ENVIRONMENT REPORT

THE HEALTH OF STREAMS IN THE WIMMERA BASIN

A REPORT BY EPA VICTORIA AND WIMMERA CMA

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SUMMARY

This is a joint report by EPA Victoria and Wimmera Catchment Management Authority (CMA) on the condition of streams in the Wimmera basin. It presents a broadscale snapshot of river health and attempts to relate this to the impacts of drought, environmental flows or other factors affecting streams in the basin. Macroinvertebrates are the primary indicator of river health used in this report and assessments are based on biotic indices specified in the *State Environment Protection Policy (Waters of Victoria)*.

The snapshot used data collected from spring 2004 to spring 2005. The region has been experiencing drought for many years, beginning in 1997–98, although varying in intensity during this time. The period of sampling does not include 2006, when the drought intensified and many streams either dried up or were greatly reduced. Data from this time period was not available when this report was being prepared.

Broadscale snapshot of condition

Many sites within the Wimmera basin rated poorly due to a lack of flow or an absence of water over the summer to autumn period. While many streams in this region are naturally intermittent, this would have been exacerbated by the long-term drought.

Significant flow diversions in the middle reaches of the Wimmera River are increasing the effects of the drought in the lower Wimmera. The impact is mainly apparent downstream of Antwerp, where the majority of ratings were 'poor' or 'very poor'.

Common problems found in the Wimmera that influenced the quality of macroinvertebrate communities were high salinity levels, low (or unnaturally high) dissolved oxygen (DO) levels, poor riparian condition and land degradation.

More than half of the sites assessed in this period were rated 'good' or 'very good', with less than a third rated 'poor' or 'very poor'. However, many sites originally selected for sampling were dry in both seasons and could not be sampled. This must influence the results, as many streams within the basin could not be assessed. This will have artificially increased the ratio of 'good' or 'very good' sites compared to the poorer quality sites. Unfortunately, the exact number of dry sites was not recorded.

The further contraction of the stream network due to the increased severity of drought in 2006 and 2007 is certain to have reduced the overall health of streams in the basin to less than that found in this assessment.

INTRODUCTION

Rivers and streams are important to our economic and social wellbeing, as well as being critical to maintaining many environmental values. The Victorian River Health Strategy (NRE, 2002) provides the statewide framework for communities to work with government to manage and restore rivers over the long term. At a regional level, CMAs have developed river health strategies that provide detailed actions and plans for the management of each individual catchment. State environment protection policies (SEPP's) developed by EPA Victoria establish objectives and attainment measures for the environmental values that the community wishes to protect.

Community groups take an active interest in the condition of their own local waterways and community education about river health reaches many landholders. These strategies and programs periodically need to assess the health of streams in order to know whether management actions have been effective, or if further environmental condition improvement actions are needed.

This joint report from EPA and Wimmera CMA presents a broadscale snapshot of aquatic condition, and attempts to relate this to the impacts of drought, environmental flows or other factors affecting streams within the Wimmera basin. The Avon–Richardson River system is included in the Wimmera basin and the snapshot assessment.

The report has been done for this basin at this time because a broadscale snapshot assessment of stream health has not been done here before. The report makes use of existing resources by utilising data collected for other purposes. This basin also has some known serious threats to freshwater environmental health.

The snapshot of stream health used data collected from spring 2004 to spring 2005.This assessment is largely concerned with the effects of drought on stream health. The region has been experiencing drought for many years, beginning in 1997–98, although varying in intensity during this time. The period of sampling does not include 2006, when the drought intensified and many streams either dried up or were greatly reduced.

Factors other than drought that may affect aquatic health in the Wimmera include the positive effects of environmental flows, and the negative effects of increasing salinity and eutrophication. Some factors may also occur simultaneously (for example, drought conditions causing increased salinity).

The rapid bioassessment (RBA) of macroinvertebrate community composition has been used in this report. This approach is well established and incorporated into state (such as Index of Stream Condition (ISC)) and national (for example, National Land and Water Audit) programs. Specific regional indicators and objectives have also been defined for macroinvertebrates in the SEPP (Waters of Victoria).

The data used in this report has been generated with funding from several sources: Wimmera CMA, EPA, the

Sustainable Rivers Audit implemented by the Murray–Darling Basin Commission, the National Action Plan for Salinity and Water Quality funded by the Commonwealth Government, and the River Health Initiative funded by the Victorian State Government. Many of these broadscale sampling programs are ongoing and subsequent data will be collected and analysed from the Wimmera Basin.

The monitoring programs for the data used in this report are aimed at condition assessment over large areas and do not lend themselves to the detailed assessment of individual or specific stresses. While the effects of such environmental factors may be apparent from these data and are commented on, these are best assessed with specifically designed and targeted studies.

Wimmera CMA has been conducting detailed monitoring of the effects of environmental flows on the Wimmera and MacKenzie Rivers (Butcher 2007). Preliminary findings from these investigations suggest that environmental flow allocations are important in lowering electrical conductivity (EC) levels in the lower Wimmera River. This better quality water is able to support a more diverse macroinvertebrate community.

THE BASIN

Description of the catchments

The Wimmera basin is situated in the north-west of Victoria and contains the Wimmera River, Victoria's largest endoreic (flow not terminating in the sea) river. The basin is large (approximately 2.4 million hectares), with a broad range of land uses.

Much of the area is farmland, primarily used for grazing (sheep and cattle) and cropping (wheat, barley, legumes and pulses). Other agricultural activities in the region include orchards, olive groves and vineyards. A small proportion of the catchment has remained uncleared, the most notable areas being the Grampians and Little Desert national parks.

The Wimmera River commences within Mount Buangor State Park, flowing north-west through Glenorchy to Horsham and being joined by major tributaries including Mt Cole, Wattle, Concongella and Mt William creeks. From this section of the river, two distributary streams, Yarriambiack Creek and Dunmunkle Creek, occasionally flow north from the river. Yarriambiack Creek flows through Warracknabeal and Hopetoun to Lake Corrong.

