

RIVER HEALTH: A SNAPSHOT OF THE EFFECTS OF THE 2003 BUSHFIRES

June 2004

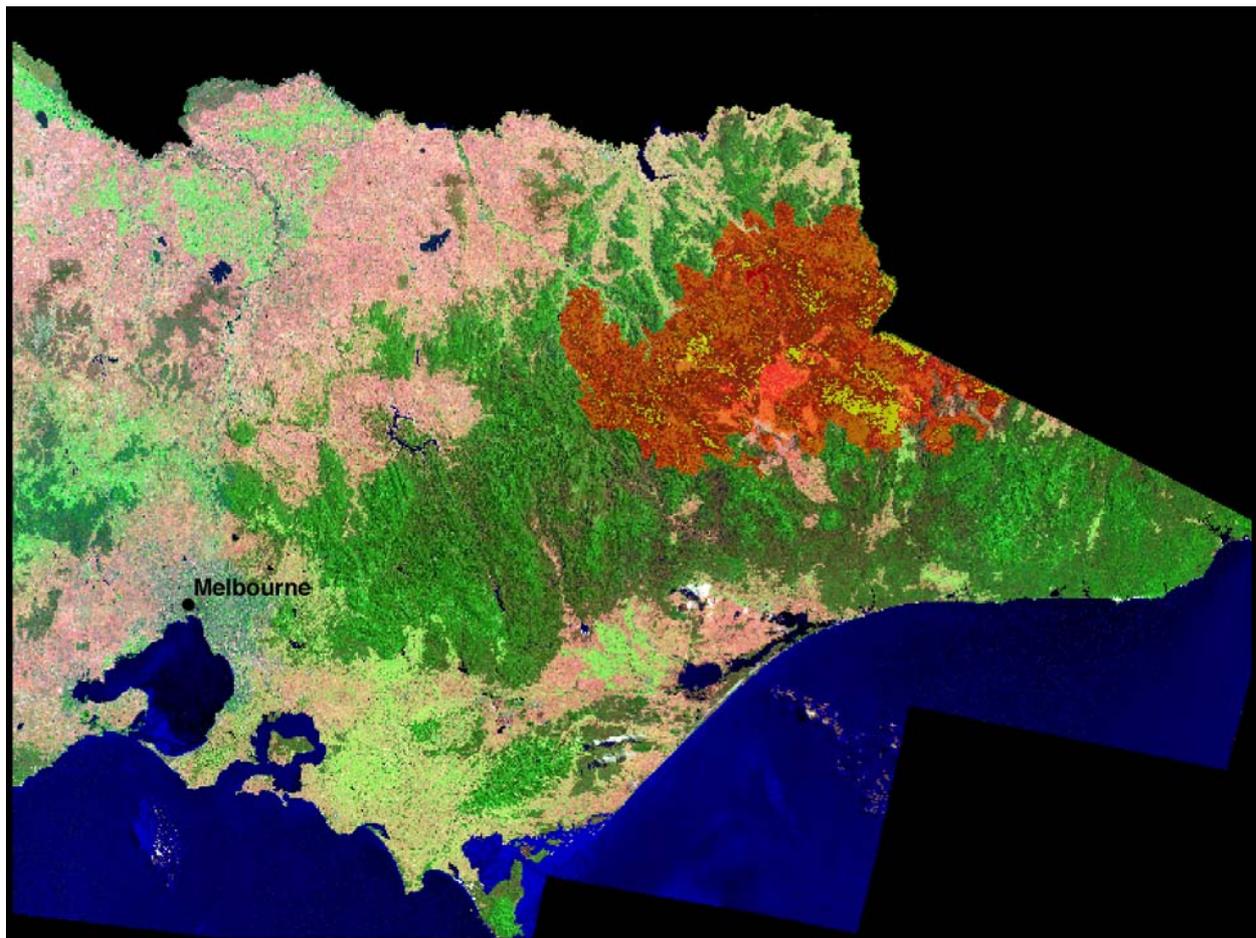
INTRODUCTION

South-eastern Australia experienced its worst drought in 100 years during 2002-2003. As a consequence of the extremely dry conditions that prevailed, fires burnt more than one million hectares of mostly State and national parks in north-east Victoria (Figure 1).

