Index of Stream Condition: The Second Benchmark of Victorian River Condition

Department of Sustainability and Environment

2 ISC











Our Water Our Future

Victoria The Place To Be

"The results of the 1999 and 2004 ISC benchmarking have provided an enormously valuable information resource, critical for setting long-term management objectives, developing priorities for action and evaluating the effectiveness of past efforts."

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Minister's Foreword

This second Index of Stream Condition (ISC) report shows that since the 1999 benchmark there has been no overall change in the condition of streams at the statewide scale and the deterioration in stream condition appears to have been controlled.

Now, the challenge is to consolidate and build on this result. We know that ongoing commitment and effort is necessary to keep our rivers healthy and functioning as the lifeblood of Victoria.

Just six years ago, the first Index of Stream Condition (ISC) showed how timely it was for the Government to undertake the first consistent and comprehensive study of environmental condition carried out anywhere in Australia. The results of this study indicated that after 200 years of neglect, while many streams still were in good or excellent condition, we faced a considerable task to ensure adequate environmental flow regimes, improve water quality and halt the degradation of riparian and floodplain areas.

With information gathered from this study, the Government developed the Victorian River Health Strategy and regionally, Catchment Management Authorities developed regional River Health Strategies. These strategies set priorities for directing government's annual investment in waterway management.

The second ISC benchmarking, undertaken during 2004, builds on the groundbreaking work begun in 1999 and documents the progress.

Recognising the role of rivers was a key part of the *Our Water Our Future* action plan launched last year. One of the fundamental principles of Victoria's new approach to water management is that a healthy economy and society depend on a healthy environment.

In the action plan, the Government committed to achieve significant improvements in the ecological condition of Victoria's rivers by 2010. We established the Environmental Water Reserve to provide a share of water for environmental values, as well as establishing water recovery programs for priority stressed rivers, increased the level of investment in river and aquifer health, and sustainable water resource management by an additional $100 million over four years, and continue to develop partnerships with CMAs and the community.

This second benchmarking of river condition will form the basis from which we can measure our progress towards the targets set in *Our Water Our Future.*

I congratulate everyone who has contributed to our achievements in improving the health of our waterways. Your support has provided the successful step forward for one of Victoria's most important environmental initiatives.

John Thwaites
Minister for Environment
Minister for Water

Foreword

Contents

In 1999, the Victorian Government, in conjunction with its Catchment Management Authorities (CMAs) benchmarked the environmental condition of Victoria's major rivers and tributaries. This was an important milestone for two reasons. It was the first complete and comprehensive study of the environmental condition of rivers anywhere in Australia. Second, the benchmark was based on the first integrated measure of river condition – the Index of Stream Condition (ISC). Before the Victorian benchmarking exercise, river health was assessed by considering single features such as water quality or aquatic macroinvertebrates. These measures focused only on very narrow individual elements of a river and could not convey a total picture of the overall environmental condition.

Introduction

The development of the ISC allowed, for the first time:

- A consistent statewide picture of the environmental condition of rivers and streams
- A consistent approach to the identification of river values and threats
- A consistent approach to the setting of strategic objectives and targets for river health at the river or river reach scale
- A clear way to communicate all the aspects of rivers that contribute to river condition and that need to be managed together to maintain or improve river health
- A way to assess the long-term effectiveness of river rehabilitation programs.

The ISC combines information on five key aspects of river health. These components, or sub-indices, measure changes in hydrology, water quality, streamside zone (vegetation), physical form (bed and bank condition and instream habitat) and aquatic life.

The Index was developed using information that could be easily understood, collected at the regional scale and fed directly into regional planning exercises. In addition, the methodology had to be accurate, easy to use, cost effective, based on good science and able to be undertaken by CMA staff, Waterwatchers and others associated with natural resource management.

Since 1999, the science behind the ISC has evolved significantly, particularly in the areas of hydrology and environmental flows, vegetation assessment and water quality. Additional work has also been undertaken on river condition assessment as part of the National Land and Water Audit and the Sustainable Rivers Audit for the Murray Darling Basin.

As a result, the ISC has been reviewed and updated to provide the most accurate, up-to-date and appropriate data. The new methodologies used in the second ISC benchmarking exercise in 2004 and their linkage with the 1999 methodology are discussed in more detail in this report. The results of the 2004 ISC are summarised in this report and published on the internet, as part of the Victorian Water Resources Data Warehouse (www.vicwaterdata.net).