Beyond Horsham, the Wimmera River heads west, joined by the MacKenzie River and Norton Creek. After this, the river turns north, flowing through Dimboola and Jeparit before entering Lake Hindmarsh. In exceptionally wet years it flows through to Lake Albacutya and the Terminal Lakes in Wyperfeld National Park. The Avon–Richardson River catchment lies to the north-east of the Wimmera River system.

This system comprises two main rivers, the Richardson and the Avon. They meet north of Marnoo, with the Richardson River coming in from the south and the Avon River from the south-west. After the confluence, the Richardson River continues north, flowing through Donald and ending at Lake Buloke.

The Parilla Sands is the main aquifer underlying much of the region in this assessment. It is highly saline, with salinities exceeding 20,000 mg/L. The aquifer intersects with the streambed in places, particularly in the lower reaches of the Wimmera River, resulting in very high salinities and the formation of saline pools in some places (Anderson and Morison 1989).

Rainfall and stream flows

Rainfall within the catchment has been below average for much of the time since 1997, with several periods of severe drought conditions (Bureau of Meteorology 2006). This has had dramatic effects on the volumes of water within streams in this catchment, resulting in greatly reduced flows since 1997 (see Figure 1 for two examples).

Flow rates can also be affected by factors other than rainfall, including the actions of humans. Water diversions, impoundments and regulatory structures are common in this catchment. Most of the larger waterways – including the Wimmera River – are highly regulated, especially in their middle and lower reaches.

The Wimmera Mallee Stock and Domestic Supply (WMSDS) system uses the Wimmera River as a supply line and substantially alters its natural flow regime (SKM 2002). The first diversion of flow occurs downstream of Glenorchy, with flows in the river remaining largely unaltered upstream. Downstream of Glenorchy, multiple structures are used to divert and store water for various agricultural, recreational and domestic purposes. These include in-stream weirs, storage lakes and dams, and connecting channels.

The MacKenzie River and Mt William Creek, two of the river's largest tributaries, are also heavily regulated. Both are interrupted by dams and flow diversions.

The Wimmera catchment naturally has a high variation in rainfall and flow rates, both temporally and spatially. Many smaller streams would naturally have been intermittent or ephemeral, while larger stream flows would be highly variable from season to season and year to year. The combination of recent weather patterns and substantial flow alterations has reduced the variability of flow in these larger streams. Reports have investigated the impacts of altered flow regimes in the Wimmera system (SKM 2002, Lind 2004, Sharpe & Quinn 2004).

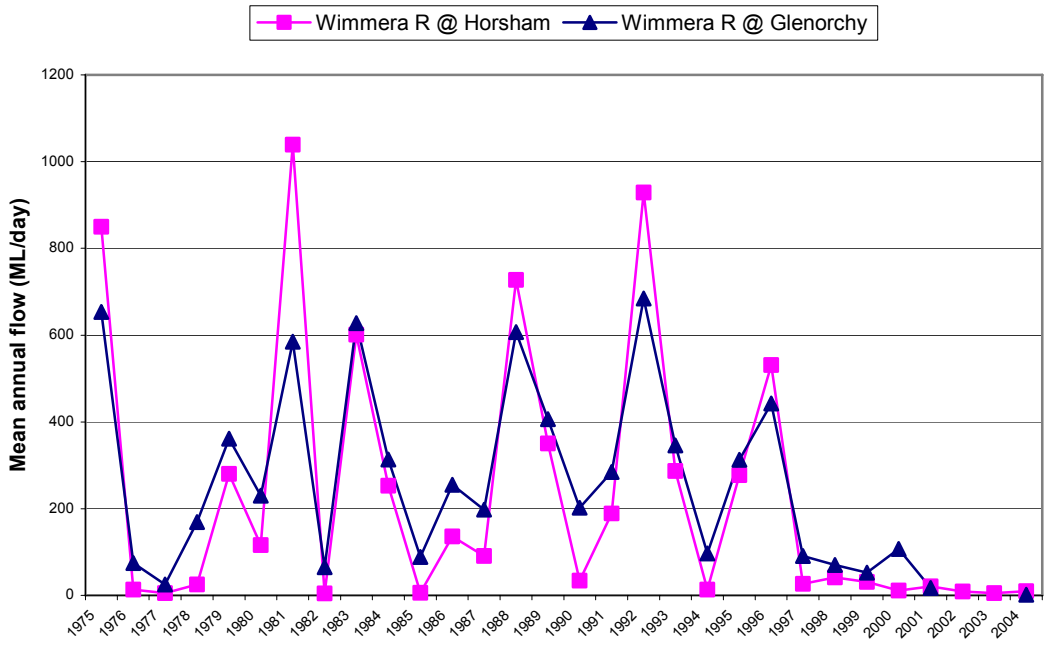

Figure 1: Mean annual flow for the Wimmera River at Horsham and Glenorchy since 1975.

In 2004, the Wimmera and MacKenzie rivers were allocated water from the environmental water entitlement defined by the Wimmera Glenelg Bulk Entitlement. The aim of the releases was to improve flow conditions, particularly during the drier months, by mimicking some flow components such as summer freshes and base flows. This approach attempts to maintain and improve the overall health and quality of the river systems. Due to low water storage levels, the full allocation of water as defined in the bulk entitlement has not been delivered in recent years.

ASSESSMENT METHODS

Rapid bioassessment (RBA)

EPA and other organisations have used macroinvertebrates as indicators of stream health for many years. Macroinvertebrates, which include snails, worms, shrimps and insects, provide information on the health of streams by their presence or absence.

Macroinvertebrates are used as indicators, as they are critical to ecological functions within streams. They are easy to collect, relatively inexpensive to sample and comparable within regions. The types of macroinvertebrates found in a stream are compared to reference sites or predicted lists of taxa from a good-quality site in the same region of Victoria. This lets us rate the stream against what we know a healthy stream should be like. These ratings can be compared with other sites in an area, and over time at the same site.

Sampling of macroinvertebrates occurs in many ways, and the rapid bioassessment (RBA) methods were used in collecting data for this report. RBA is best at providing a general overview of stream health, although it can also be used to investigate the effects of a specific stressor. It is often adopted for large-scale projects such as whole-catchment investigations. Detailed information on RBA procedures can be found in EPA publication 604, *Rapid bioassessment methodology for rivers and streams* (EPA 2003).

