Plenty River

Streamflow Management Plan:

Assessment of Sustainable Winterfill Harvesting Volumes

Final Report

By

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Summary

As part of the process for developing a Streamflow Management Plan for the Plenty River catchment, the streamflow patterns and volumes in the Plenty River at Greensborough were investigated.

"Natural" flow regimes were developed as part of the TEDI modelling process (SKM 2001). on a monthly time step. The natural flows were calculated as the gauged flows at Greensborough, plus upstream licensed diversions, plus known diversions from Tourourrong Reservoir, plus diversions due to the impact of catchment dams, less the inflows from Mernda STP. As flows from Mernda STP do not contribute to the majority of diversions (and should not be included in an environmental allocation), a modelled "current" flow was adopted as natural flows minus the licensed diversions, minus known diversions from Tourourrong Reservoir minus diversions due to the impact of catchment dams.

The High Flow Season was selected from examination of seasonal trends in mean and median flows, as well as analysis of the flow frequency distributions between the months. For the Plenty River catchment, the high flow months consisted of July, August, September and October. Streamflow volumes were evenly distributed over the 4 month period.

The average monthly current (post-diversion) flows were between 51 and 67% of the natural flows at Greensborough during the High Flow Season. Reductions were more severe in the other months with current flows between 26 and 58% of natural values. During the drought years of 1982 and 1997, flows during the High Flow Season were reduced by 75 and 72% respectively. The diversions were dominated by farm dams and Tourourrong Reservoir, with diversions from these sources averaging over 10 times the volume diverted by licences.

These high levels of current diversions and demands were reflected in the measure of environmental flow stress (calculated by the Cascading Seasonal Flow methodology) of 1.38 for the High Flow Season. Diversions in other seasons also produced stress ratings greater

than 1 (1.60 in January, June, November and December, 1.71 in May, and 1.76 in the Low Flow Season of February to April). This suggests that the current rates of diversion from all sources (licences, farm dams and Tourourrong Reservoir) are higher than that required to maintain ecological values in the river.

When the annual volume of flow over the High Flow Season (1981 – 1998) was compared to the current level of demand (licences, farm dams and Tourourrong), supply could be guaranteed with 100% security (i.e. the volume of water required was available every year). However, as the natural flows were calculated at Greensborough, a proportion of the flow which entered the river downstream of the diversions would not be available, so this would probably be an overestimate, with shortfalls likely in 1-2 years out of 18. Demands in dry years were a significant proportion of natural flows, up to 80% in 1982.

Two potential environmental flow components were included in the analysis. A 1.5 Ml/d flow still allowed Winterfill demand (licences and farm dams) to be met each year but with a smaller margin. If diversions were not allowed to commence until the 80th percentile daily exceedence flow was reached, then the demand volume in the High Flow Season could not be met in 4 years out of 18.

Security of supply for months outside the High Flow Season was low, with the total demand exceeding the total natural streamflow in 10 years out of 18.

It is concluded that:

- The Plenty River currently has too much water diverted in all seasons to maintain adequate environmental values;
- While current High Flow Season licences may be able to be satisfied under current conditions, there is little, if no, opportunity to allow additional diversions without an impact on security of supply.

Background

Melbourne Water is in the process of developing a Streamflow Management Plan (SMP) for the Plenty River catchment, as required under the State Environment Protection Policy (Waters of Victoria) Schedule F7 (Waters of the Yarra Catchment). Streamflow Management Plans will eventually provide a framework of rules to operate a specific river system to ensure the long term sustainability of river system health, by reaching an appropriate balance between environmental requirements and consumptive uses of water.

This project examines the streamflow patterns and volumes in the Plenty River, using flow data at Greensborough, to provide information for the development of the Streamflow Management Plan.

Project Objectives

A key component of the SMP process is the assessment of potential volumes of water harvestable under "winterfill" rules and conditions (e.g. specified restricted time period for harvesting, a cap on diversion volumes and diversion rate and annual volume). The process for assessing winterfill harvesting must ensure the environmental health of the waterway is not compromised. Therefore, when assessing potential new winterfill diversions, a conservative approach is required to ensure environmental risk remain low. The Streamflow Deviation Project (SDP) Phases 1 - 4 has assessed potential winterfill harvesting volumes in many Yarra River tributaries utilising the "Cascading Seasonal Flow" (CSF) method.

Hydrological analysis to assess the alteration of winter flows from natural is presently the only mechanism for determining potential environmental risk during these high flow months. The key aspects of the assessment are frequency, magnitude, duration and timing of flow events. It is these data that are presented in this report.

Project Study Area

Catchment Description

The Plenty River system is located north of Melbourne and drains a catchment of 351 km^2. The east and west branches of the river rise at an altitude of approximately 790 m on a plateau north-east of Mount Disappointment in the Great Dividing Range. The west branch flows south and the east branch flows south-east to a confluence approximately 2 km upstream of Whittlesea. From this point the main stem of the Plenty River continues to flow in a southerly direction to the Yarra River at Heidelberg. The major tributaries of the Plenty River are Jack Creek, Barber Creek, Scrubby Creek and Bruce's Creek, all of which join the system upstream of Mernda.

The upper part of the east branch of the Plenty River catchment is State Forest, used as a water supply catchment for Melbourne Water (Tourourrong Reservoir). Vegetation within the State Forest consists predominantly of mountain ash (*Eucalyptus regnans*) and mixed woodland. Downstream of Tourourrong Reservoir the Plenty River flows through a floodplain until Mernda. This section of the catchment has been extensively cleared for livestock grazing. Between Mernda and South Morang and from Plenty to Greensborough the catchment is only lightly timbered with some development in light industry and agriculture. The Plenty Gorge, between South Morang and Plenty is an exception to the poor stream condition in the middle to lower catchment. This section of river is in a relatively natural state with an intact riparian zone and a rich diversity of flora and fauna. The lower portion of the river, downstream of Greensborough to the Yarra River confluence, has undergone extensive development and complete urbanisation.

Licensed Diversions

There are a total of 18 licensed diverters in the Plenty River catchment. Water is diverted for direct irrigation, on and off-stream dam filling, and stock and domestic use. A total of 407 ML is currently to diverters (S. Nicol, Melbourne Water, pers. comm.), with 353 ML/a allocated as winter-fill for off- and on-stream dams (Table 1). Winter filling is conducted over the higher flow winter/spring period from May to December. Not all licences are currently active (SKM 2001), but the analysis in this report assumes that any inactive licences may be re-activated or traded and so constitute potential diversions.

