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

Tasmania

Hydrological Analysis of Rivers in the Pipers Catchment

A Report Forming Part of the Requirements for State of Rivers Reporting

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Hydrological Analysis of the Pipers Catchment

1. Historical Background

Catchments and Drainage System

The study catchment was that containing the Pipers River system. The Pipers River itself is situated in the north-east of the state and flows north into Bass Strait. It is an unregulated stream but it has tributary streams that are impacted by on-stream storages. There are few irrigation rights in the catchment with most water extracted for stock and domestic purposes.

The catchment is bounded to the south by the St Patricks catchment, the west by the Tamar Valley, and to the east by the Little Forester and the Pipers Brook catchments. There are several significant tributaries of the Pipers River which include Second and Third rivers, Butchers, Venns, Montgomery and Dead Horse creeks (Figure 1.1).

The catchment geology is largely composed of Jurassic dolerite in its upper reaches, and a mixture of Triassic sedimentary sequences including Devonian mud-stone and alluvial sands and gravel in the lower reaches. Stream substrate grades are predominantly boulder/cobble and gravel. In-stream habitat is dominated by pools and runs with pools providing the largest size categories.

Land use within the catchment varies considerably with plantation forestry and clear-felling activities occurring on some tributaries and within the headwaters. Within the middle to lower reach, land use is composed predominantly of cleared pasture for stock grazing with some small scale intensive cropping.

The total river length is 48 km originating at an altitude of approximately 960m and the catchment area is 380 km^2. The median summer and annual flows from the catchment are 0.145 and 0.79 cumecs (12.53 and 68.26 Ml/day) respectively.

Climate and Rainfall

Although the climatic conditions of the northeast region are generally influenced by its proximity to the sea, the distribution of rainfall is mainly controlled by topographic changes, with highest rainfall occurring around the Ben Nevis and associated ranges. The average annual rainfall range for the catchment is 700 - 900 mm. Nearer the coast, annual average rainfall is approximately 700 - 800 mm (Bridport and Low Head) increasing to around 1200 mm near the top of the catchment (Mt Barrow).

Thunderstorms can occur throughout the catchment at any time of year, however they are most prevalent during summer and autumn when there is a greater frequency of north to north-westerly winds creating uplift of warmer air from the coast. Temperatures throughout the catchment are influenced by distance from the coast rather than topographic variation, with inland areas experiencing greater extremes than those nearer the coast.