The RBA method usually involves taking macroinvertebrate samples from both edge (no-flow or slow-moving water) and riffle (medium to fast-moving water) habitats. Only edge data was used in this assessment due to the scarcity of riffle habitat within the basin. While the absence of riffle habitat is largely due to the natural characteristics of the streams in this basin, drought conditions may be limiting any riffle areas that were formerly present.

Sampling is conducted using pond nets, sweeping edge habitats to dislodge aquatic macroinvertebrates into the net. This sampling is qualitative, with approximately 10 m of habitat along the stream's edge sampled on each occasion.

Figure 2: Live-picking macroinvertebrates from the Wimmera River

Data sources

The majority of data was obtained from biological monitoring undertaken by EPA for various projects. These include the Sustainable Rivers Audit (SRA), internal long-term investigations and the National Action Plan (NAP). Water's Edge Consulting, under contract to Wimmera CMA, collected 41 samples in 2005. All data used in this report was collected from spring of 2004 up to and including spring of 2005. This incorporated a large number of sites assessed within this period under the SRA program. As a result, a total of 112 sites are assessed in this report (Figure 3).

Many sites over this period were found to be dry. Only sites with sufficient water levels in one or more seasons contributed data to this report. Many sites were assessed using only one season's data, rather than the recommended two combined seasons of data.

Analysis methods

Three biotic indices were calculated from the macroinvertebrate RBA data: AUSRIVAS, SIGNAL and Total Taxa. These are established biological indicators for the region where most of the sites occur and are specified in the SEPP (Waters of Victoria) (Government of Victoria 2003).

The three individual index scores were aggregated to provide one value using the same approach as the Index of Stream Condition (DSE 2005). The aggregated score is a simple score out of ten. This value is called the Macroinvertebrate Biological Indicator score (MBI score). MBI scores were then translated into equally sized rating categories of condition, for ease of understanding, as follows:

0–2	very poor
3–4	poor
5–6	moderate
7–8	good
9–10	very good.

Prior to further analyses, a comparison between the source data collected under different programs was undertaken. This was to provide assurance that the data sets were comparable and not inherently different due to different samplers. An analysis of similarity (ANOSIM) was carried out, along with appraisal of the associated dendrograms, ordination plots and taxa lists. Particular attention was given to sites in close proximity to each other, on the assumption that their fauna were likely to be similar. Although not exactly the same, no inherent differences between samples taken by different samplers were found. A global R of 0.173 generated via ANOSIM revealed no statistical difference between data sets.

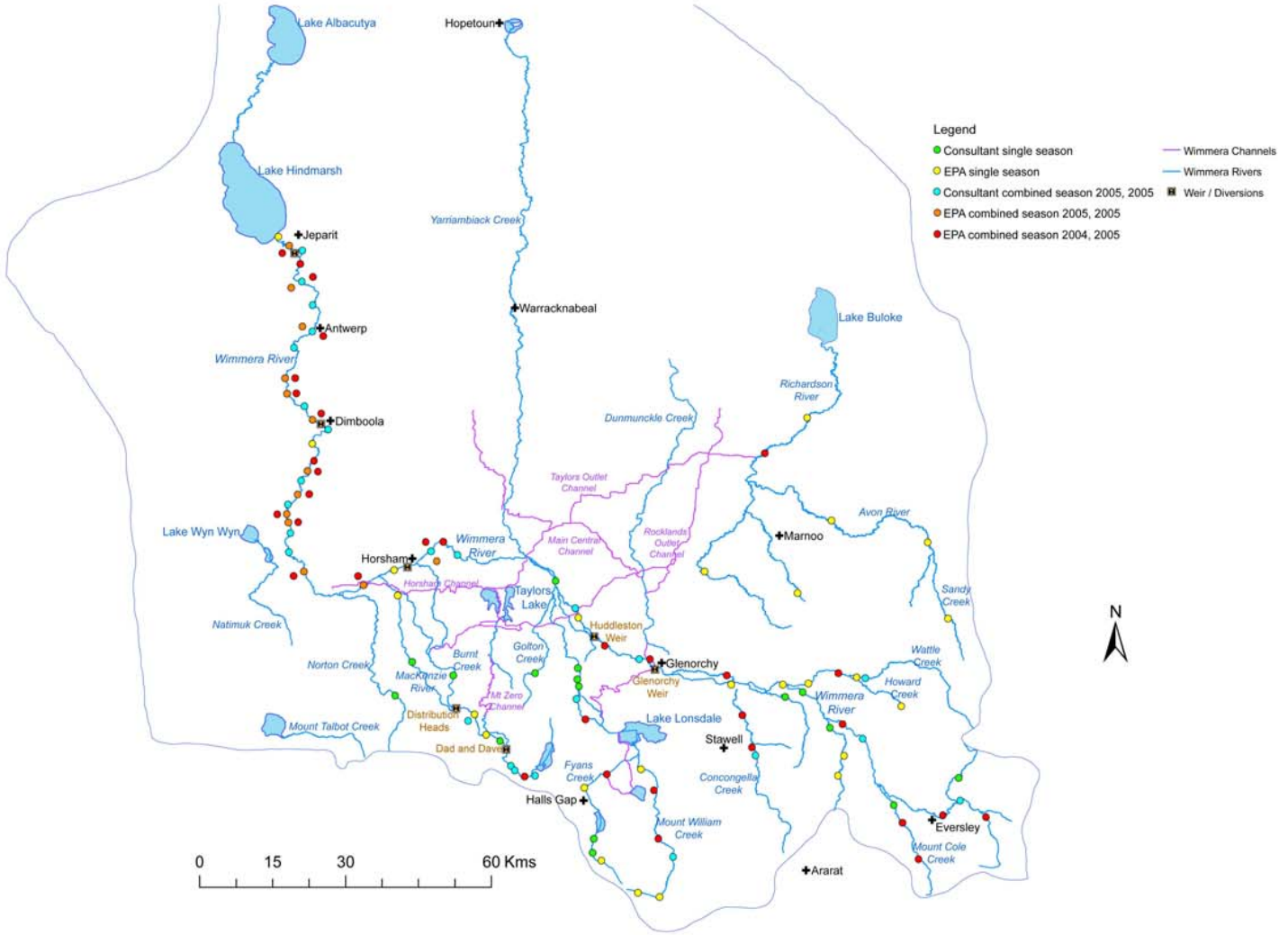

Figure 3: Wimmera basin sites sampled between spring 2004 and spring 2005.

