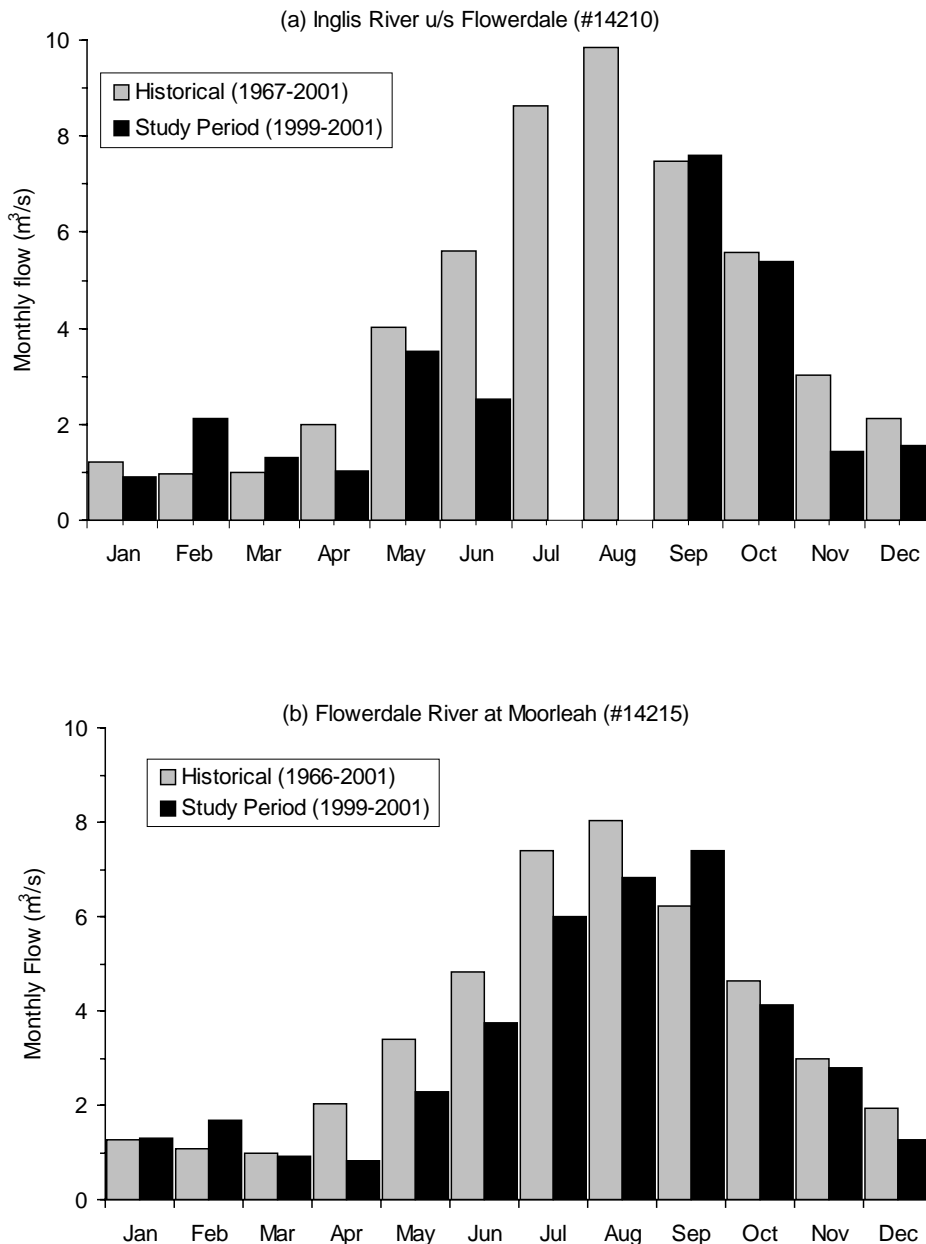


Figure 4.1a&b Comparison of monthly flows from (a) Inglis River u/s Flowerdale and (b) Flowerdale River at Moorleah.