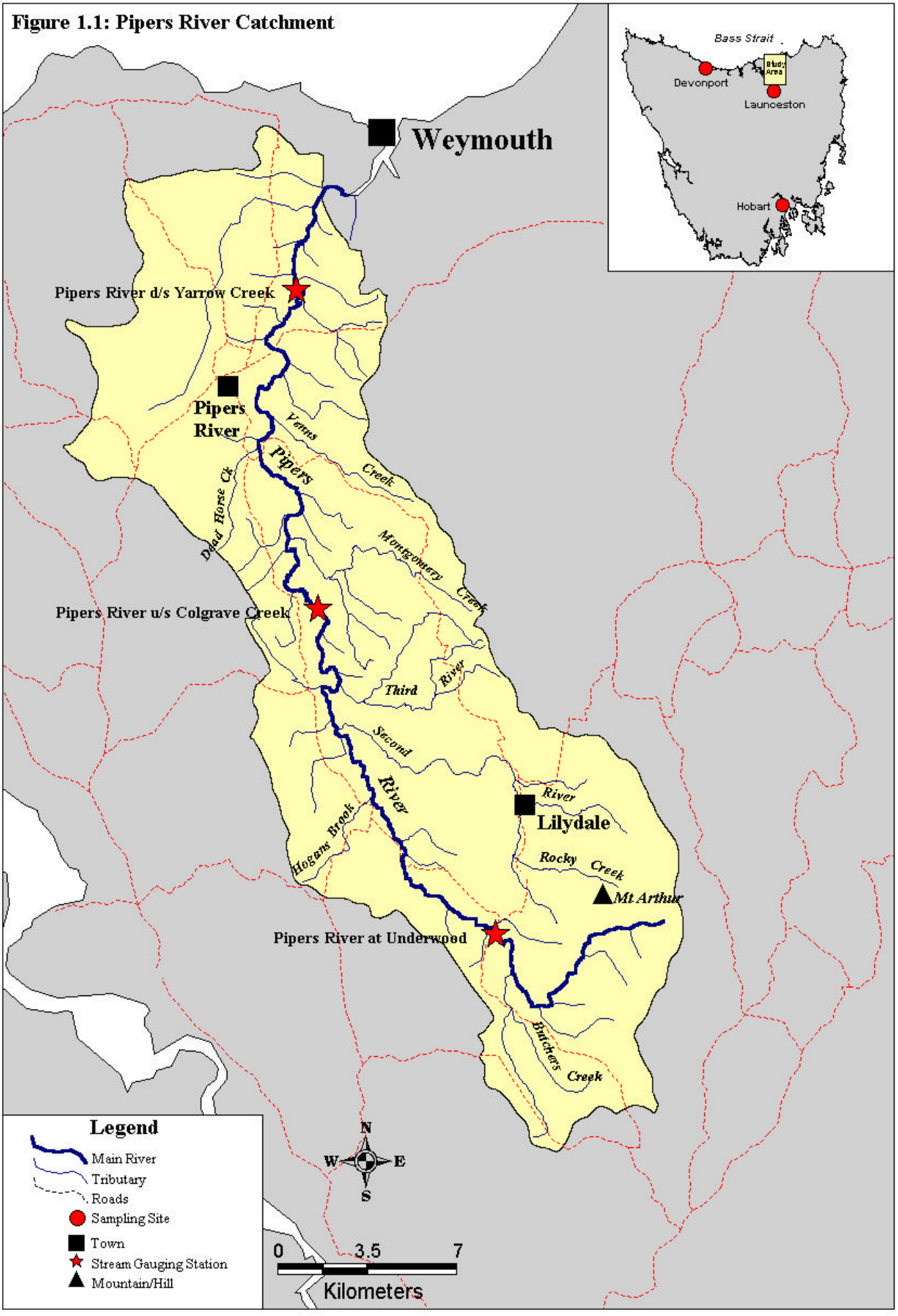


Figure 1.1: Pipers River Catchment
Bass Strait
Devonport
Launceston
Hobart
Weymouth
Pipers River d/s Yarrow Creek
Pipers River
Vanns
Pipers
Creek
Dead Horse Ck
Montgomery Creek
Pipers River u/s Colgrave Creek
Third River
Second River
Hogans Brook
River
Lilydale
Rocky Creek
Mt Arthur
Pipers River at Underwood
Butchers Creek
Legend
Main River
Tributary
Roads
Sampling Site
Town
Stream Gauging Station
Mountain/Hill
N
W
E
S
0
3.5
7
Kilometers

2. Monitoring in the Catchment

Bureau of Meteorology

As part of the Statewide rainfall monitoring network, the federal Bureau of Meteorology currently operate five monitoring station around or within the Pipers catchment, these are shown in Table 2.1. These stations are primarily maintained for climate monitoring purposes. The data from these, and all other sites in Tasmania can now be accessed on the world-wide web at www.bom.gov.au.

Station Number	Name
091284	Bridport (Emma St)
091057	Low Head (Comparison)
091053	Lilydale (Post Office)
091198	Mt Barrow (South Barrow)
091271	Nunamurra Offtake (St Pats River)

Table 2.1 Bureau of Meteorology rainfall stations

Rivers and Water Supply Commission / DPIWE

There are two sites on the Pipers River where river level has been monitored in the past by the Rivers and Water Supply Commission. At Underwood the level of the Pipers River was continuously recorded between 1952 and 1993. Upstream of Colgrave Creek the level of the Pipers River was continuously recorded between 1980 and 1990. No records have been collected at either site since they closed.