BROADSCALE SNAPSHOT OF CONDITION

Based on the MBI scores, over half the sites in the Wimmera basin were rated as 'good' or 'very good', with just fewer than 30 per cent rated as 'poor' or 'very poor' (Figure 4).

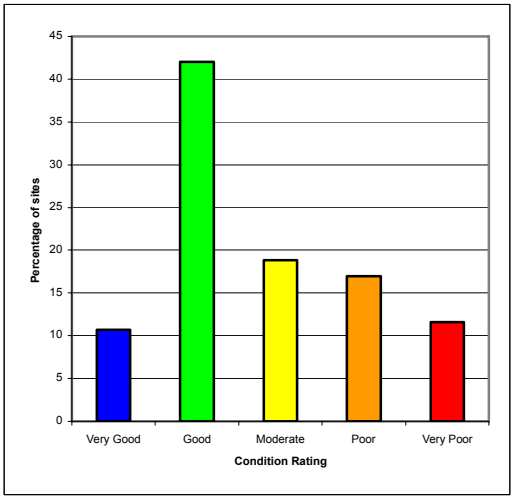

Figure 4: Summary of site condition (as percentages) in the Wimmera basin, based on MBI scores.

The locations and ratings of the assessed sites are displayed in Figure 5. Some general trends within the basin were that Wimmera River sites at or downstream of Antwerp were in poor or very poor health, while the rest of the river was rated moderate to very good. Streams in the Grampians (upper MacKenzie River, Fyans Creek) generally were rated good or very good, while streams in other parts of the basin were rated lower. The Avon–Richardson River system was rated very poor on all occasions except one.

The results shown in Figure 5 are further discussed on a reach-by-reach or stream-by-stream basis (Figures 6–10).

Wimmera River reach 1: Lake Hindmarsh to Antwerp

The lowest reaches of the Wimmera River contained a large proportion of the 'very poor' and 'poor' sites in this assessment. Four 'very poor' and seven 'poor' sites occurred between Antwerp and Lake Hindmarsh.

Lack of flow in this region is an obvious cause of degradation. As very little freshwater flow has reached this section of the river in recent years, saline groundwater intrusions have had serious impacts on water quality.

Algal blooms have also been common in this area, often causing high DO levels. This is due to photosynthetic activity in the afternoon, and low DO levels at night or in the early morning due to algal respiration without any photosynthesis. Salinity and dissolved oxygen issues are almost certainly the cause of the 'very poor' or 'poor' macroinvertebrate results.

Wimmera River reach 2: Antwerp to Dimboola

This reach has also experienced low freshwater flows in recent years. However, these sites had lower salinity and DO levels closer to those expected. They were all rated either 'moderate' or 'good' by the biotic indices.

While there is still a lack of flow at these sites, the size and continuity of pools allowed water quality factors (such as DO and salinity) to remain within reasonable bounds. The presence of acceptable water quality and habitat conditions in turn allowed for a reasonable suite of biota.

The inflow of groundwater in this section of the river may be less than in reach 1, due to topography and reduced intersection of the streambed with the saline aquifer. However, further reduced surface flows in this reach may result in greater intrusion of groundwater, with associated reductions in water quality. This is consistent with initial observations from 2006 and 2007.

Wimmera River reach 3: Dimboola to MacKenzie River

Sites between Dimboola and the MacKenzie River confluence were mostly rated 'good', with some exceptions rating 'moderate' or 'very good'.

As with sites around Dimboola, these sites have acceptable salinity and DO levels. The reasons behind the sites in this area generally rating better than those downstream appear to be due to two main factors.

Firstly, they receive freshwater more often, allowing for better water quality throughout the year, as the weir pool at Dimboola restricts flows of freshwater passing to the downstream reaches. Structural alterations to the weir and the development of new operating rules have recently allowed freshwater flows in the Wimmera and other tributaries to have greater influence on downstream reaches. However, due to recent drought conditions, the volume of water has generally not been enough to dramatically improve sites downstream of Dimboola. Sites close to the MacKenzie River confluence may benefit from flows coming into the Wimmera River, although this is expected to be slight, as flows in the MacKenzie River have only reached the Wimmera once in the past five years. Environmental flows delivered from both the MacKenzie River and further upstream in the Wimmera River can be important in providing adequate freshwater flows to these lower reaches.

Norton Creek also flows into this section of the Wimmera, and may occasionally provide additional freshwater after rains.