The ISC combines information on five key aspects of river health: hydrology + water quality + streamside zone + physical form + aquatic life

The ISC – an integrated measurement tool

The concept

The ISC brings together data from a variety of sources to give a detailed overall picture of river condition. Five sub-indices make up the ISC score – hydrology, water quality, streamside zone, physical form, and aquatic life. Each sub-index comprises individually measured variables. The ISC is evaluated for individual river reaches, which are generally between 10 and 30 km long and with similar hydrological, vegetation and landscape characteristics.

Variables for streamside zone and physical form are measured in the field by Catchment Management Authority field staff. Within each reach, three sites for assessment are selected randomly to take account of the variability of condition found along the reach. The results from these sites are combined to then provide an assessment of the entire reach. In heavily forested reaches where there is less variability along the reach, only one site is assessed. All field work is done in autumn, when usually, streams are naturally at low flow.

The aquatic life sub-index is based on data that looks specifically at the presence of particular macroinvertebrate families. This work is undertaken by a Victorian Environment Protection Authority field program, covering, on average, 150 sites per year.

The hydrology sub-index is based on monthly flow data to determine changes to flow regimes.

The ISC uses monthly water quality data collected over 12 months, taken from a statewide network of 163 fixed water quality monitoring stations. These stations provide data to allow confident assessments of water quality to be made for 224 reaches.

Data for all five sub-indices is not available for all reaches. If at least 3 sub-index scores are available, then the missing sub-index scores are calculated on a pro rata basis. If only 1 or 2 sub-index scores are available, then an overall ISC score cannot be calculated.

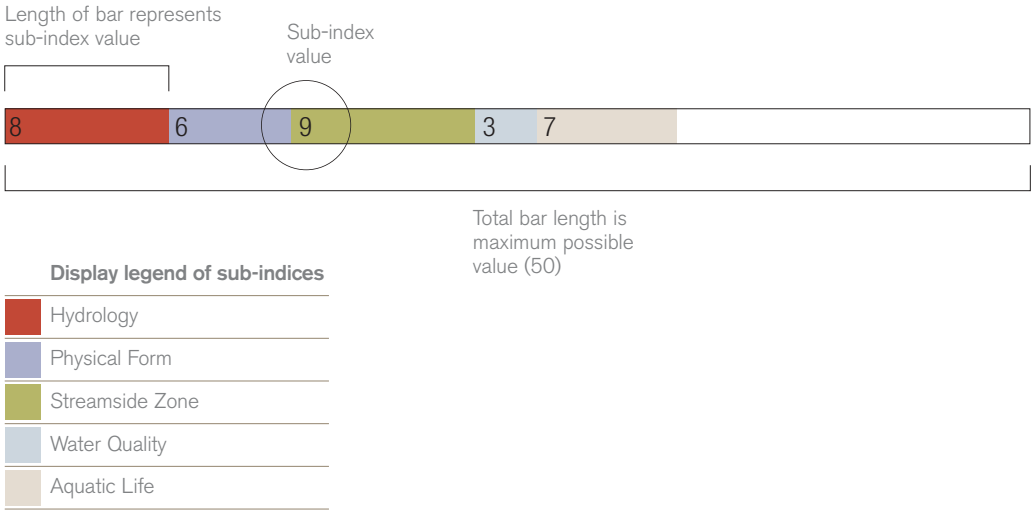
Each sub-index is scored out of 10 and the overall index out of 50. However, the overall score is not a simple aggregate of the five sub-indices; the ISC is weighted to recognise that a particularly low score in one sub-index may have a limiting effect on river health, even if the other sub-indices score highly.

Further information on the ISC, its sub-components, data collection and score calculations is at www.vicwaterdata.net.

The ISC result is presented as a bar graph of the five sub-indices, as shown in Figure 1.

The total ISC score is then categorised into one of five broad groups of condition – excellent, good, moderate, poor and very poor. It is important to emphasise that while this overall condition class is useful for providing a general picture of the condition of a reach, the detail of each sub-index and its sub-components (i.e. the individual variables) are required to better understand the issues affecting the environmental condition of streams on a reach basis.