Table 1 Types of licence and annual volume (Ml/year) in the Plenty River catchment

	Stock and Domestic	Irrigation	Off Stream dams	On Stream dams
Total	6	48	338	15

Tourourrong Reservoir

Tourourrong Reservoir is located on the Plenty River East Branch and receives inputs from the Plenty River, Jack Creek and transfers from Wallaby Creek (including Silver Creek and its tributaries) in the Goulburn River basin. The reservoir has a capacity of 273 ML and was constructed in 1884 as a water storage facility and silt trap. Once the capacity of Tourourrong Reservoir is reached during periods of high flow, excess water overflows into the Plenty River East Branch, although this is rare (SKM 2001). Water is transported from Tourourrong Reservoir to Yan Yean Reservoir via an aqueduct known as the "Clear Water Channel".

Methods

Streamflows

"Natural" flow regimes for gauge at Greensborough (S.I.229615) for the period 1980-1998 were derived as part of the TEDI modelling process (SKM 2001) on a monthly time step (expressed in Ml/day). The natural flows were calculated as the gauged flows plus the diversions due to upstream licenses, plus known diversions from Tourourrong Reservoir, plus the impact of catchment dams, less the inflows from Mernda STP.

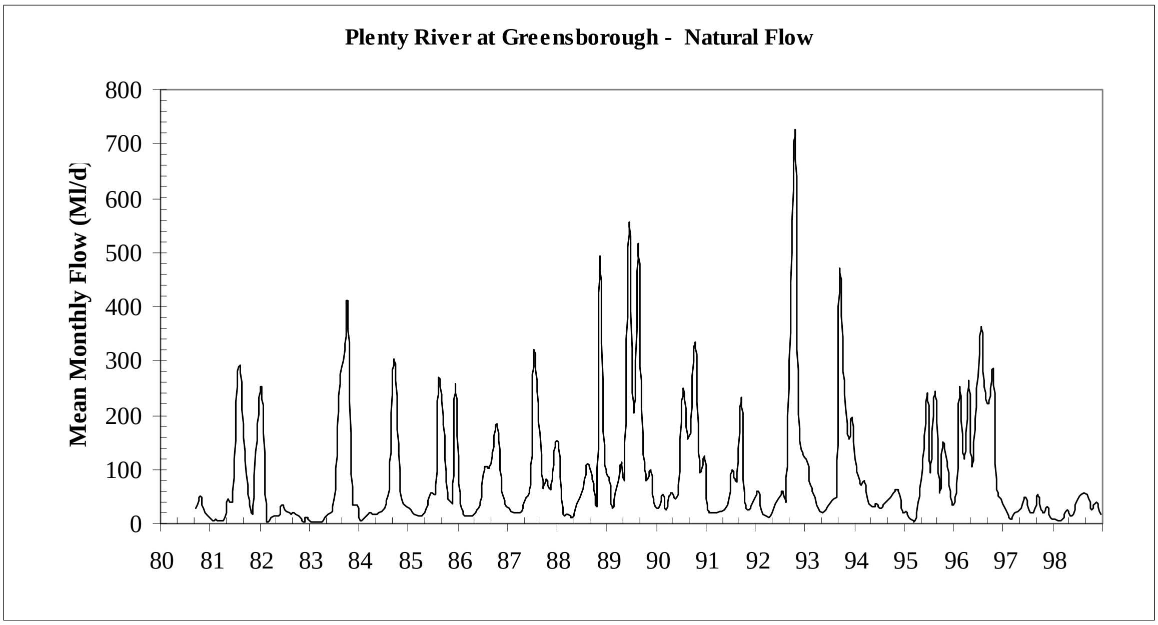
The contribution of licensed diversion volumes were based on the annual volume adjusted for monthly use for the different types of licences according to the proportions derived by Melbourne Water. The assumption that the full licence volume is used each year is clearly incorrect, as not all demand will be used each year. By adding the full demand to the gauged volume to obtain natural flows, in many cases, the natural flow rates will be over-estimated. This would occur both in wet years (where the full licence volume would not need to be diverted) and potentially in dry years (when the full licence volume would simply not be available due to low flows). Without detailed metering of actual volumes diverted, this is the best estimate of usage.

As the outflows from Mernda STP are located downstream of the majority of diverters, and thus are unavailable for any potential additional winter diversions, a modelled “current” flow was adopted as the natural flows minus the licensed diversions, minus known diversions from Tourourrong Reservoir, minus the impact of catchment dams. In any case, it could be argued that outflows from STPs should not be included in an environmental allocation.

The natural and current flow data were manipulated to create a standard set of outputs as set out in the project brief, and these are presented in the results.

Results

Time Series



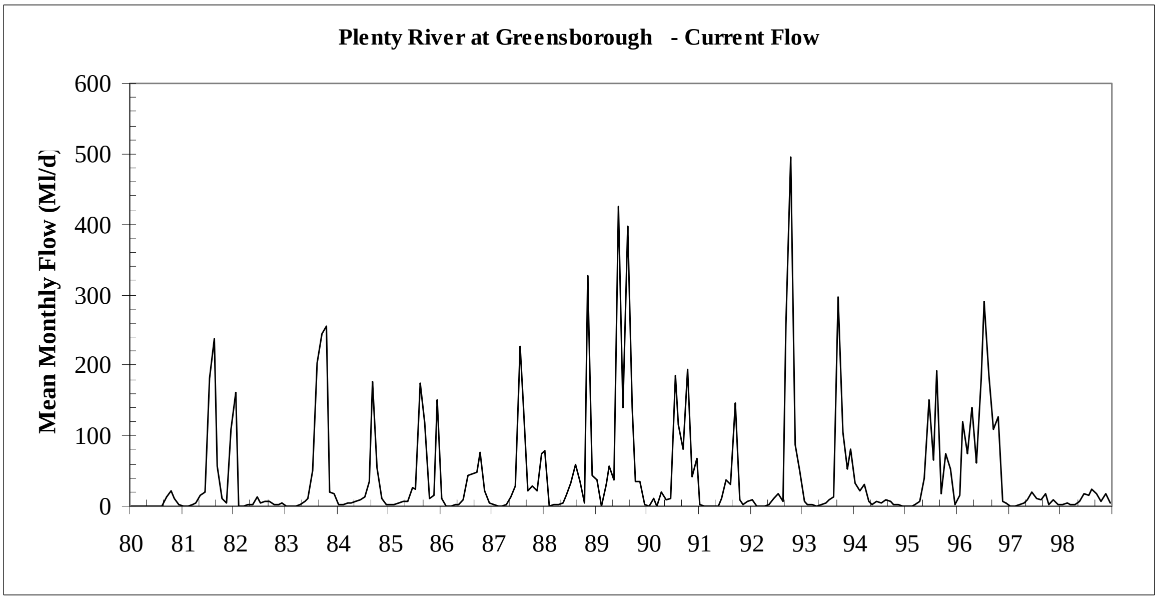


Figure 1 Natural and Current time series flows in the Plenty River (Ml/d)