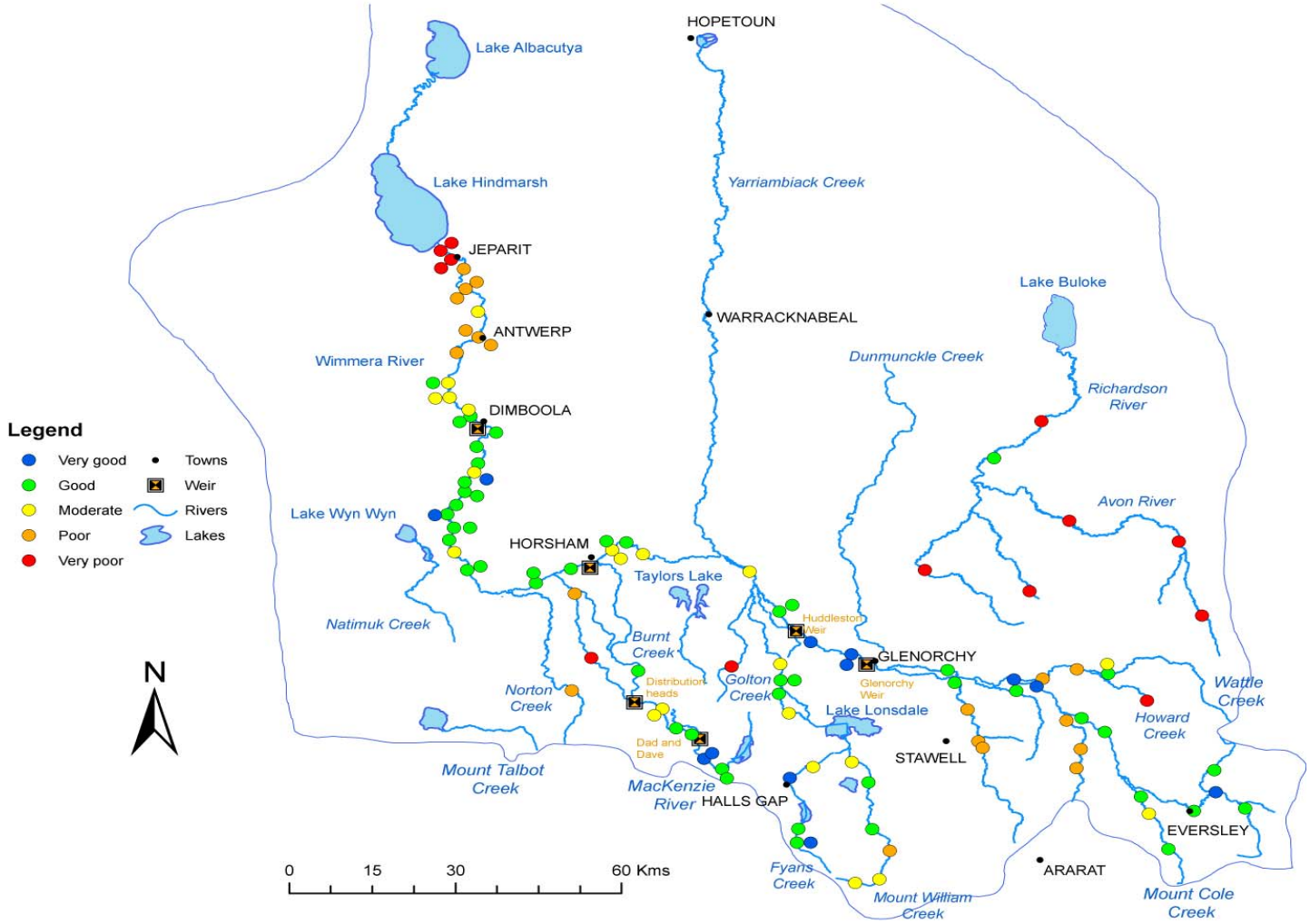

Figure 5: Condition of sites in the Wimmera basin based on MBI scores.

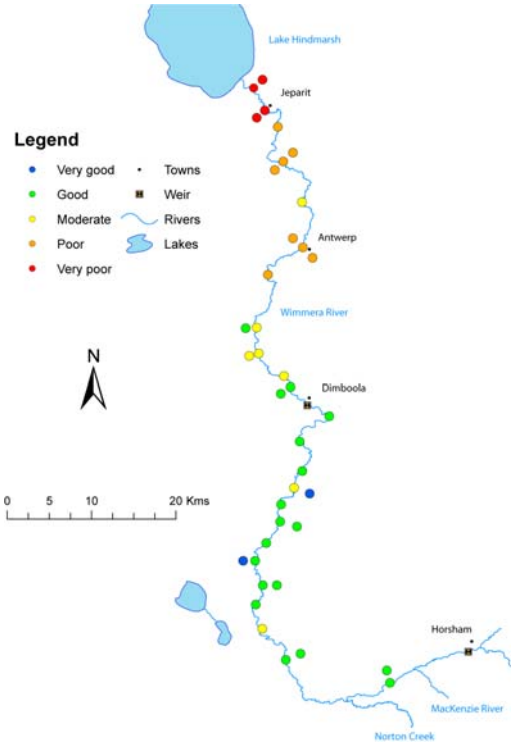

Figure 6: Wimmera River reaches 1–3.

The second factor that is likely to be contributing to the healthier community is the riparian zones, which are wider and have better quality. Land-use impacts are also less apparent. The Little Desert National Park abuts the river within this reach, providing natural riparian characteristics, in contrast to the farmland in other areas. Riparian vegetation is important for providing organic matter in the form of leaves and habitat material like twigs and branches, reducing sediment and nutrient run-off from the surrounding catchment and regulating temperature by providing shading.

Two sites on the river received 'very good' ratings in this reach. Both of these were on the edge of the Little Desert National Park.

Wimmera River reach 4: MacKenzie River to Mt William Creek

The section of the Wimmera River between the MacKenzie River and Mt William Creek contained four sites rated 'moderate', and three sites rated 'good'.

There are no national parks and few areas of riparian vegetation of significant extent or excellent condition. Land use is predominantly farmland in this area, with narrow strips of trees commonly forming the riparian zone. The junction with Yarriambiack Creek is one area where riparian vegetation is in good condition.

The city of Horsham is in this reach and stormwater or other run-off is likely to have adverse effects on the aquatic biota. This reach is also strongly influenced by the Huddleston Weir, where river flows have to exceed 1600 ML/day before any flow can pass downstream. Planned modifications to this structure will help to return low flows to the river.

As with most sections of the lower to middle Wimmera, low flow conditions produced low DO levels in this reach, particularly during autumn 2005.