Figure 1
The ISC bar showing the 5 sub-indices



The ISC in 1999

In 1999, 950 river reaches, representing 18,000 km of major rivers and tributaries, were assessed using the ISC. The actual variables measured in 1999, which made up the five sub-components, or sub-indices, are listed in Table 1 and defined in the glossary.

These variables represent the key factors that contribute to, or affect, river health. But while this set of variables represented the best available science at the time, in some cases, they are actually a coarse measure of the impact that the factor has on river health.

For example, the major hydrology variable only measured a very gross change in monthly flow volumes and seasonality. Very large changes in the flow regime due to water extraction (for example, the impact of large dams on a river) were able to be measured; but smaller changes, which can still cause significant river stress (for instance the impact of summer diversions on unregulated rivers or the supply of water to a small town), could not be measured.

Similarly, some of the variables assessed only the presence or absence of a particular feature rather than any measure of its quality. For example, the condition of streamside vegetation needs to reflect not only the amounts of vegetation present but also its health and how much of it is native.

Despite these limitations, the benefits of the 1999 benchmarking of river condition were immense. The ISC provided the first benchmark of stream condition in the State, giving a total picture of river health across Victoria to feed into statewide decision-making.

The ISC played an important educative role, drove the development of river assessment tools and improved evaluation of environmental condition.

The ISC also influenced the development of environmental assessment models by the National Land and Water Resources Audit (an Australia-wide assessment of stream health) and the Murray Darling Basin's Sustainable Rivers Audit.

At the regional level, CMAs used the ISC data gathered from the benchmark for developing regional river health strategies and identifying river values, assets and threats. The sub-indices used for the ISC provided a common language for setting management objectives and priorities and, significantly, resulted in a standardised understanding and interpretation of river health across the State.

Table 1
Sub-indices and variables used in the 1999 ISC

Hydrology	Physical form	Streamside zone	Water quality	Aquatic life
• Amended Annual Proportional Flow Deviation – a measure of the gross change between natural and existing monthly flows including any change in seasonality • Catchment permeability • Presence of hydroelectric power stations	• Bank stability • Bed stability • Artificial barriers • Instream physical habitat	• Width • Longitudinal Continuity • Structural intactness • Cover of exotic vegetation • Regeneration of native species • Billabong condition	• Total Phosphorus • Turbidity • Electrical conductivity (salinity) • pH	Macroinvertebrates • AUSRIVAS (habitat) • SIGNAL (pollution)

The 1999 ISC benchmarking was instrumental in developing the *Victorian River Health Strategy* and the current set of regional river health strategies. The State strategy is the framework for the integrated management of Victoria's rivers and streams. The regional strategies outline priorities, regional targets and integrated works programs needed to achieve these targets. These State and regional strategies form the framework for tackling the causes of poor river health, including treating problems of low flows, declining water quality and degraded riverine habitats, as well as restoring stressed rivers and protecting healthy rivers. Activities undertaken under regional river health programs between 1999 and 2004 included:

- **Installing fish ladders to open up large reaches of river for fish migration and breeding**
- **Riparian restoration with land holders including:**
  - **Fencing to limit stock access to riparian areas and improve the likelihood of regeneration and bank stabilisation**
  - **Planting native vegetation and weed control in riparian corridors**
  - **Removing willows and other exotics**
- **Reintroducing large wood into streams to improve instream habitat**
- **Stabilising bed and banks**
- **Increasing environmental flows and improving flow regimes**
- **Improved land management practices to minimise impact on water quality**

Results of the 1999 Benchmarking of River Condition

The results of the 1999 benchmarking exercise allowed for the broad classification of the condition of Victorian rivers. In general, it showed that basins in the east of the State were in better condition than those in the west. This was largely attributed to the lack of development, both hydrological (dams, diversions and stream pumping) and land clearing, in the east. Results collated for each of the major river basins are shown in Figure 2 below. Results for each sub-index and variable at a reach level are available on the internet as part of the Victorian Water Resources Data Warehouse (www.vicwaterdata.net).