5. Recessions and Low Flows

Segments of peak flow hydrographs covering the study period were analysed to describe the recession flows for the Inglis River at Railway Bridge (14260) and Flowerdale River at Moorleah (14215) sites. The recession curves are segments of hydrographs, which show how the water storage in the river decreases over time following peak river flows. Using several recession segments for the analysis, a 'recession curve' can be generated which represents the basic pattern of decrease of flow in the river. The recession curve also reflects the groundwater discharge to the river and how groundwater storage influences and sustains flows in rivers.

The winter and summer recession curves for the Inglis River and Flowerdale River sites are presented in Figures 5.1a&b. The upper part of the recession curves is comprised mostly of surface water flow. With time, the surface flow contribution gradually decreases until the flow is comprised almost entirely of groundwater flow (or base flow) which is depicted on the lower section of the curves.

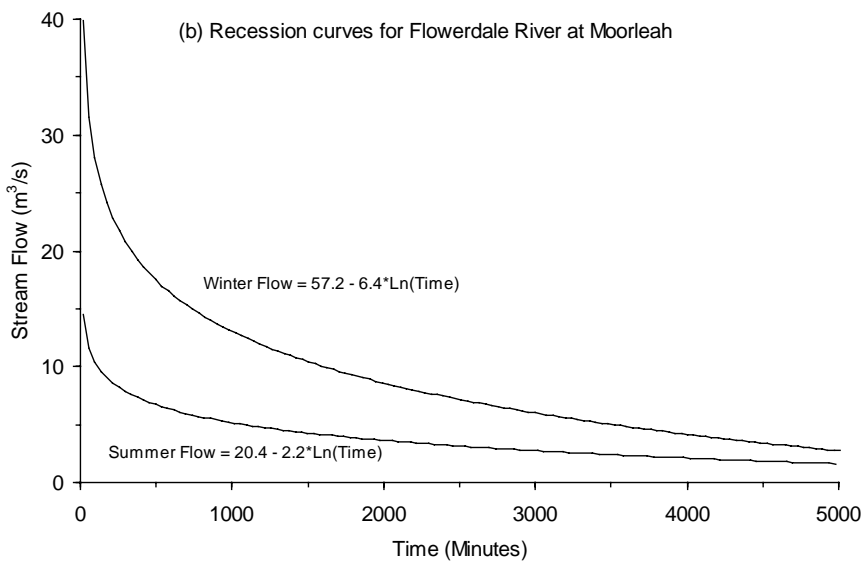
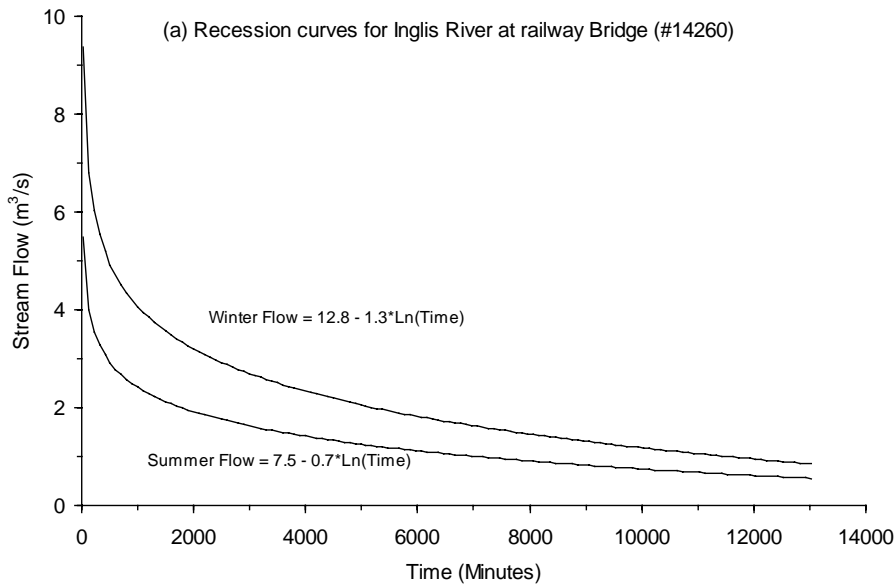


Figure 5.1a&b Recession curves for (a) Inglis River at Railway Bridge and (b) Flowerdale River at Moorleah.