The site on the Pipers River down stream of Yarrow Creek; is currently operated by the Department of Primary Industries, Water and Environment (DPIWE). Records of river flow have been collected at this site since 1972. Water quality monitoring including, turbidity, conductivity and temperature; has been undertaken at this site from 1996. This data is discussed in another section.

3. Monthly Flows

The variability of monthly flows in the Pipers catchment is shown in Figures 3.1, 3.2 and 3.3, which provides box and whisker style plot for data from the three monitoring sites on the Pipers River. The plots display the median (or the middle of the data) as a line across the inside of the box. The bottom and top edges of the box mark the first and third quartiles respectively, indicating the middle 50% of the data. The ends of the whiskers show the spread of the data and together enclose 95% of the data. The dots beyond the whiskers indicate the high and low extrema.

The box and whisker plot shows a strong seasonal pattern, with flows peaking in the period July through to September. Lowest flows are experienced between January and April.

The monthly flows may appear to be variable especially in the winter months, but when compared to other areas such as the South Esk, the monthly flows can be viewed as relatively consistent or regular. Compared to the Brid River, the pattern of monthly flows for Pipers River (down stream of Yarrow Creek) is very similar, the winter volume is approximately 2.5 times greater, while the summer average flows are similar although some months have less flow than that experienced in the smaller Brid catchment.

Comparing the sites shows the increase in monthly flow volumes down the catchment. Also of note is the high variability of monthly flows in April and December at all three sites, which could be attributed to thunderstorm activity in these months.

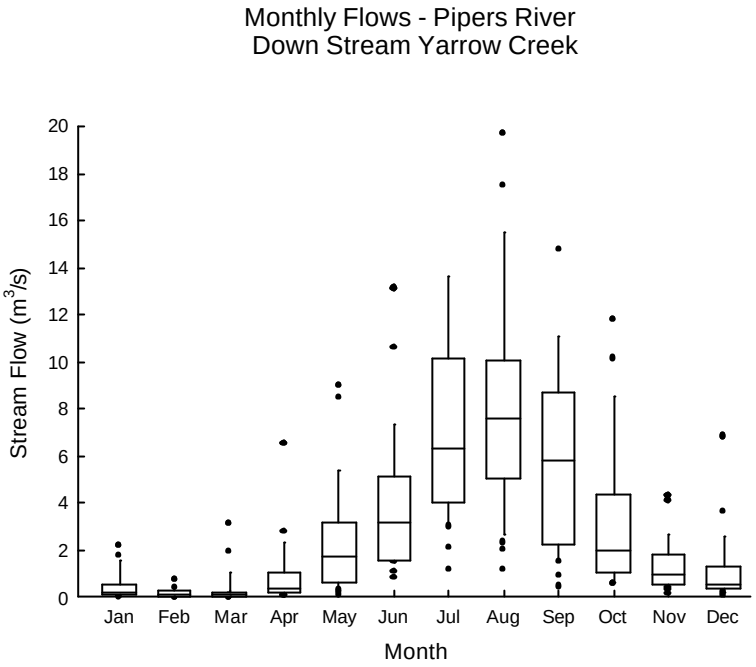


Figure 3.1 Monthly Flow Analysis from Pipers River down stream Yarrow Creek.