Improving the ISC

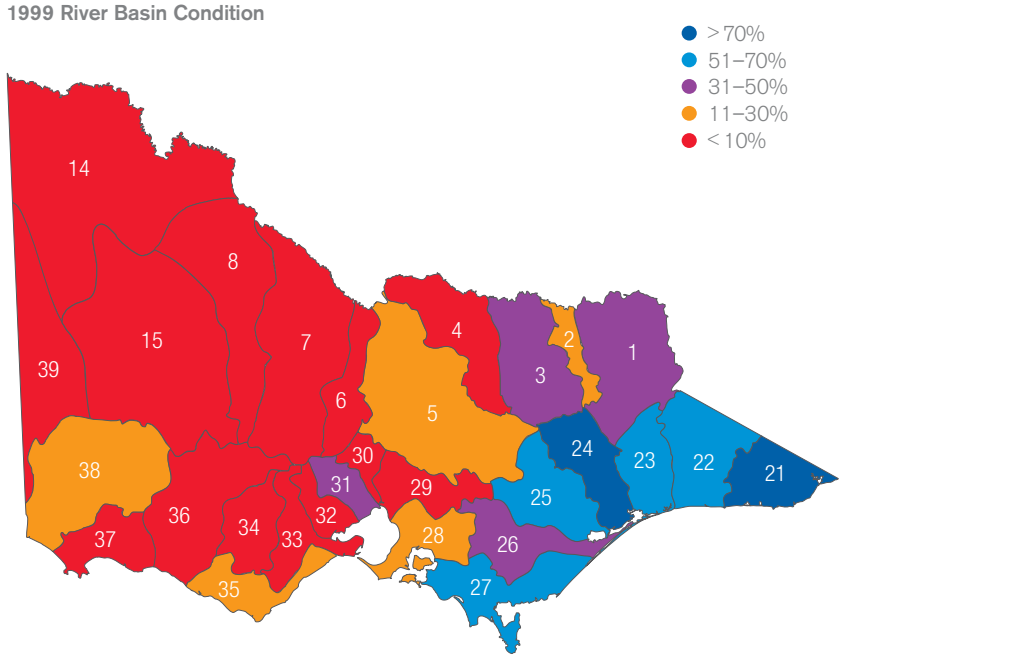
As with any scientifically based methodology, advancements in the measurement, collection and assessment of data can improve the methodology. In the case of the ISC, much of the methodology underpinning the 1999 benchmark was developed in the mid 1990s. Since then, scientific knowledge has advanced, particularly for environmental flows and the effects of changes to hydrology on river condition, assessing vegetation health and refining water quality models.

To take advantage of this and to ensure that the ISC was as up to date as possible for the second benchmark, the methodology was reviewed. A panel of independent scientific experts oversaw the review, which included all five sub-indices. The panel aimed to strike a balance between incorporating new scientific advances while maintaining comparability of results with the 1999 benchmark. A series of "rules" were developed to guide any changes made to the

"A panel of independent scientific experts oversaw the review, which included all five sub-indices. The panel aimed to strike a balance between incorporating new scientific advances while maintaining comparability of results with the 1999 benchmark."

Figure 2
Percentage length of major rivers and tributaries in each river basin in good or excellent condition (a score above 37 out of 50 results in a condition rating of good or excellent)

1999 River Basin Condition



1 Upper Murray
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5 Goulburn
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7 Loddon
8 Avoca
14 Mallee
15 Wimmera
21 East Gippsland
22 Snowy
23 Tambo
24 Mitchell
25 Thomson
26 LaTrobe
27 South Gippsland
28 Bunyip
29 Yarra
30 Maribyrnong
31 Werribee
32 Moorabool
33 Barwon
34 Corangamite
35 Otway
36 Hopkins
37 Portland
38 Glenelg
39 Millicent

five sub-indices. It was agreed that a variable would only be changed or new variables added if:

- It was demonstrated that the new method was an improvement on the old method
- There was a strong reason to integrate with an existing method and improve it along the way
- The new method had been rigorously tested
- The new method conformed to the original ISC criteria (transparent, intuitive and an appropriate balance of cost, speed, accuracy and scientific rigour).

The improvements made to the method as a result of the review are shown in Table 2. The 23 variables measured in the 2004 ISC benchmarking exercise are listed in Table 3 and defined in the glossary.

As a result of the change to some variables, the method by which the total ISC data-set and scores were interpreted also required minor adjustments. In addition, improvements in technology meant that some factors, such as stream length could be measured digitally instead of manually.

In 1999, 950 reaches representing 18,000 km of major rivers and tributaries were assessed as part of the first benchmarking exercise. In 2004, the number of reaches assessed increased to 1,040, representing 26,000 km of major rivers and tributaries.