The flow recessions at Inglis and Flowerdale Rivers roughly follow lognormal fitted curves described by the following equations:

Inglis River at Railway Bridge (14260)

$$\text{Winter Flow} = 12.8 - 1.3 * \ln(\text{Time in minutes}), R^2 = 0.88$$

$$\text{Summer Flow} = 7.5 - 0.7 * \ln(\text{Time in minutes}), R^2 = 0.89$$

Flowerdale River at Moorleah (14215)

$$\text{Winter Flow} = 57.2 - 6.4 * \ln(\text{Time in minutes}), R^2 = 0.94$$

$$\text{Summer Flow} = 20.4 - 2.2 * \ln(\text{Time in minutes}), R^2 = 0.96$$

The recession curves for Inglis River site indicate that it takes approximately 12000 minutes (8 days) for the flows to recede from 9 m³/s to 1 m³/s during winter. The summer recession period for flows to recede from 5 m³/s to 1 m³/s was approximately 5 days. The winter and summer flow recession periods for the Flowerdale River site were 4 days and 2 days respectively.

Low flow frequency curves were derived for 1, 30, 60 and 90 days durations (Figures 5.2a&b). The curves are intended to indicate probability of minimum flow occurrence over various time periods. For example in the Inglis River (14210), the probability that a minimum average daily flow of 1.0 m³/s will occur over 30 days in any given year is approximately 82%, while over a longer period such as 90 days this probability decreases to around 60% (Figure 5.1a). The corresponding probability of minimum flows of 1.0 m³/s in the Flowerdale River (14215) over 30 days and 90 days durations were 83% and 62% respectively (Figure 5.1b)

This information has implications for the establishment of environmental flow allocations for the Inglis and Flowerdale River catchments and for the assessment of risk in supply of water from the rivers for purposes such as irrigation and domestic use. Such risks will also need to be taken into account during the Water Management Planning process to be carried out as part of the Water Management Act, 1999.