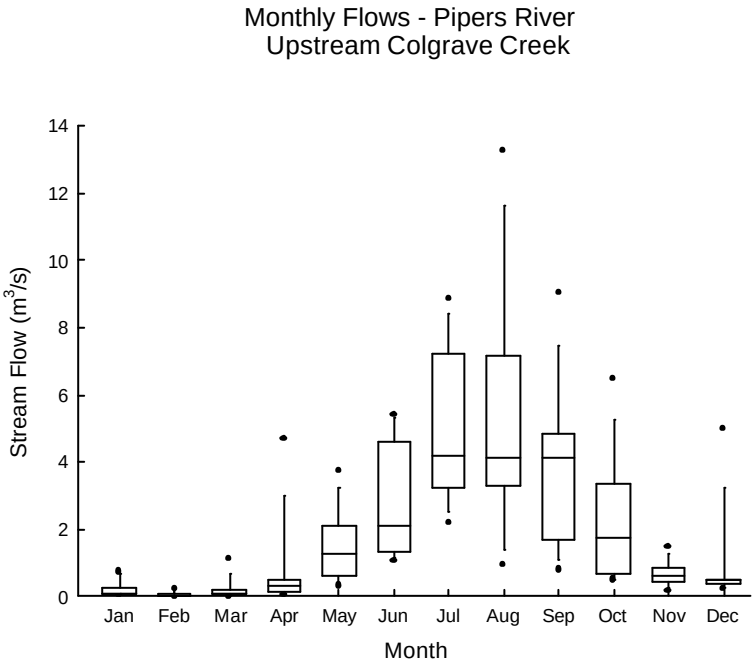


Figure 3.2 Monthly Flow Analysis from Pipers River upstream Colgrave Creek

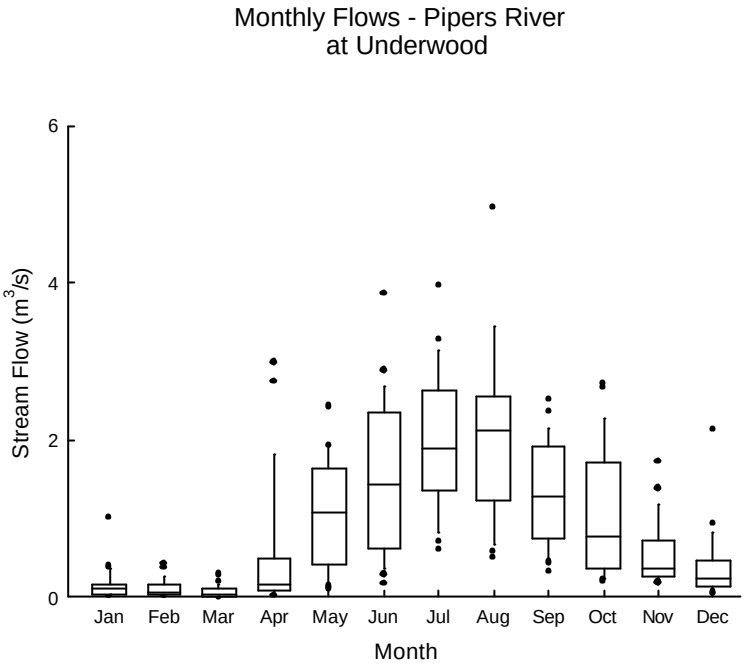


Figure 3.3 Monthly Flow Analysis from Pipers River at Underwood

Site Statistics

The following displays the historical statistics for the record from the sites
Pipers River down stream Yarrow Creek.

Site	Site Number	Start of Record	End of Record
Pipers River down stream Yarrow Creek	19204	26/4/1972	Present

Catchment Area	Approx AAR	Easting	Northing	Control
298 km^2	900 mm	509300	5453900	Weir

	Median	Average	Maximum	Minimum
Flow Record (m^3s^{-1})	0.79	3.034	341.4	0.00

Note: Zero values have been recorded in 1973, 1983, 1988, 1989, 1994,and 1995.

Pipers River upstream Colgrave Creek

Site	Site Number	Start of Record	End of Record
Pipers River upstream Colgrave Creek	19208	Dec 1980	Sep 1990

Catchment Area	Approx AAR	Easting	Northing	Control
198 km^2	950 mm	510200	5441150	Natural

	Median	Average	Maximum	Minimum
Flow Record (m^3s^{-1})	0.586	2.03	34.94	0.003

Pipers River at Underwood

Site	Site Number	Start of Record	End of Record
Pipers River at Underwood	116	1/2/1947	Sept 1993

Catchment Area	Approx AAR	Easting	Northing	Control
50 km^2	1000 mm	517080	5428600	Weir

	Median	Average	Maximum	Minimum
Flow Record (m^3s^{-1})	0.255	0.894	67.02	0.006

Note: Station did not operate between November 1966 and August 1985

4. Comparison of Monthly Flows; Historical vs Study Period

The following bar chart demonstrates the type of season that was experienced in the study period compared to the historical record (Figure 4.1). During the study, July, September, October and November experienced higher monthly average flows than the historical record. All other months experienced flows that were less than the historical average flow for the site. This was especially marked during May and August.