In addition to the effects on livestock and property, the fires also caused significant ecological impacts. While devastation to the land is a highly visible consequence of fire,

rivers are also affected because surrounding catchment condition is critical to river health. Of particular concern are the short and long-term impacts of the fires on water quality and stream life.

A total of six Victorian river catchments were affected (the Upper Murray, Kiewa, Ovens, Mitchell, Tambo and Snowy) in these fires, the worst since 1939. This report presents a snapshot of river health across the fire-affected region in the year after the fires.



Eastern Victoria, showing the area burnt in 2003

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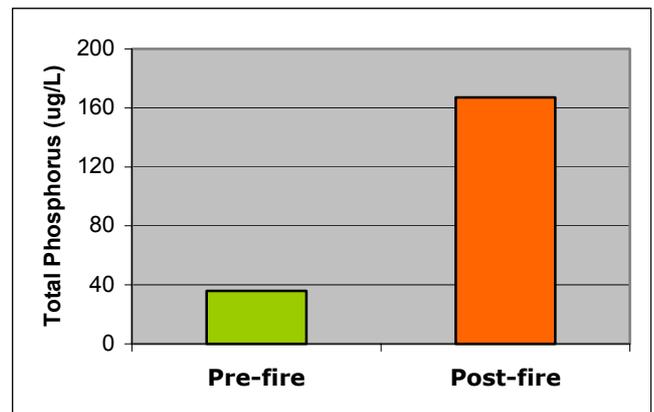
HOW FIRES CAN AFFECT RIVER HEALTH

The immediate impact of the fires themselves appear to be minimal, however there are several key ways in which stream ecosystems can be affected by fires. These include:

- **Changes in hydrology** - Flows will initially be higher following fires due to increased runoff from the cleared catchments. After several years, the regeneration of forest may result in lower flows as young forests tend to use and intercept more water than old growth forests.
- **Sedimentation** – Loss of vegetation coupled with changes in soil structure can lead to a build up of loose sediment and ash, that can be rapidly washed into streams during heavy rains (a sediment 'slug'). These sediments scour and smother instream habitat, reduce dissolved oxygen and light penetration in the water column, and clog the gills of fish and other aquatic biota.
- **Algal blooms** – Greater amounts of sediment entering the waterways also increase the concentrations of nutrients within the system. Higher levels of nitrogen and phosphorous coupled with reduced stream shading can lead to excessive plant and algal growth.



A sediment slug in the Ovens River at Whorouly. Further information on this event can be obtained at the EPA Victoria website www.epa.vic.gov.au



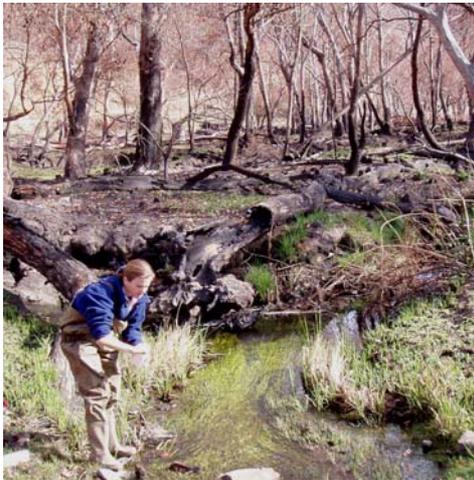
Phosphorus concentrations in the Buchan River before and after the fires

EPA'S BUSHFIRE RECOVERY PROGRAM

Fire is an integral part of the Australian landscape, yet our understanding of its effect on stream life is limited. To investigate this issue and to gather what may be new baseline data to meet future management needs, the State Bushfire Recovery Taskforce commissioned EPA Victoria to undertake a series of studies over a period of three years:

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- An in-depth study examining the health of two rivers, the Buffalo River which was affected by fire and the King River which was unaffected;
- A study focusing on post-fire changes in water quality and its effect on river health at five key sites within the region; and
- An assessment of river health across the entire fire affected area using aquatic macroinvertebrates (such as insects, snails and worms) as indicators of environmental condition.