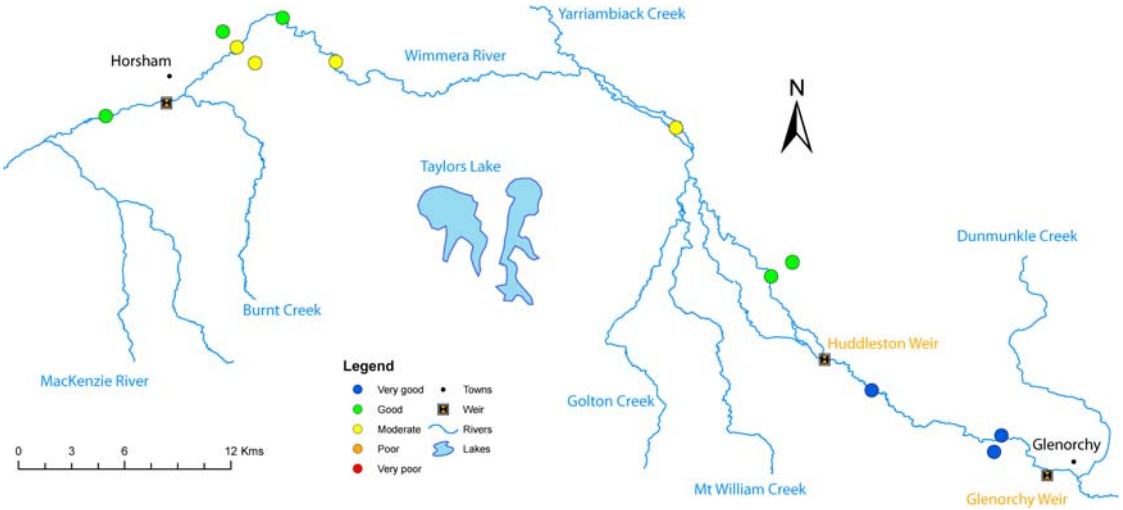

Figure 7: Wimmera River reaches 4 and 5.

Wimmera River reach 5: Mt William Creek to Glenorchy

Between the Mt William Creek confluence and Glenorchy, five sites were assessed. Three were rated 'very good', and two 'good'.

The two main diversion points within the Wimmera River occur in this reach, at Huddleston's and Glenorchy weirs. The three sites rated 'very good' were all upstream of Huddleston's Weir. Although water diversions occur, the more natural flow regime upstream of Huddleston's Weir may be the reason for the better condition rating here.

Wimmera River reach 6: Upstream of Glenorchy weir

From upstream of Glenorchy Weir to the Wimmera's source the flow regime is close to natural. In this section of the river, all sites scored either 'good' or 'very good'.

This is likely to be due to the lack of flow alteration and greater habitat diversity at these sites. Other variables (such as catchment clearing for agricultural use, and water quality parameters) remain similar to other sections of the river. Glenlofty and Mt Cole creeks, small tributaries of the upper Wimmera River, similarly rated well for the same reasons.

Concongella Creek

All four sites on Concongella Creek had water in both spring and autumn. However, some sites were reduced to isolated pools in autumn, indicative of the intermittent nature of this stream.

The furthest downstream site, close to the confluence with the Wimmera River, was rated as 'good'. The three sites further upstream were rated 'poor', and generally had higher salinity and lower DO levels, particularly during autumn sampling. The 'poor' sites also had highly degraded riparian zones, which would contribute to the low biotic scores.

Six Mile Creek

The three sites on Six Mile Creek were all rated 'poor'.

This creek flows within farmland and all sites were found to have isolated pools or low water levels in spring and no water in autumn. Similarly to the Concongella Creek sites, poor ratings were generally associated with high salinity and turbidity, and low DO levels.

The condition of Six Mile Creek is a result of a lack of flow and poor riparian conditions in the farmland area.

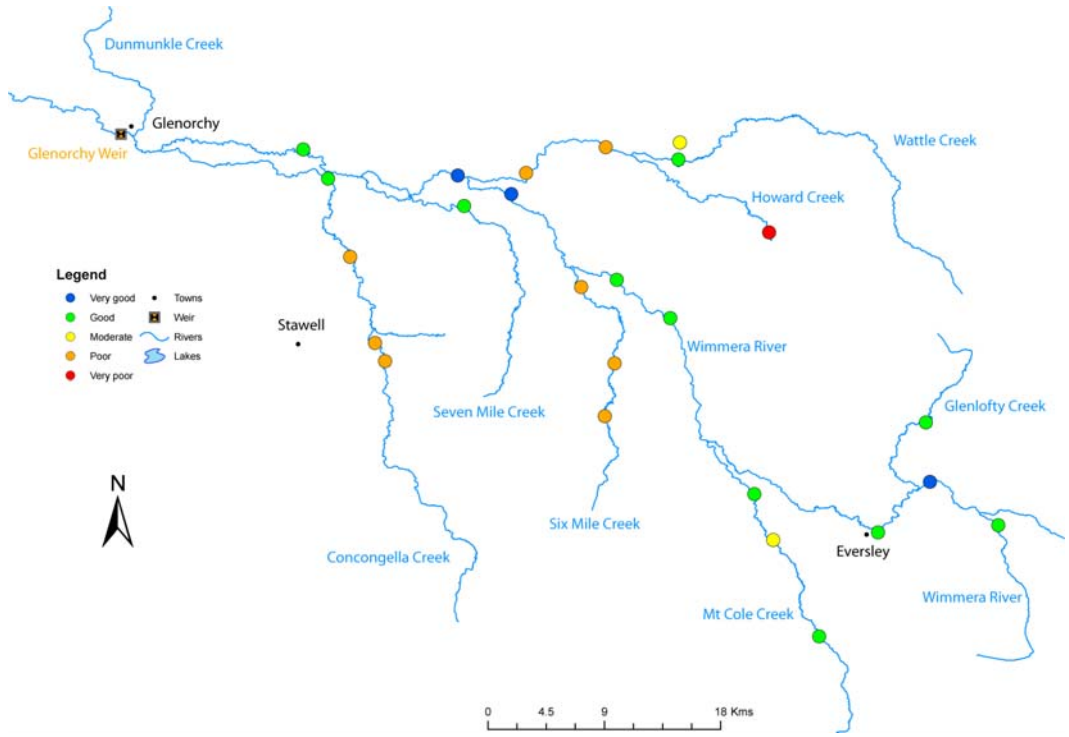

Figure 8: Wimmera River reach 6 – Concongella Creek, and Six Mile Creek.