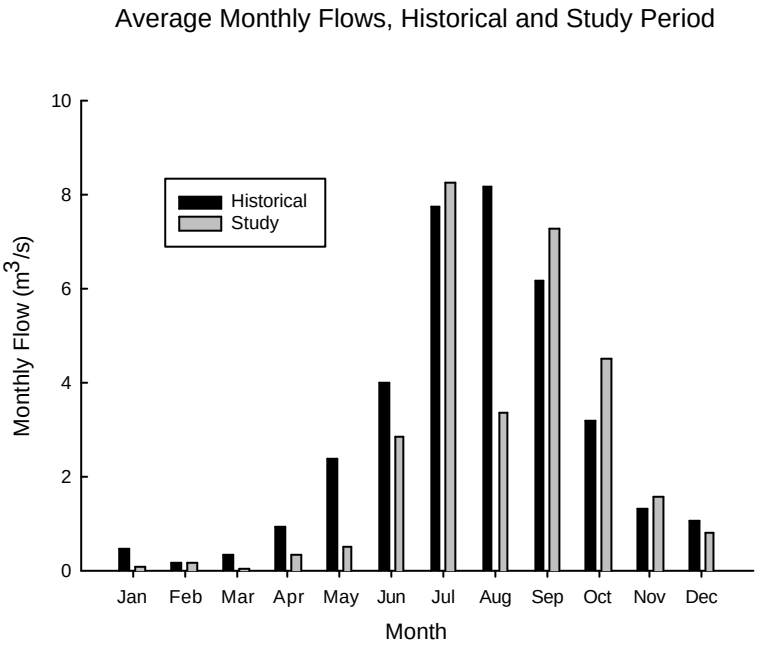


Figure 4.1 Comparison of monthly flows for the Pipers River down stream Yarrow Creek, (Historical Record vs Study Period).

5. Floods

Flood frequency analysis was conducted on flows in Pipers River down stream Yarrow Creek. An annual series of peak flood events was extracted for use in the flood frequency analysis. The sample coefficient of skew was insignificant at the 95% level, as a result a 2 parameter log normal distribution was fitted. The analysis was corrected for the under estimation of flood peaks that results when using an annual series. The results of this analysis are shown in Figure 5.1. As the plot is shown in logarithmic form, the vertical and horizontal grid lines are of unequal spacing. Some examples of how to read this graph are; (a) there is a 1 in 10 year chance that a flood of approximately 200 cumecs or more will occur (river height of approximately 2.56m). (b) there is a 1 in 2 year chance that a flood of approximately 100 cumecs or more will occur (river height of approximately 1.87m).

During the study there was a moderate flood which occurred on September 23rd, which had a peak flow of approximately 144.6 cumecs (corresponding river height of approximately 2.22m down stream Yarrow Creek). Examining Figure 5.1, it can be concluded that a flood of this magnitude corresponds to an approximate annual exceedence probability (A.E.P.) of 1:5