High Flow Season determination

Graphs of mean and median flows suggest a highly seasonal flow regime (Figure 2), with the minimum monthly mean or median being around 15% of the maximum monthly value. The difference between the mean and median traces also suggests that there is are highly variable flows between years (as the mean is dominated by occasional high flows more than the median).

The median flows in each month would suggest a Low Flow Season of January to May, and a High Flow Season of, at least, July to October.

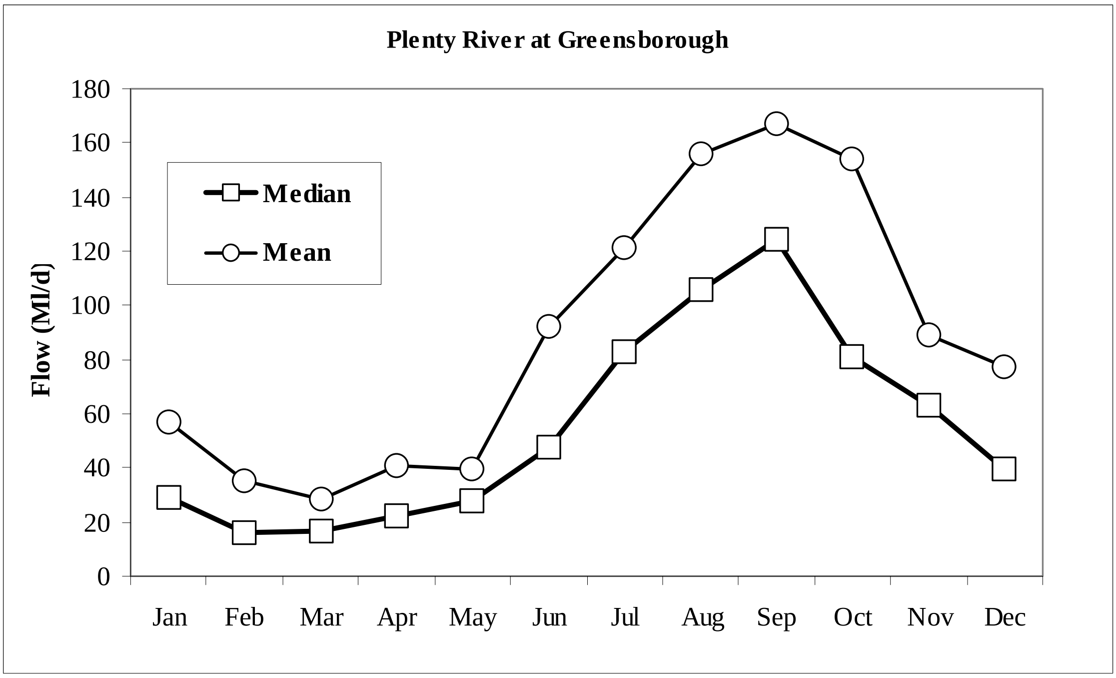


Figure 2 Natural mean and median monthly flows (Ml/d) in the Plenty River

The flow frequencies in different flow bands (Table 2) shows sporadic high flow months, even in the months with relatively low mean or median flows (e.g. January and December). However, resource assessment should not be based on occasional events. The frequency data in Table 2 was used to classify the months into different seasons. This suggested that the Low Flow Season was short, comprising only February to April. And the High Flow Season was comparatively long at June to October.

The median flows (Figure 2) and flow frequency data (Table 2) would suggest that June should be seen as a relatively marginal member of the High Flow Season. The majority of the flows were in the bands between 22 and 56 Ml/d, while for the other months of the season, the majority of flows were in higher bands than this.

Additionally, the cumulative percentage of High Flow Season flows per month also suggests that June contributes less than its share of flows in the season, with only 13.1% of available volume (Figure 3). The other months contributed relatively more, with, on average, 17.8% of the total annual flow occurring in July, 22.9% in August, 23.7% in September and 22.6% in October.

Due to the low contribution to potential flows, it would probably be unsound to base resource allocations on a winterfill period that included June.

Hence the seasonal classification used in this analysis was:

High Flow Season:	July to October
Medium Flow Season:	January, May, June, November, December
Low Flow Season:	February to April

With this High Flow Season, the contribution of each month to total winterfill flows was more even, with July (20.4%), August (26.3%), September (27.2%) and October (26.0%).

Table 2 Frequency of flows in each of 20 flow bands (based on percentile values) for each month

Flow Band	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0-7	**3**	**3**	**3**	1							1	
7-13	1	**4**	**2**	**2**								**2**
13-16		1	**3**	**3**	**2**					1		1
16-19		**2**	**2**	**2**	**2**			1	1			1
19-22		**2**	**3**	1	1		1			1	1	1
22-25	**2**		1	**4**	1	**2**	1					
25-28	**2**	**2**			**3**		1			1	**2**	
28-34	**2**				**2**	**2**		1	1		1	**2**
34-39	1			1	1	**2**	1			1	**2**	**2**
39-44				1		**2**	1	**2**		**2**	1	**2**
44-49					**3**	**3**			**2**	1	1	1
49-56		1	1	1		**2**	**2**	1	1	**2**		
56-69	**2**		1			1	1	1	**2**		**3**	
69-83		**2**	1		1	1	**2**	**2**		1	1	
83-103	**2**				**2**		**2**	1	1	1	**2**	
103-127	1		1	1			1	1	**2**	1	1	**2**
127-198	1							1	**2**	**2**	1	**4**
198-246	1					**2**	1	**2**	**3**	1	1	
246-303		1		1			**2**	**4**	1	1		1
>303						1	**2**	1	**3**	**3**	1	