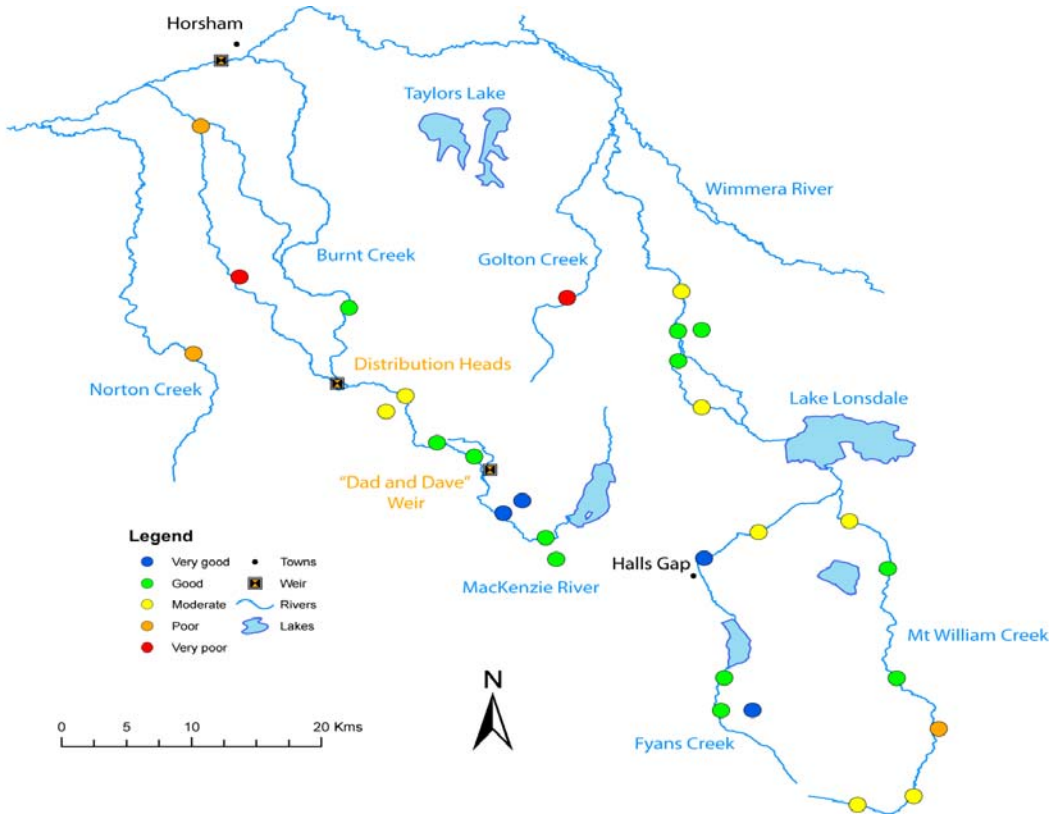

Figure 9: MacKenzie River, Fyans and Mt William Creeks, and several smaller streams.

MacKenzie River: below Distribution Heads

The MacKenzie River was found to be dry in the lower reaches during autumn 2005. The single-season results from the two sites in this area were 'poor' and 'very poor'.

This would primarily be due to the lack of persistent water in this section of the river, as riparian condition and land use was similar to sites elsewhere that rated higher.

The lack of water in the lower reaches over summer/autumn is due to low rainfall and the diversions further upstream, at Dad and Dave Weir, and Distribution Heads. These diversions direct water to storages such as Taylor's Lake and Pine Lake, and to Horsham's town water supply via the Mt Zero channel.

MacKenzie River: Distribution Heads to Dad and Dave Weir

Sites upstream of Distribution Heads but below Dad and Dave Weir were rated higher by the biotic indices, scoring 'moderate' and 'good'.

Only one site out of four was found to be dry in autumn (2005), suggesting better flow regimes. This section of river received environmental flows, which are likely to be the primary reason for the higher ratings, compared to results downstream. The proximity to the Grampians National Park may also be having an effect, as sites closer to the park were rated 'good'.

The more natural riparian zones and minimal land degradation in the Grampians provide favourable conditions for the biota and a source for downstream recruitment of sensitive species.

MacKenzie River: upstream of Dad and Dave Weir

At Dad and Dave Weir, water is diverted to the Mt Zero channel for Horsham's town water supply. This leads to a constant water supply above this point. Sites upstream of Dad and Dave weir and Distribution Heads had water all year round, and scored either 'good' or 'very good'.

These sites are all inside the boundary of the Grampians National Park and remain relatively natural streams. This provides excellent conditions for the biota, as shown by results of the biotic indices.

The modified flow regimes in this reach may have benefited aquatic macroinvertebrates through the creation of a permanent water supply, eliminating the stresses caused by low or zero flows. Altered flow regimes negatively affect aquatic life in most cases, but there appear to be positive effects in this reach.

Fyans Creek

Of the five sites in Fyans Creek four were rated 'good' or 'very good'.

Water levels at the other 'moderate' site were substantially lower in autumn, leading to reduced habitat availability for the biota. This site was also the only one outside the national park and may be showing impacts from land alteration or loss of riparian zone.

While two of the sites upstream of Lake Bellfield on Fyans Creek were dry in autumn, they still rated 'good', based on their spring samples, suggesting that the near-natural condition of the catchment has helped reduce any impact to the stream.

Mt William Creek

Mt William Creek runs along the outskirts of the eastern boundary of the Grampians National Park and all but one site scored either 'moderate' or 'good'.

The exception was a 'poor' rating at Redmans Road in the upper reaches of the river. The stream was reduced to isolated pools by autumn 2005 and experienced low DO levels.

Two other sites higher up in the system were dry or nearly dry over autumn, indicating that this section of the creek is intermittent or ephemeral in drier conditions such as those experienced in recent years.

Other sites on this stream varied with regard to persistence of water or continuous flow. Downstream of Lake Lonsdale the water levels were generally very low, with three sites dry in autumn and other sites with little water. This is likely due to the diversion of flows to Glenorchy, and minor impoundment of water in Lake Lonsdale (which was dry for the majority of the period) preventing downstream flow for a large proportion of the year.

Other small Wimmera River tributaries

Three smaller streams – Norton, Golton, and Howard creeks – had 'poor' or 'very poor' ratings for all sites sampled (Figures 7 and 8).

Norton and Howard creeks occur within farmland and were found to have isolated pools or low water levels in spring, and no water in autumn. The 'poor' to 'very poor' ratings were generally associated with degraded water quality, including high salinity and turbidity, and low DO levels. This can be linked to a lack of flow in these systems, and poor riparian conditions within the farmland area.