In keeping with standard assessment requirements, sample sites along each reach were re-randomised. The use of randomised sampling gives a better picture over the long-term of the condition of a reach, but can raise issues in comparing two different sets of reach samples (eg. when comparing data for streamside zone and physical form from 1999 and 2004 for an individual reach). This issue is discussed later. However, despite its limitations this field sampling remains the best alternative until technology has advanced enough to measure all the relevant variables for an entire reach using remote sensing.

Table 2
Comparison of 1999 and 2004 ISC sub-components

	1999	2004
Hydrology	Comparatively crude measure of change in monthly flow and change in seasonality	Measure of five ecologically sensitive flow attributes – low flow, high flow, zero flow, variability in monthly stream flows and the seasonal timing of when low and high flows occur.
	Use of 1 year's data	Use of 15 years' data Incorporation of impact of farm dams and sustainable diversion limits. Measure of summer and winter stress.
Water Quality	No allowance for the geographic regionalisation of stream types – only upland and lowland divisions	Delineation of several stream regions for each indicator taking better account of geographic variation.
Streamside Zone	ISC developed measures that concentrated on the function of the streamside zone. Included measures for width, longitudinal continuity, structural intactness, cover of exotic vegetation, regeneration and billabong condition.	Adoption of statewide standard method for assessing vegetation health, based on the method known as habitat hectares. The method combines a quality and quantity measure and takes into account narrow riparian corridors. Use of Ecological Vegetation Classes (EVCs), a standard method to assess and define natural, or undisturbed, condition of vegetation, regardless of where it occurs.
Physical Form	Bank stability, bed stability, artificial barriers and instream physical habitat (large woody debris) measured.	Measure of bed stability removed as it cannot be easily or accurately measured. It needs to occur over a longer period and placed in correct historical perspective.
Aquatic Life	No allowance for the geographic regionalisation of stream types – only upland and lowland divisions	A greater amount of biological data has enabled the delineation of 5 regions for aquatic macroinvertebrates, taking better account of geographic variation.

Table 3
Sub-indices and variables used in the 2004 ISC

Hydrology
- Low flows
- High flows
- Zero flows
- Seasonality
- Variability

Water quality
- Total Phosphorus
- Turbidity
- Salinity (EC)
- pH

Streamside zone
- Width
- Longitudinal continuity
- Understorey diversity
- Recruitment
- Large trees
- Tree canopy
- Litter
- Logs
- Weeds

Physical form
- Bank stability
- Large wood
- Fish passage

Aquatic life
- AUSRIVAS (habitat)
- SIGNAL (pollution)

Comparing 1999 and 2004

In updating the methodologies for each sub-index, a trade-off had to be made between comparability of 1999 and 2004 results and an improved, more accurate and useful data set. The effects of the new methodologies were most pronounced for the hydrology and streamside zone sub-indices.

The new method for the hydrology sub-index was quite different to that used in 1999 so results could not be directly compared. Because of the greater degree of sensitivity and accuracy of the new methodology, many of the 2004 scores for hydrology were lower than those recorded in 1999. This does not mean that the actual river flows deteriorated since 1999; rather, the 2004 results provide a more accurate representation of the state of the flow regime in these river systems.

In fact since 1999, the Government has taken serious action to stop further deterioration in the flow regimes of rivers across the State. These actions include:

- Introducing and maintaining the Murray Darling Basin Cap in all the northern basins. This limits water extraction in these basins to 1993/94 levels of development
- Defining the balance of water for consumption and environment through Bulk Entitlement conversions
- Introducing legislation to include catchment dams in the water allocation framework
- Introducing sustainable diversion limits so any further water extraction is only allowed where this will not have a significant environmental effect
- Establishing Environmental Water Reserves for all rivers and groundwater aquifers.

The hydrology sub-index has been designed to allow a consistent statewide comparison of all major rivers and streams. However, it is not sufficient to use as a basis for determining environmental flows in water allocation decisions. These decisions require more detailed environment flow assessments, which will provide information on the flow regime required to maintain ecological values and the health of the river at a finer level of detail.

"At a statewide level, river health has remained basically the same, with basins in the east of the State generally in better condition than those in the mid and west regions."