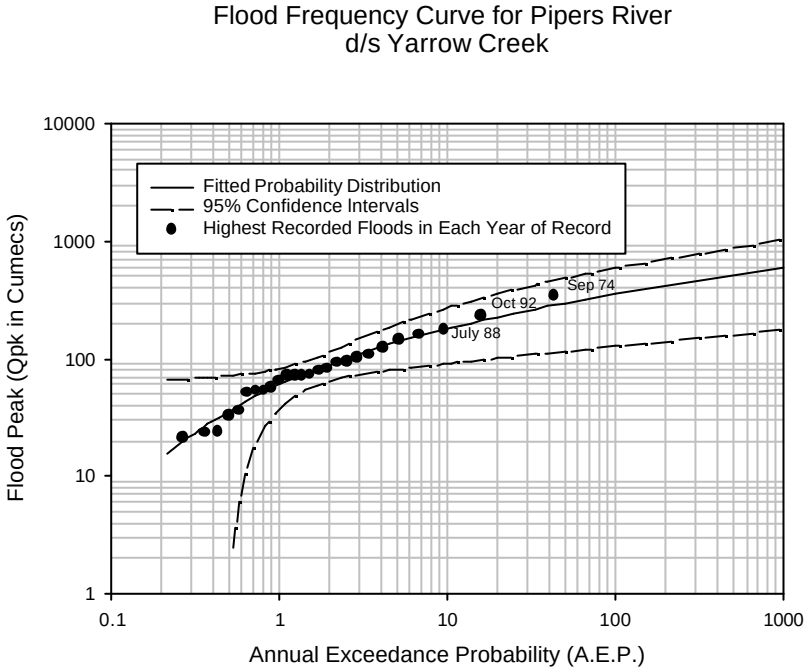


Figure 5.1 Flood Frequency Curve for Pipers River Down Stream Yarrow Creek.

6. Droughts and Low Flows

Several hydrographs were analysed to describe the recession flows for the Pipers River down stream Yarrow Creek. The recession segment of a hydrograph is that part which displays how the water storage in the river decreases over time following high 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 essentially reflects groundwater discharge to the river and how groundwater storage influences and sustains flows in rivers.

The recession curve for the Pipers River downstream of Yarrow Creek is described by the following equation, and is presented graphically in Figure 6.1

$$\text{Flow} = 1.995 * 0.9998965^{\text{Time (Minutes)}}$$

The upper part of the recession curve contains mainly surface flow (runoff) while the lower section is more representative of groundwater discharge to the river. The curve demonstrate that once the flow recedes to approximately 2 m^3/s on the recession limb it takes close to 50 days to return to a base flow of approximately 0.01 m^3/s. This lower bound for base flow reflects the summer period of flows in the Pipers River where, at times the flow ceases. Base flow experienced in winter months is higher and is estimated to be 1 to 2 cumecs.

Low flow frequency curves have been derived for a range of durations from 1 day through 90 days (Figures 6a to 6f). The curves give the probability that any given minimum flow will occur over various time periods. For example, over a five day period, the probability that an average daily flow of 0.125 cumecs occurring is approximately 95%, while over a longer period such as sixty days this probability decreases to 60%.

This information has implications for the establishment of environmental flow allocations for the Pipers River and for the assessment of risk in supply of water from the river for purposes such 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 currently proposed water reforms.