Biological sampling of Limestone Creek in autumn 2003

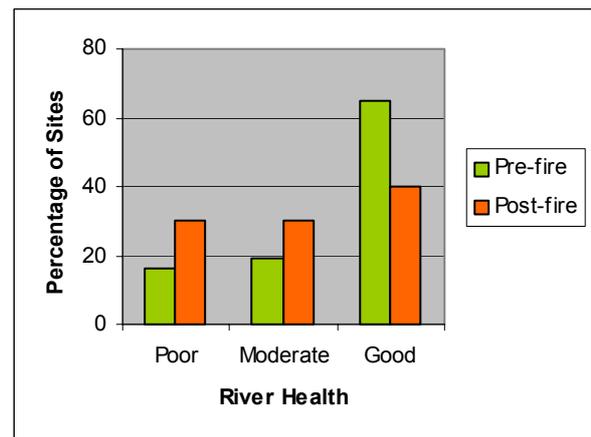
REGIONAL ASSESSMENT OF RIVER HEALTH

River health was assessed at 60 sites in the year following the 2003 bushfires. Forty-seven of these sites had pre-fire biological data which could be used to make comparisons with post-fire stream conditions.

River health ratings provided in this report are based on the environmental quality

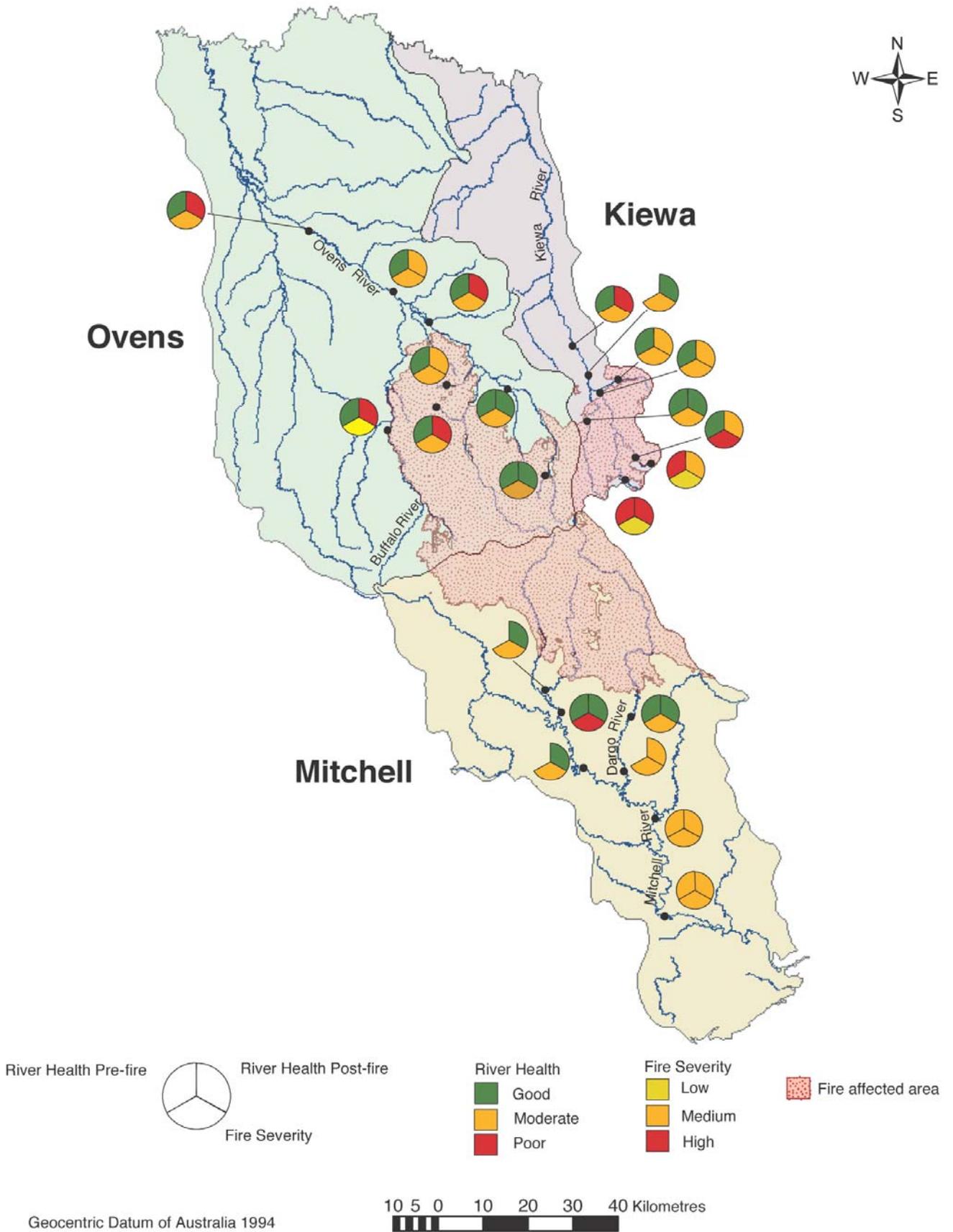
objectives in the *State environment protection policy (Waters of Victoria)*, and are derived from the proportion of objectives met for each site. The data on which the ratings are based is combined autumn and spring sampling of aquatic macroinvertebrates collected using the EPA's rapid biological assessment method (EPA publication 604.1). Fire severity ratings used in this report are derived from fire mapping undertaken by DSE and relate to fire severity within the fire affected areas and not the catchment as a whole.