A significant proportion of Golton Creek occurs within the Grampians National Park and the single site assessed on this stream was within the park. Despite the minimal land degradation and excellent riparian conditions surrounding this site, it rated 'very poor'. The site had low water levels in spring, and was dry by autumn.

Fyans Creek, a considerably larger creek, has a similar high-quality catchment that maintains a good invertebrate community. This suggests that the low rating for Golton Creek is due to the highly ephemeral nature of the stream and the absence of larger pools that act as refuges for aquatic biota.

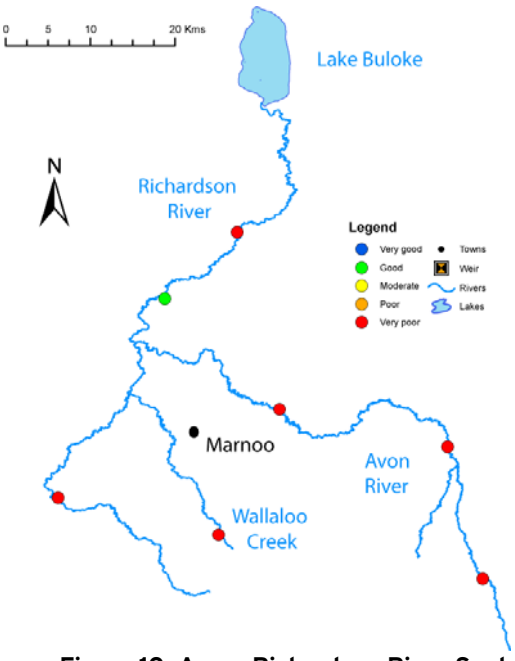

Figure 10: Avon–Richardson River System

Avon—Richardson River system

Many of the sites in the Wimmera basin that rated 'very poor' came from the Avon–Richardson system. Six of the seven sites were rated 'very poor' and all but one of these were dry in autumn.

The site that had water during both spring and autumn was rated as 'good'. It was located on the Richardson River downstream of the confluence with the Avon. Large, continuous pools persisted here throughout the year, enabling water quality to remain at acceptable levels.

Further downstream, the Richardson River opposite Middle Settlement Road rated 'very poor'. This site had very little water by autumn 2005 and was extremely saline (> 120,000µS/cm). It is likely that the water present was groundwater, as salinity levels such as these would not normally occur in runoff-supplied surface water systems.

At many of the single-season sites, DO levels were very low, which is often the case in isolated pools and streams with no flow. This can be extremely detrimental to many types of in-stream biota.

The primary problem in the Avon–Richardson system appears to be a lack of freshwater, caused by the prolonged dry period. As seen at Richardson River at

Keogh's Rd, the rivers can provide suitable habitat for the biota when enough freshwater is present.

SNAPSHOT SUMMARY

Many sites in the Wimmera basin rated poorly due to a lack of flow or an absence of water over the summer-to-autumn period. While many streams in this region are naturally intermittent, this would have been exacerbated by the long-term drought.

While RBA sampling is suitable for ephemeral streams, the way the indices are used to assess aquatic health could be refined to better cater for such streams.

Stream regulation is also a factor contributing to low flow conditions at some sites. Significant flow diversions in the middle reaches of the Wimmera River are increasing the effects of the drought in the lower Wimmera. The impact is mainly occurring at sites downstream of Antwerp, where the majority of ratings were 'poor' or 'very poor' due to significant saline groundwater intrusion.

Common problems found in the Wimmera that influenced the quality of macroinvertebrate communities were high salinity levels, low (or unnaturally high) DO levels, poor riparian condition and land degradation.

Water quality problems relate directly to low flows within the basin. While salinity and DO are influenced by many factors — including land degradation, nutrient enrichment, loss of shade and groundwater intrusions —, reduced flow conditions are certain to impact upon both parameters regardless of any other factors. The flow diversions and drought that resulted in low or no flow conditions will have had significant impacts on water quality.

More than half of the sites assessed in this period were rated 'good' or 'very good', with less than a third rated 'poor' or 'very poor'.

Considering recent drought conditions in the Wimmera, this suggests that stream health over the 20—2005 period was better than expected. However, many sites in the basin were found to be dry in both seasons and could not be sampled. This must influence the results, as many streams in the basin could not be assessed. This would have artificially increased the ratio of 'good' or 'very good' sites compared to the lower-rated sites.

As many 'poor' and 'very poor' ratings were attributed directly or indirectly to low flows or the absence of water in one season, reasonable water levels are a good indicator of a site being in moderate condition or better.

The further contraction of the stream network due to the increased severity of drought in 2006 and 2007 is certain to have reduced the overall health of streams in the basin to less than that found in this assessment.

REFERENCES

Anderson JR and Morison AK (1989). *Environmental flow studies for the Wimmera River — Part C: Water Quality and the Effects of an Experimental Release of Water*. Arthur Rylah Institute for Environmental Research, Technical Report Series No. 75.

Bureau of Meteorology, Australian Government, viewed 10 June 2006.

http://www.bom.gov.au

Butcher R (2007). *Wimmera River catchment macroinvertebrate monitoring program: 2006 sampling program*. Report to Wimmera Catchment Management Authority.

DSE (2005). *Index of Stream Condition: The Second Benchmark of Victorian River Condition*. Department of Sustainability and Environment, Melbourne.

EPA (2003). EPA Victoria's *Rapid bioassessment methodology for rivers and streams*. Publication 604.1, EPA Victoria.

Lind PR (2004). *Ecological Response to Environmental Flows in two Lowland Rivers*. PhD Thesis. Deakin University, Warrnambool.

NRE (2002). *Victorian River Health Strategy - Healthy Rivers, Health Communities and Regional Growth*. Department of Natural Resources and Environment, Melbourne.

Sharpe AK & Quinn GP. (2004). *Monitoring Environmental Flows in the Wimmera and Glenelg Rivers*. Sinclair Knight Merz and Cooperative Research Centre for Freshwater Ecology, Melbourne.

SKM (2002). *Stressed Rivers project – Environmental flows study, Wimmera River System*. Sinclair Knight Merz, Armadale.