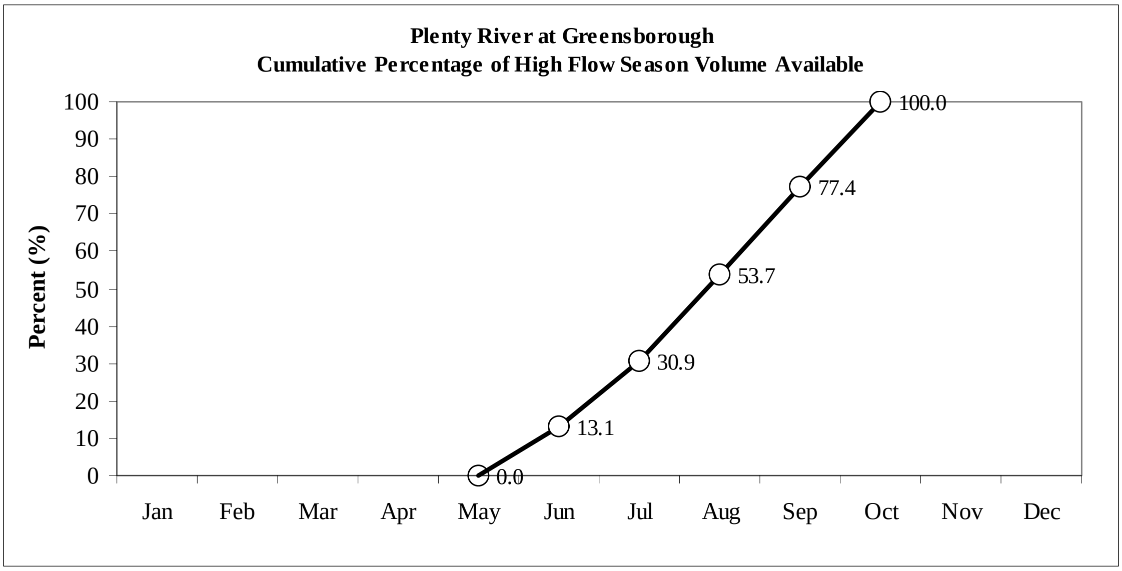


Figure 3 Cumulative percentage of total volume (%) in each of June to October for the Plenty River at Greensborough (based on mean volume in each month over the period of record)

Natural and current flows in the High Flow Season

Comparisons between the natural and current flow patterns show a large difference between the two in mean monthly flow over the whole year (Figure 4, Table 3). During the High Flow Season (July to October) current flows were between 51 and 67% of the natural flows (Table 3). Reductions were more severe in the other seasons with current flows between 26 and 58% of natural values.

A comparison between the total volume of flow in the High Flow Season each year also suggests a large impact of the current levels of diversions (Figure 5). The proportion of natural flows that were not diverted varied between only 11% in 1994 to 70% in 1989. On average, over the period 1980-1998, current High Flow Season flow volumes were only 50% of the natural flows.

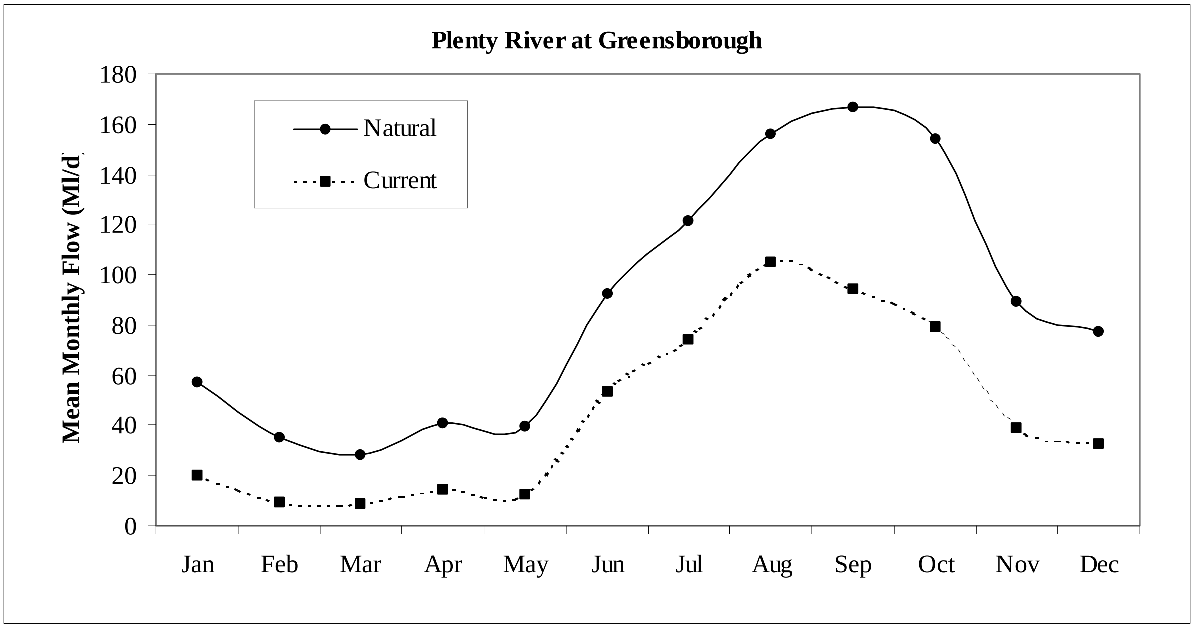
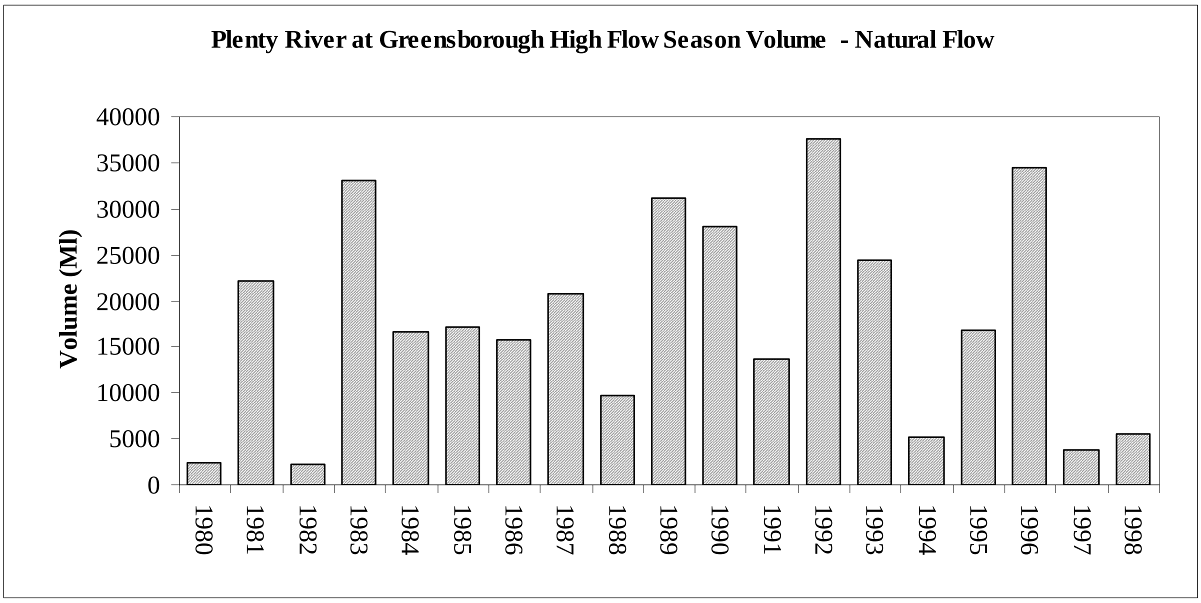