The first year of post-fire sampling (results are shown in the two maps Figures 2 and 3) clearly shows that stream condition at many sites has declined after the 2003 bushfires. Prior to the fires, 65 per cent of sites in this region were assessed as being in good condition. This figure fell to 40 per cent in the year after the fires, while the percentage of sites rated as poor rose from 16 per cent to 30 per cent.



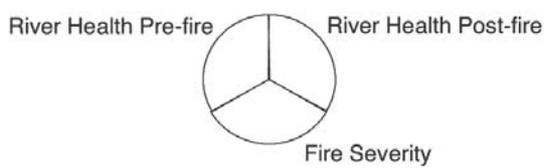
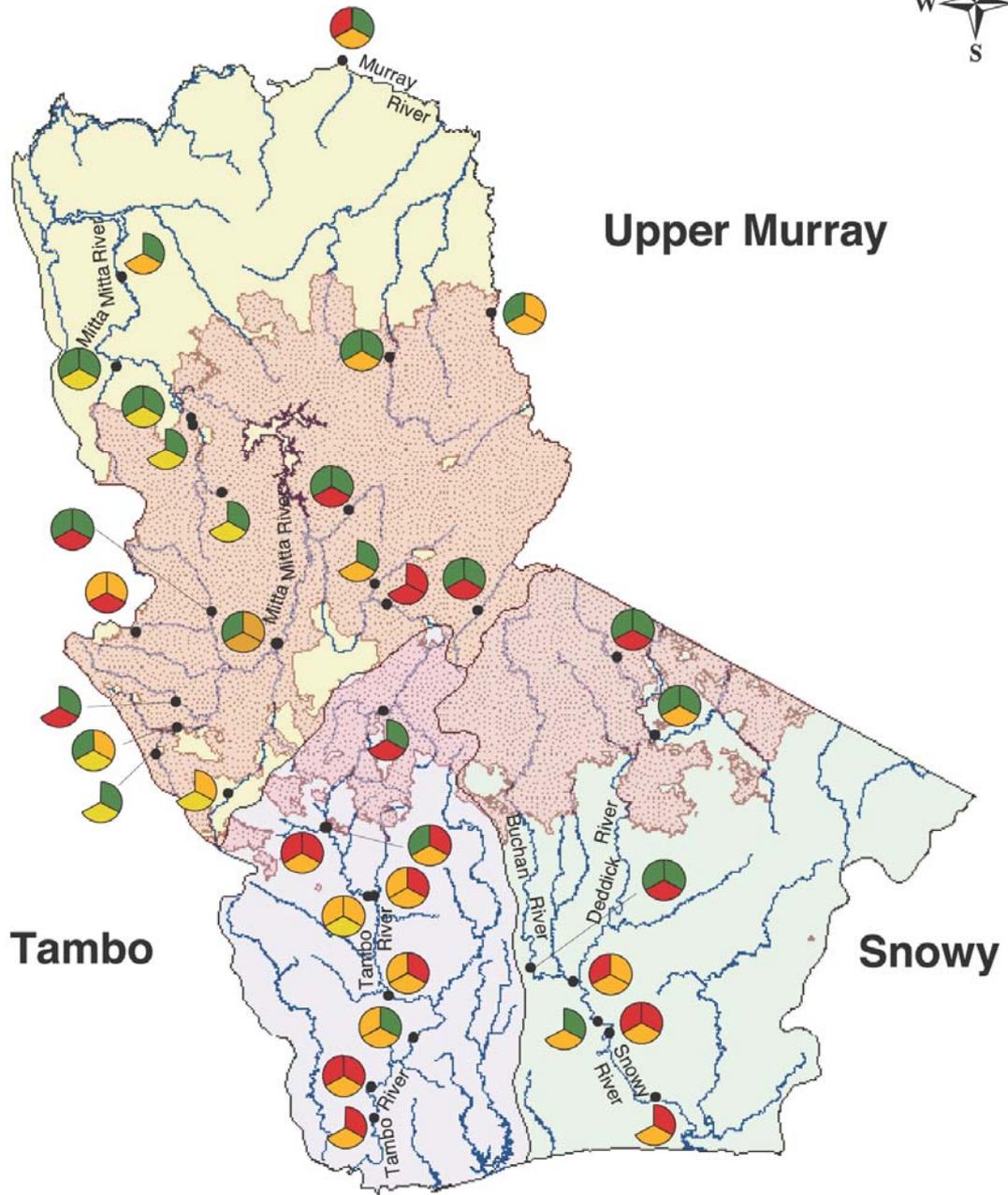
River health pre and post-fire

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Results from first year of post-fire sampling for the Ovens, Kiewa and Mitchell catchments

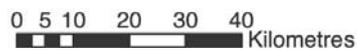
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River Health		Fire Severity	
■	Good	■	Low
■	Moderate	■	Medium
■	Poor	■	High

■ Fire affected area

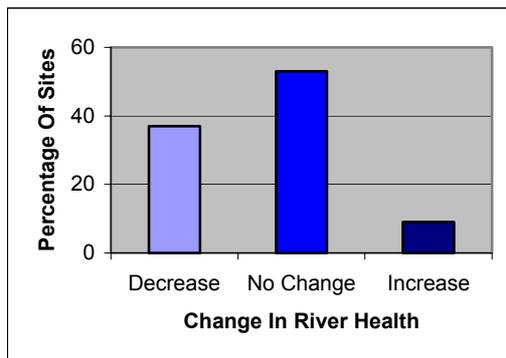
Geocentric Datum of Australia 1994



**Results from first year of post-fire sampling
for the Upper Murray, Tambo and Snowy catchments**

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More than 35 per cent of sites showed a decline in river health. All fire affected catchments, except the Mitchell, showed some degree of impact. About 10 per cent of sites showed an improvement in condition. Stream ecosystems are dynamic and will naturally vary to some extent over time, and the improved condition seen at some sites is attributable to this natural variation.



Pre and post-fire changes for all fire affected sites.