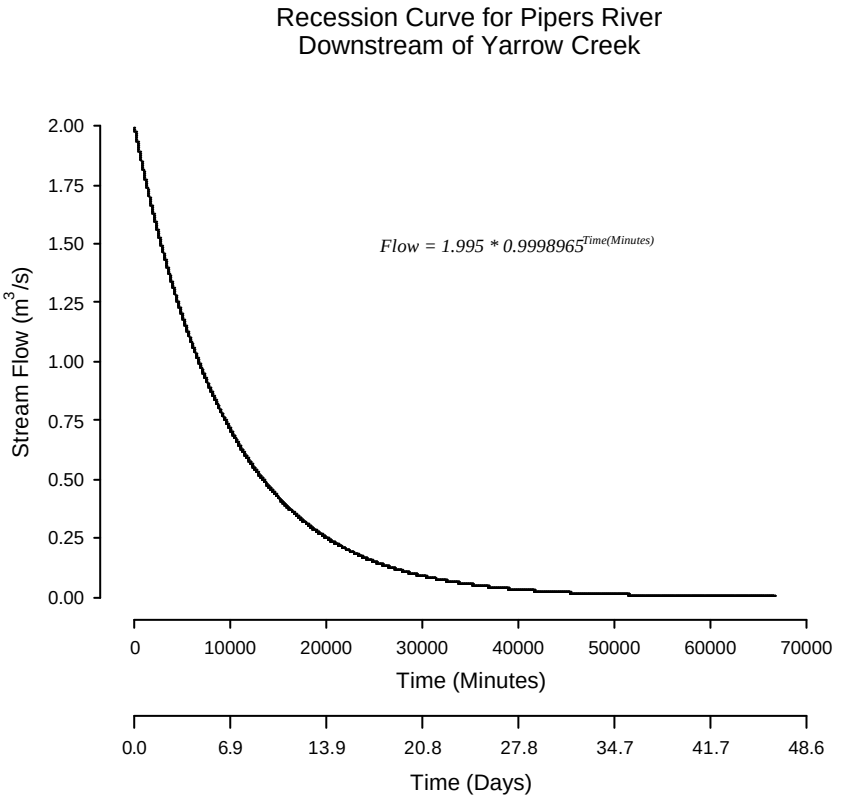
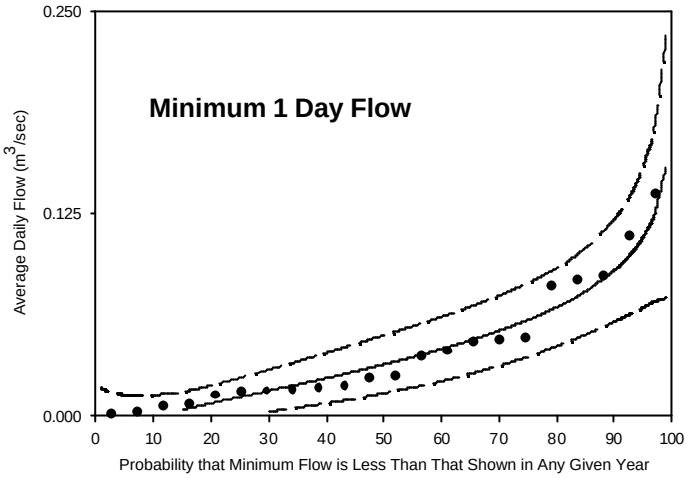
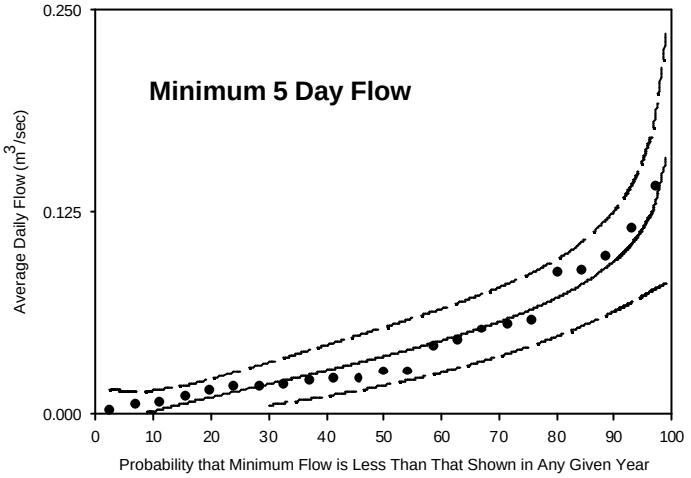
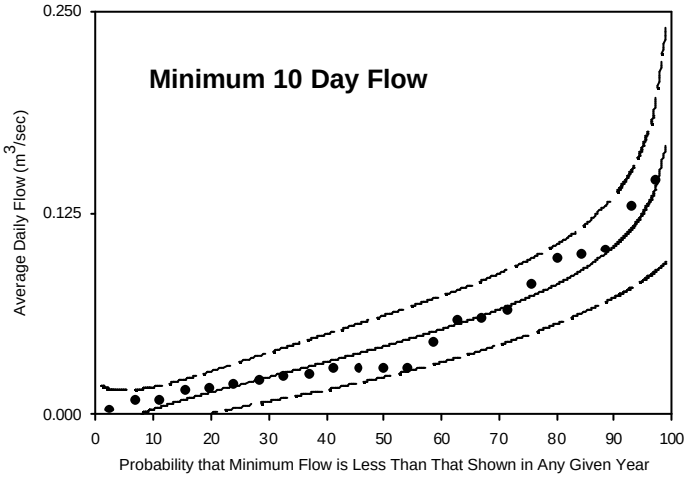