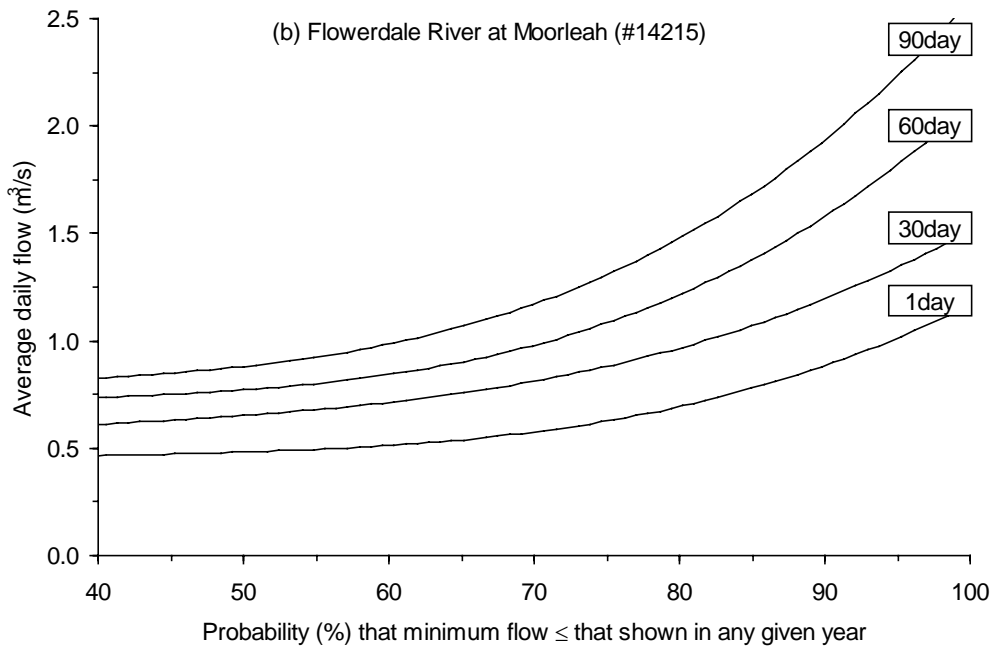
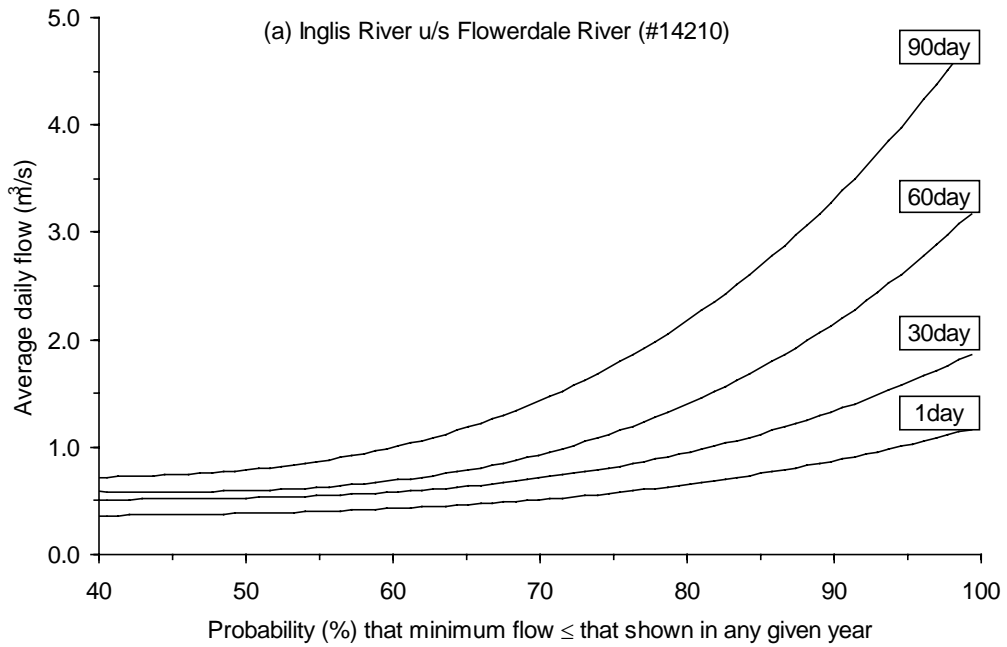


Figure 5.2a&b Low flow frequency curves for (a) Inglis River u/s Flowerdale and (b) Flowerdale River at Moorleah.

6. Floods

Flood frequency analyses of flows were undertaken for the Inglis River (14210) and Flowerdale River sites (14215). The results of this analysis are presented in Figures 6.1a&b. An example of how to read this graphs is that in any given year there is a 10% chance that a flood of approximately 83 m³/s or more will occur at the Inglis River site (Figure 6.1a). Similarly, in any given year there is a 10% chance that a flood of approximately 119 m³/s or more will occur at the Flowerdale River site (Figure 6.1b). The historical annual peak floods in the Flowerdale River site ranged from 11 m³/s to 147 m³/s over 33 years of record period (1967-2001). During the study period, the highest discharge of 139 m³/s (3.3m river level) occurred at Flowerdale River site on 21/07/2000. Discharge of this magnitude is equivalent to 1 in 20 years flood event.