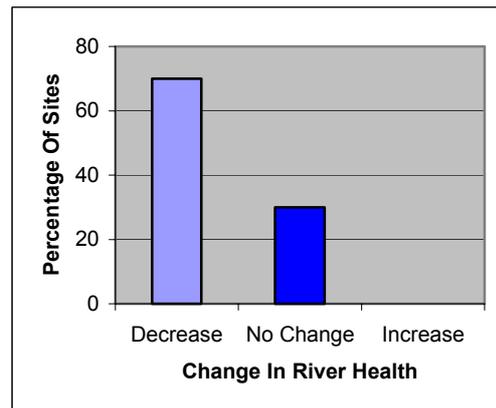
While there was an overall general decline in stream condition, there was no direct correlation between fire severity and river health. Other factors such as subsequent rainfall events, fire patchiness and the presence of streams unaffected by fire that could be a source for recolonisation, will also be important in determining river recovery.

STREAMS AFFECTED BY SEDIMENT SLUGS

Several large rivers are known to have been affected by sediment slugs in the year following the fires including the Tambo, Ovens, Buchan, Suggan Buggan and Mitta

Rivers. Many smaller streams have also been affected by such slugs.

Approximately 70 per cent of sites on rivers known to have experienced a sediment slug, declined in condition. In contrast, only 35 per cent of sites across the entire fire region showed a decline.



Pre and post-fire changes for sites affected by sediment 'slugs'.

Extremely high turbidity (a measure of cloudiness in the water column) occurred in both the Ovens and Tambo Rivers during a slug event, with peak levels rising above 60,000 Nephelometric Turbidity Units (NTU). By comparison an average storm flow produces turbidity levels of several hundred NTU while the SEPP environmental quality objective for these streams is only 5 NTU.

In the Ovens River, dissolved oxygen concentrations during the peak of the slug declined to almost zero for about one day, causing fish deaths and prompting crayfish to escape from the water. While adversely affecting river health, these sediment slugs also have serious consequences for the quality and treatment of downstream water supplies.

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EPA'S FINDINGS

The 2003 bushfires had a negative impact on many streams in eastern Victoria. The fires occurred towards the end of a long drought, the worst in 100 years, which may also have contributed to the decline in river health in the fire affected region. Other sites assessed by EPA in unburnt areas (such as the Latrobe, Tambo and Upper Yarra catchments) have remained in good condition despite the drought, suggesting that the bushfires are the prime cause of the changes observed in stream condition.

More than half the streams assessed did not decline in condition as a result of the fires. Given that fire and drought have been shaping the Australian landscape for millions of years, it is not surprising that aquatic systems have evolved to cope with these short-term disturbances.

The major impact on sites that have declined in river health appears to be from sediment slugs. Factors influencing the formation of these slugs include rainfall intensity, hill slope and fire intensity. However, sediment slugs do not uniformly affect stream condition with several sites showing no decline after severe slugs have occurred. Sediment type, slug duration and the time interval between slug and subsequent flushing flows may all play a part in this relationship. As yet high nutrient levels and algal growth do not appear to be having a major effect on river health.

Large quantities of coarse sediment in the form of 'sand slugs' have also built up in

many smaller streams. These sand slugs have the potential to alter the character of the stream bed, as the length of time they remain in the stream is much longer than that of finer sediments. The progress of these sand slugs from small tributaries to larger rivers may have effects during the next decade or longer. In streams unaffected by these coarse sand slugs, recovery from the fires is expected to be quite rapid.



A sand slug in a tributary of the Big River

WHERE TO FROM HERE

As part of the Bushfire Recovery program, EPA Victoria will continue to monitor 30 fire affected sites during the next two years to assess the impact of fire on streams and their recovery over time. A detailed report on the findings will be issued in June 2006.

FURTHER READING

Rapid Bioassessment protocol for Rivers and Streams (604.1)

<http://epanote2.epa.vic.gov.au/EPA/Publications.NSF/PubDocsLU/604.1?OpenDocument>

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Biological Objectives For Rivers and
Streams-Ecosystem Protection (793.2)

<http://epanote2.epa.vic.gov.au/EPA/Publications.NSF/PubDocsLU/793.2?OpenDocument>

The impact of Bushfires Following a Flash
Flood Event in the Catchment of the Ovens
River

http://www.epa.vic.gov.au/Water/Programs/Ovens_report.asp