Figure 4 **Mean monthly flow (Ml/d) in the Plenty River at Greensborough – natural and current flows**

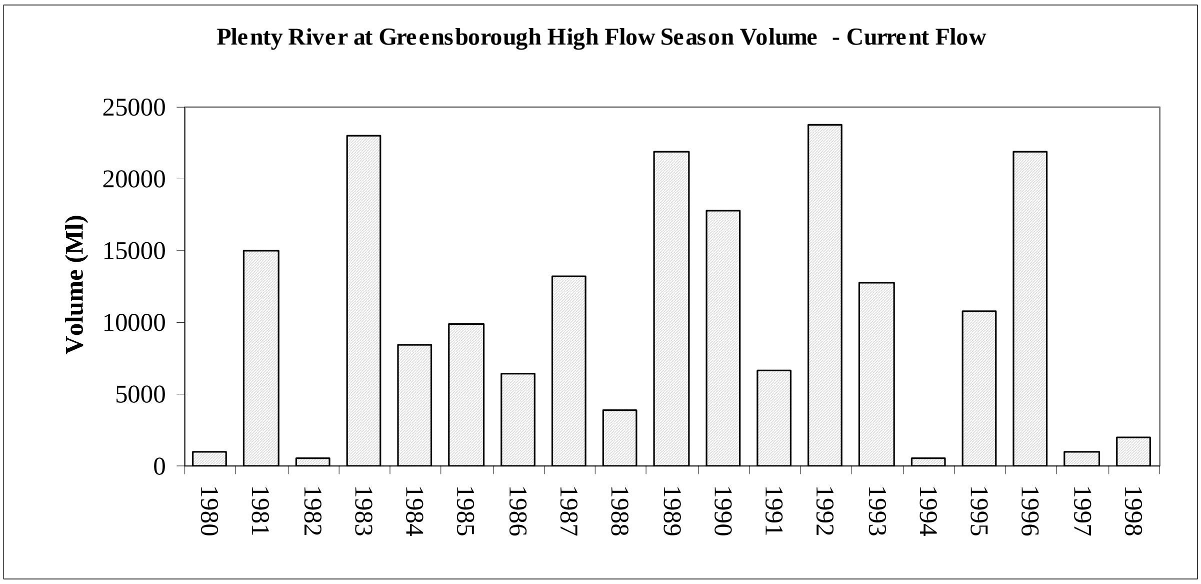
Table 3 **Mean monthly flow (Ml/d) in the Plenty River – natural and current flows – and percentage of natural flow.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Natural	57.2	35.1	28.5	40.8	39.5	92.3	121.2	156.1	167.0	154.1	89.1	77.3
Current	20.2	9.2	8.7	14.5	12.3	53.7	74.5	104.8	94.5	79.1	38.9	32.7
Percent	35.3	26.3	30.7	35.5	31.2	58.2	61.4	67.1	56.6	51.3	43.7	42.3



Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Volume	2407	22235	2200	33118	16562	17128	15835	20821	9743	31181
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	
Volume	28129	13711	37593	24371	5240	16760	34426	3742	5491	

Note: the low value for 1980 was because only 2 months of data were available for that year in the High Flow Season.



Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Volume	1032	14945	546	22999	8415	9930	6437	13198	3893	21892
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	
Volume	17734	6674	23793	12782	579	10820	21849	1047	1947	

Note: the low value for 1980 was because only 2 months of data were available for that year in the High Flow Season.

Figure 5 Total volume of flow (Ml) over the High Flow Season in each year in the Plenty River at Greensborough – natural and current

The diversions in the Plenty River are almost totally dominated by the impact of farm dams and diversions from Tourourrong Reservoir. Compared with the winterfill licensed demand of 353 Ml/year, total diversions due to farm dams and Tourourrong Reservoir were, on average, 10.6 time higher in each year (Figure 6).