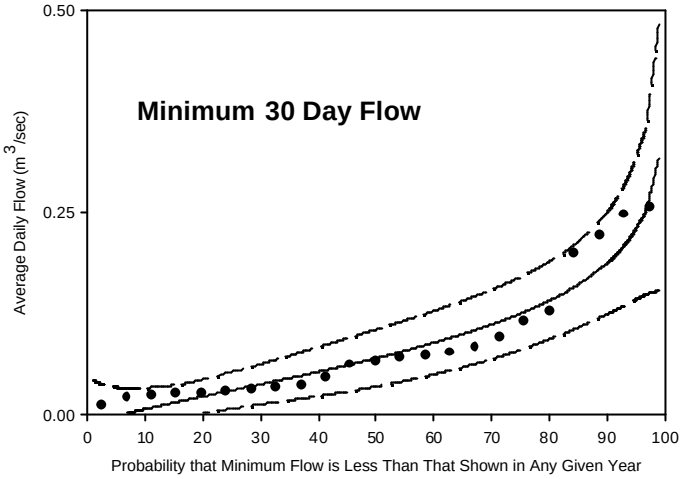
Figure 6.1 Recession Curve for Pipers River Downstream Yarrow Creek.

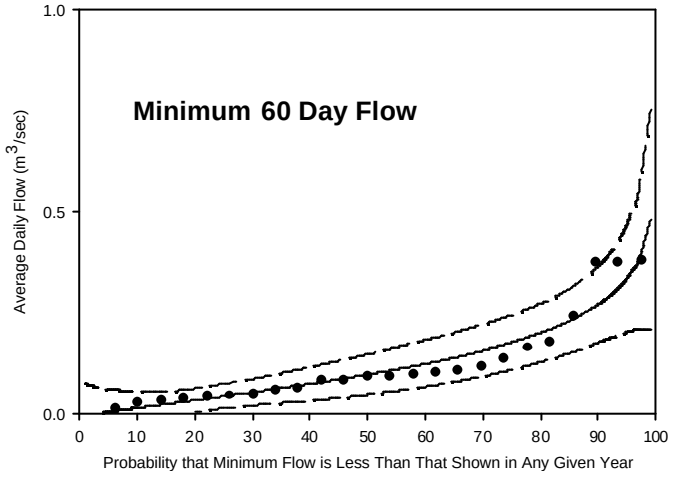


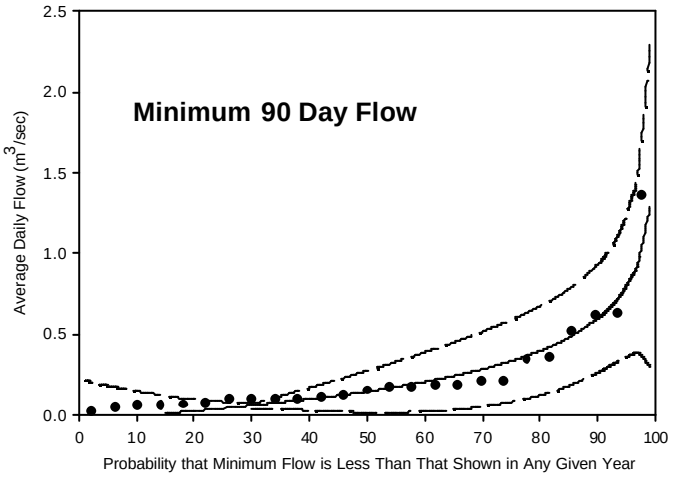




Figures 6.2 (a-c) Low flow frequency curves for the Pipers River 2.6 km upstream of the Tidal Limit. Each graph shows the probability that any given minimum flow will occur at each time period







Figures 6.2 (d-f) Low flow frequency curves for the Pipers River 2.6 km upstream of the Tidal Limit. Each graph shows the probability that any given minimum flow will occur at each time period