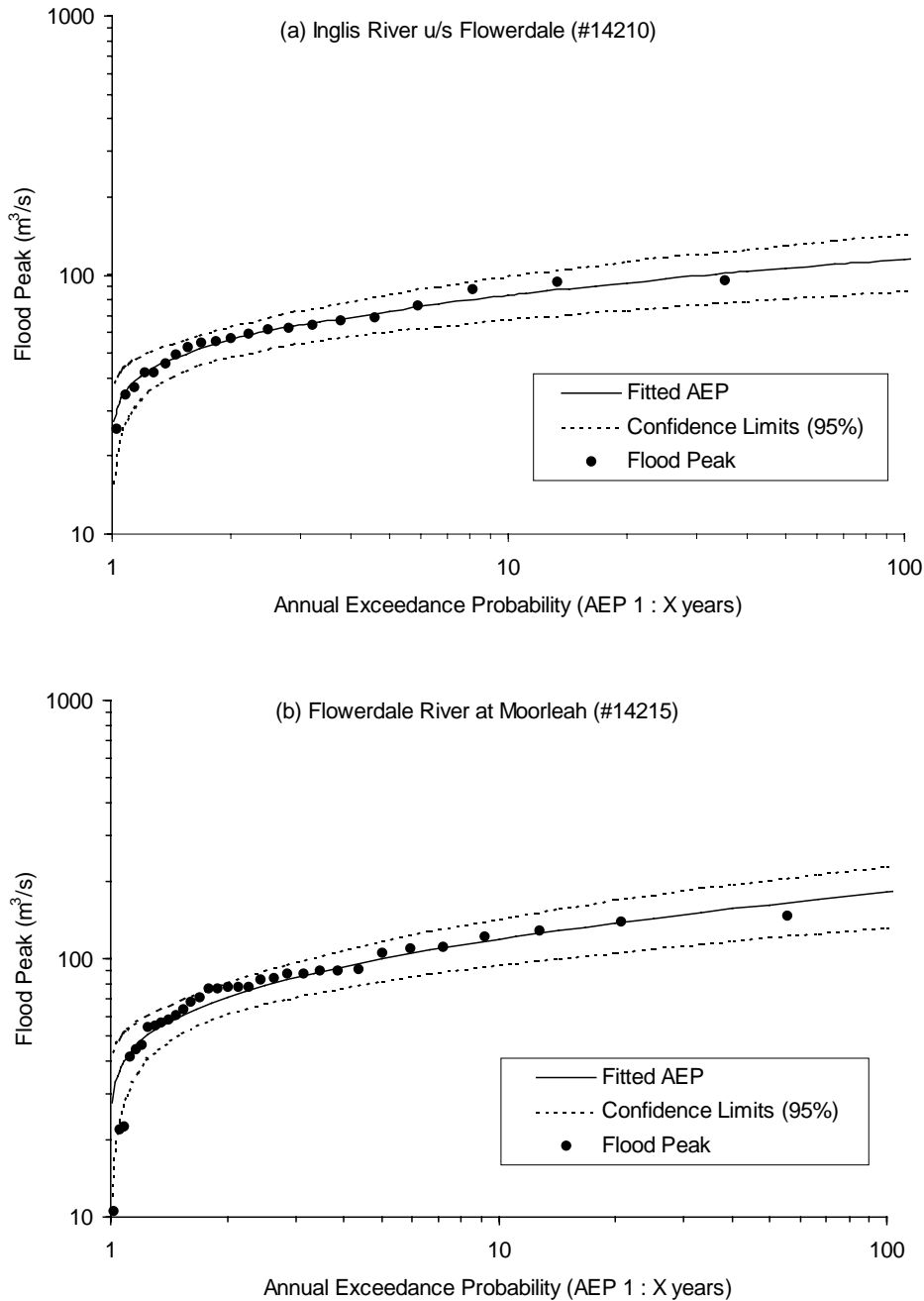


Figure 6.1 Flood frequency curves for (a) Inglis River u/s Flowerdale and (b) Flowerdale River at Moorleah.

7. References

WIMS: Water Information Management System, <http://wims.dpiwe.tas.gov.au>

BOM, 2001. Bureau of Meteorology rainfall data, <http://www.bom.gov.au>

HYDROL: DPIWE Water Quantity and Quality Database.