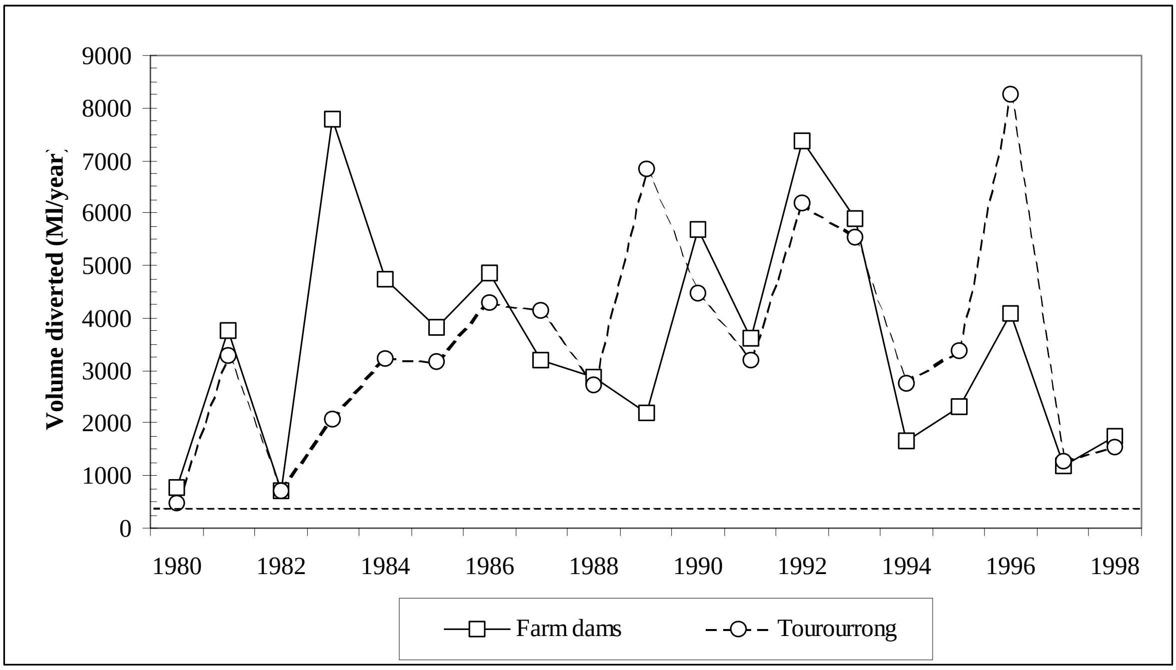


Figure 6 Annual volumes diverted between July and October due to farm dams and Tourourrong Reservoir. The dashed line across the bottom represents the winterfill licensed volume of 353 Ml/year.

Environmental impact of current levels of diversions

The CSF calculates a stress value for each of the seasons, based on a comparison between the median natural and current flows, and the median of a selected month called the "Minimum Flow Pattern" month. This "Minimum Flow Pattern" is an acceptable flow regime for a season after water has been diverted, so as not to seriously reduce the flows and frequencies from natural. In the CSF, the basis of selecting a Minimum Flow Pattern is the observation that diversion of water tends to transform the flow regime of one season into the flow regime of a drier season. It would seem to be inappropriate for the flow regime of a particular season to be completely changed to that of the next driest season, so the Minimum Flow Pattern for one season is the wettest month of the next driest season.

Hence, for the High Flow Season in the Plenty River (July to October), the Minimum Flow Pattern is that of the month of November.

A stress value of 1.00 means that diversions have changed the flow regime from natural to that of the Minimum Flow Pattern. Any further diversions increase the stress values higher than 1.00, and it is proposed that this causes a potentially unacceptable risk to environmental values. See the reports from the Streamflow Deviation Project for a full explanation of the CSF calculations and rationale.

The CSF analysis shows that the Plenty River is stressed due to flow diversions in all seasons of the year. This suggests that the current rates of diversion from all sources (licences, farm dams and Tourourrong Reservoir) are higher than that desirable to maintain ecological values in the river.

Table 4 CSF table showing stress values for each season

Season	High Flow Season	Medium Flow Season (1)	Medium Flow Season (2)	Low Flow Season
Months	Jul - Oct	Jan Jun Nov Dec	May	Feb - Apr
Median Natural Flow (Ml/d)	90.6	41.0	28.0	17.5
Minimum Flow Pattern	Nov	May	Apr	
Median MFP Flow (Ml/d)	63.0	28.0	22.0	7.8
Median Current Flow (Ml/d)	39.3	11.3	6.3	1.8
Stress	**1.38**	**1.60**	**1.71**	**1.76**

The reason for the low value for the stress index in the season can be seen from the mean monthly flows (Figure 4, Table 3) and the monthly flow duration curves during the High Flow Season (Figure 7) which both show large changes in the flows due to the current levels of diversions.

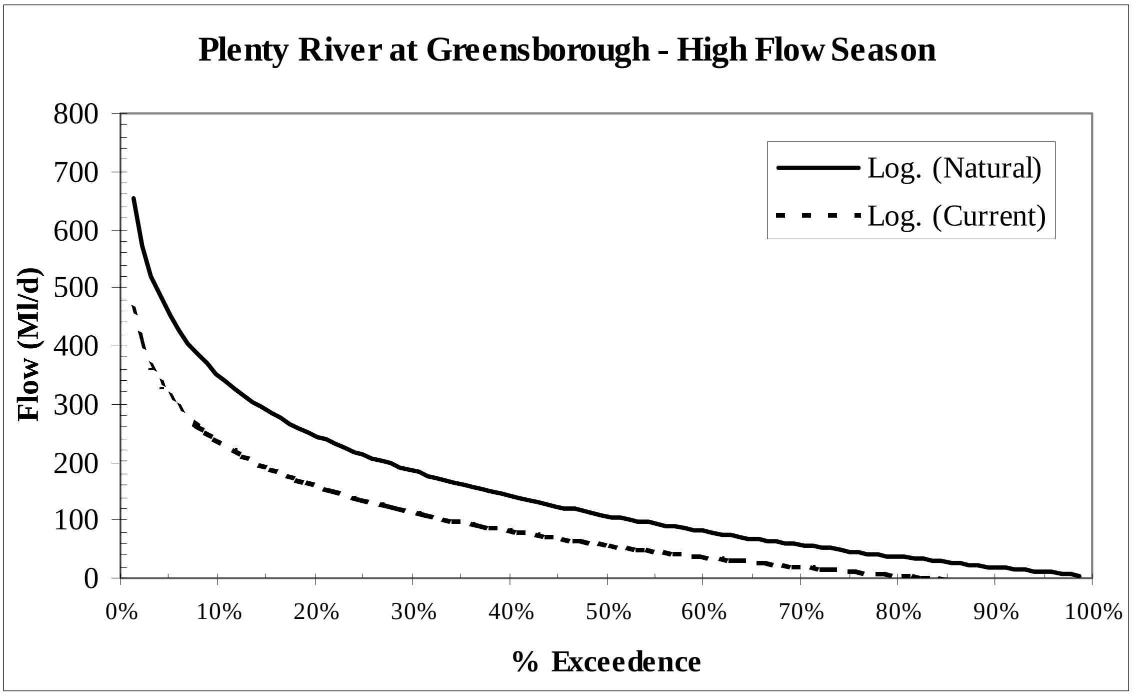


Figure 7 Flow duration curve for the Plenty River at Greensborough for natural (upper) and current (lower) flows.

Security of Supply High Flow Season – Current demand and Natural flows

The level of security for the current demand over the High Flow Season (assuming all current winterfill licences are to be supplied only over that season, and not maintained as May to November diversions) is 100% or 18 years out of 18 (Table 5). However, in a number of years (1982 and 1997) the demand represents a relatively high proportion of the natural flow volume (79.9 and 75.3% respectively).

However, the flow data used were from Greensborough, in the lower part of the catchment. The majority of licences and farm dams are located further up in the catchment, so any inflows between Mernda and Greensborough would be included in the total flow volumes, but would be unavailable for diversion. SKM (2001) calculated a regression between the flow data at the Mernda and Greensborough gauges, finding that the flows at Mernda were about 92% of the flows at Greensborough. Thus, about 8% of the flow volumes calculated in this report may not be available for current diversions, making the reported margins between flows and demand even smaller.

Additionally, as noted above, the natural flows are likely to be an over-estimate as it is assumed that the licensed volumes are totally utilised each year. So while there is currently a 100% calculated security of supply, this should be seen as relatively borderline, with shortfalls likely in 1-2 years in 18.

Table 5 Total flow volumes, from Figure 5, and total demand over the High Flow Season for each year (Ml). 1980 is not included as data is only available for 2 months of the High Flow Season.

Year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
Volume		22235	2200	33118	16562	17128	15835	20821	9743	31181
Demand		7396	1758	10217	8312	7327	9504	7714	5962	9389
%		33.3	79.9	30.9	50.2	42.8	60.0	37.1	61.2	30.1
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	
Volume	28129	13711	37593	24371	5240	16760	34426	3742	5491	
Demand	10510	7171	13933	11771	4771	6040	12694	2816	3648	
%	37.4	52.3	37.1	48.3	91.1	36.0	36.9	75.3	66.4	

Impact of potential environmental flows

The data analysed above do not include a component for an environmental flow. Lieschke *et al*. (2000) recommended low flow (December to May) minimum environmental flows for three sites in the Plenty River. One site was located at Yarrambat, a short distance upstream from the Greensborough gauge. They recommended a minimum flow of 1.5 Ml/d in December and May (with lower minimums in other months). They also recommended that, for the winterfill period (suggested as June to November), diversions only be allowed to commence once the 80th percentile daily exceedence flow for any given month (June to November inclusive) has been attained at site 229216 (Plenty River at Mernda).

To get an idea of the likely impact of an environmental flow allocation, both 1.5 Ml/d and the 80th percentile exceedence flow for each month was applied to the data. The demand volumes was the same as for Table 5, but the available volume changed in the two cases (Figure 8).

As no individual month in the data had a flow of less than 1.5 Ml/d, an environmental flow of this magnitude would reduce the available by 185 Ml/year over the High Flow Season. While this further reduced the margin between available flow and demand, supply was still available in each year (but see comments above). Using the 80th percentile exceedence flow of each month as a passing flow, supply could not be secure in 5 years out of 18, with another 2 years marginal.

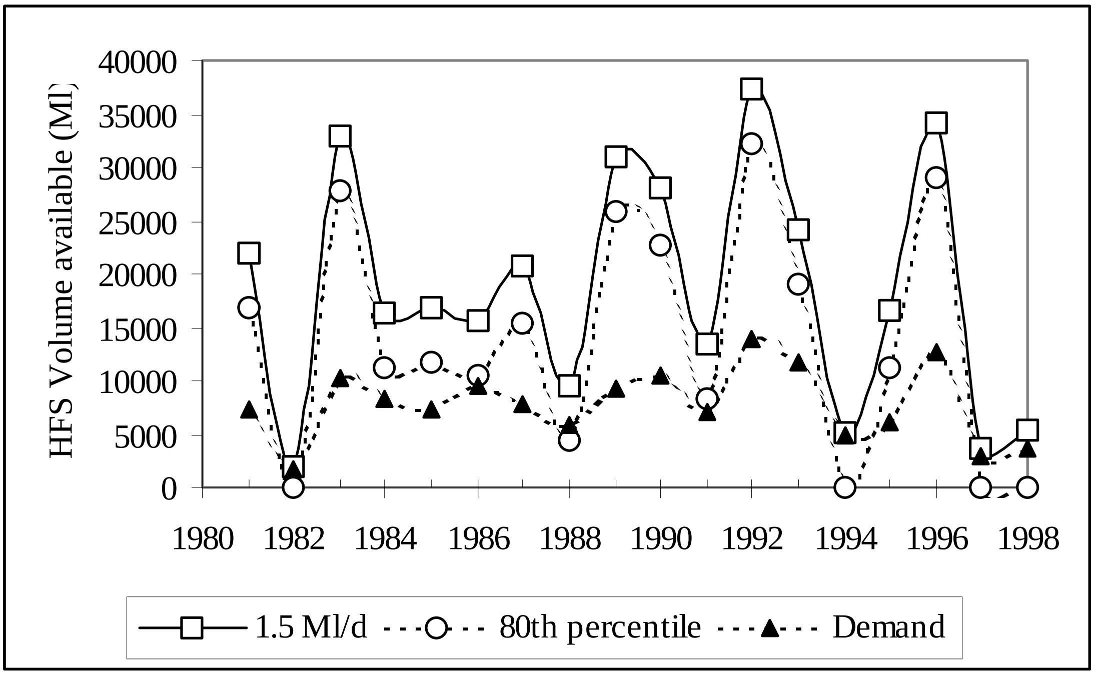


Figure 8 **Total flow volume with a 1.5 Ml/d and an 80th percentile minimum environmental flow and total demand in the Plenty River**

Drought Years (1982, 1997)

Total flow over the two drought years in the record were 12.3 and 20.8% of the mean annual High Flow Season flows in 1982 and 1997 respectively (Table 6). In both years, there was sufficient total flow to accommodate the demand (licences, farm dams and Tourourrong). Given the comments above, the differences between the demand and the calculated total flows are probably much smaller.

The impact of diversions on total flow volumes during the drought is substantial (Table 7). In 1982 and 1997, flows were reduced by 75% and 72% respectively. Given the scale of this reduction, it is not surprising that the stress index suggests that the river is over-stressed.

Table 6 Total flow (Ml) in each month of the High Flow Season and percentage of mean monthly flow in the Plenty River at Greensborough

Total flow						
Year	**Jul**	**Aug**	**Sep**	**Oct**	**Total**	**Demand**
1982	691	559	553	397	2200	1748
1997	624	889	1615	614	3742	2806
Percentage of mean flow						
Year	**Jul**	**Aug**	**Sep**	**Oct**	**Total**	
1982	18.4	11.5	11.0	8.3	12.3	
1997	16.6	18.4	32.2	12.8	20.8	

Table 7 Total natural and current flows (Ml) in each month for the two drought years.

Total flow						
1982	**Jul**	**Aug**	**Sep**	**Oct**	**Total**	**Demand**
Natural	691	559	553	397	2200	1748
Current	142	163	174	67	546	
Percentage of mean flow						
1997	**Jul**	**Aug**	**Sep**	**Oct**	**Total**	
Natural	624	889	1615	614	3742	2806
Current	299	227	483	37	1047	

Security of Supply – Low and Medium Flow Season

The security of supply for months outside of the High Flow Season can be calculated in the same way as for the High Flow Season above. The total annual volume for the months of January to June and November and December were compared to the total demand calculated over those months.

This shows a very low level of security of supply, with the demand volume higher than the available volume in 10 years out of 18 (Figure 9).

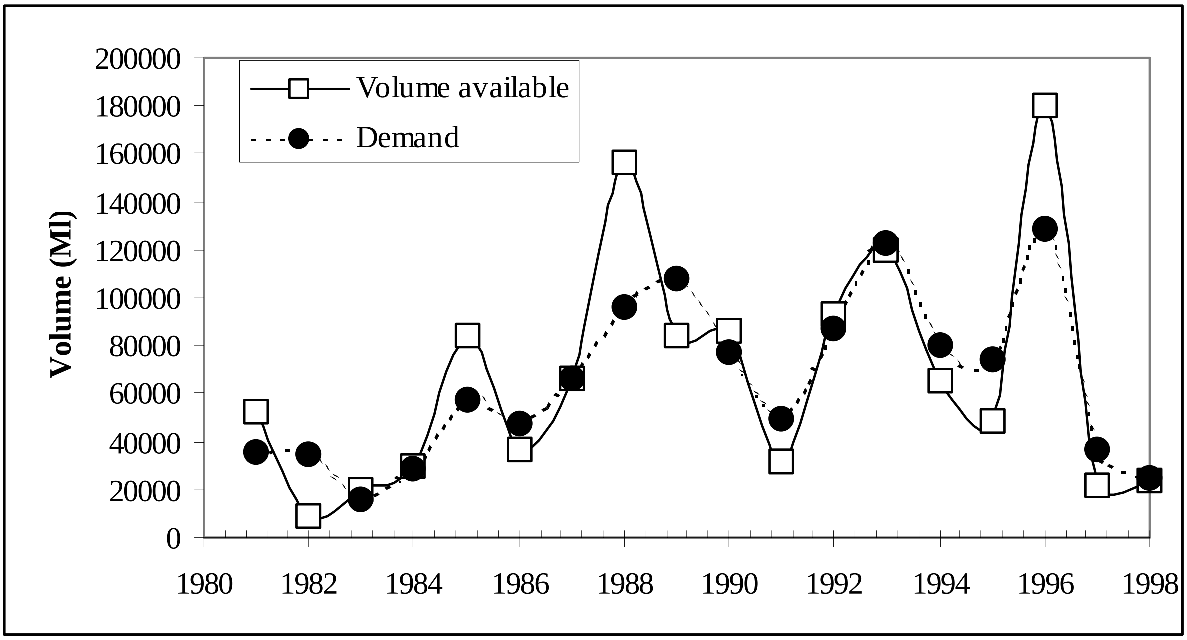


Figure 9 **Volume available and demand over the non- High Flow Season months of January to June and November to December.**

Comparison with Phase 3 results

Comparing the results from this study with those obtained during the Phase 3 project is difficult due to a number of differences:

- The Phase 3 flow data was generated for a point immediately upstream of the junction with the Yarra River, and was based on an area relationship with flows gauged at Mernda;
- No accounting for the inflow of the Mernda STP was made;
- The data did not include diversions due to the presence of farm dams;
- The Minimum Flow Pattern for the High Flow Season was based on the two wettest months of the Medium Flow Season; and
- Diversion data was based on licences issued to 10 September 1998.

The Phase 3 results (Table 8) had a different seasonal analysis, with a much shorter High Flow Season and a much longer Low Flow Season (*cf.* Table 4). This may be a result of using different gauged data to generate natural flows, but may also reflect the impact of additional diversions due to farm dams. Additional diversions due to farm dams, particularly in December, January, June and July may well be sufficient to shift the seasonal pattern for those months.

For a more direct comparison, stress levels using the current data (based at Greensborough and which includes farm dam impacts) were calculated for the seasonality used in the Phase 3 analysis. This demonstrates the additional stress in the river due to the farm dam component of the diversions. In each season, the stress levels increased, particularly demonstrating the impact of farm dam filling during the High Flow Season.

This emphasises the potential impact of farm dams. SKM (2001) showed that the diversions of flow due to farm dams was much higher than the recorded licensed diversions in the Plenty

River (see Figure 6). In many months, the impact of farm dams was greater (in volumetric terms) than the impact of diversions from the East Branch at Tourourrong Reservoir. Without detailed knowledge of farm dam impacts, analyses of flows and licensed or recorded diversions may well underestimate the true impact on flow regimes.

Table 8 CSF table from Phase 3 analysis showing stress values for each season, and stress values when the current data are analysed with the same seasonality.

Season	High Flow Season	Medium Flow Season (1)	Medium Flow Season (2)	Low Flow Season
Months	August-October	July	November	January-June, December
Median Natural Flow (Ml/d)	79.8	50.9	34.8	22.8
Minimum Flow Pattern	July, November	November	December	
Median MFP Flow (Ml/d)	46.0	34.8	30.6	10.5
Median Current Flow (Ml/d)	51.5	26.9	16.5	6.6
Stress	**0.84**	**1.23**	**1.46**	**1.37**
Stress - current data	**1.27**	**1.46**	**1.66**	**1.72**

References

Lieschke, J., Grgat, L. and Zampatti, B. (2000) An Assessment of Environmental Flow Requirements for the Plenty River Catchment. Report prepared for Melbourne Water Waterways and Drainage by Department of Natural Resources and Environment.

SKM (2001) Assessment of the impact of farm dams in the Plenty River catchment. Report prepared for Melbourne Water Waterways and Drainage by Sinclair Knight Mertz (Draft 1).