As with the hydrology sub-index, the new streamside zone methodology provided a more detailed, accurate result with a greater degree of differentiation between key site characteristics. For example, the use of the new methodology does not treat all vegetation "equally". Sites with large numbers of exotic plant species, such as willows, would score lower in 2004 compared with sites with the equivalent amount of native vegetation in 1999.

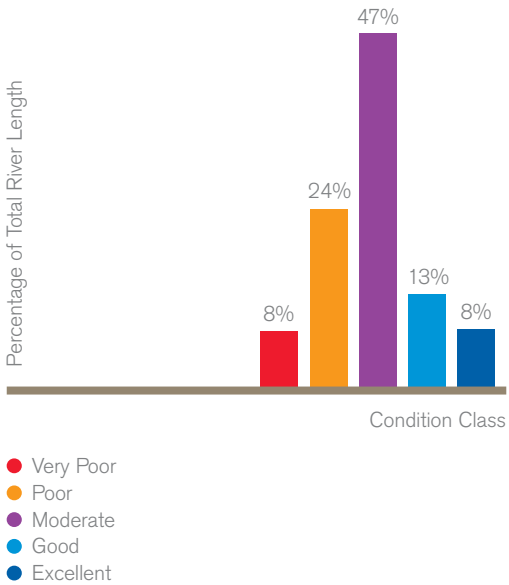
The more detailed information available for the construction of the reference condition for both water quality and aquatic life sub-indices also has allowed for greater detail and accuracy.

To determine comparability between the 1999 and 2004 results, the raw data for both 1999 and 2004 were run through the methodologies used for each benchmarking exercise, where possible. This allowed for the effects of the different methodologies to be corrected.

Using this analysis to compare the 1999 and 2004 results showed that overall at the statewide scale, no major changes had occurred to the condition of Victoria's major rivers and tributaries in the intervening five years. No general improvement was detected, but importantly, overall deterioration in stream condition appears to have been controlled. In 2004, about 21% of major rivers and tributaries were in good or excellent condition, 47% were in moderate condition and 32% were in poor or very poor condition (Figure 3). At a statewide level, river health has remained basically the same, with basins in the east of the State generally in better condition than those in the mid and west regions (Figure 4).

Although the statewide distribution of river health has generally stayed the same, the condition of some individual reaches and streams may have changed. There have been improvements in river health and, in a few cases, deterioration. For this reason, it is useful to review the changes to overall river condition by basin and for each sub-index.

Figure 3
2004 statewide river condition



Comparing the proportion of streams in good or excellent condition in the major river basins between 1999 and 2004 shows some changes. However it should be noted that whilst it is possible to correct for the difference in methodologies when undertaking a statewide comparison, it is not appropriate at the basin or reach scale. Therefore a comparison at these scales will often show results that are purely due to the change in methodology or the fact that, in some basins, more streams were assessed in 2004 than in 1999. For example, in the Otway basin, the additional assessments revealed a higher proportion of streams in good or excellent condition.

Several basins, notably South Gippsland, Glenelg, Thomson, Ovens and Werribee, recorded a reduced proportion of stream length in good or excellent condition since 1999. These results are predominantly attributed to changes to the hydrology sub-index. In 1999, most reaches in those basins were assessed as having unmodified or natural hydrology, but impacted hydrology in 2004. For example, in the Thomson basin, almost 60% of reaches scored 10 (indicating no impact on natural flow regimes) for hydrology in 1999, while in 2004 only 6% of reaches scored 10. This does not mean that the hydrology is more impacted but rather, the new method more accurately describes the true hydrological condition.

In contrast, however, the new methodology for the hydrology sub-index also revealed less impacted natural flow regimes. For example in the Kiewa basin, many reaches in 2004 had higher hydrology sub-index scores, due to the 1999 method over-emphasising the impact of regulation caused by the hydro-electric power stations on the upper Kiewa River.

Changes to the methodology for streamside zone also affected some overall basin results. For example, in the South Gippsland basin, the more detailed approach taken in 2004 meant that many reaches scored lower than in 1999. This was due to the increased sensitivity of the new methodology to sites with large numbers of exotic plant species, such as willows.

The 2003 bushfires also had a measurable impact on vegetation, particularly in the north-east. This impact will be seen for many years to come. The longer term impact of the loss of riparian vegetation may not yet be fully revealed.

In relation to the aquatic life sub-index a comparison between the 1999 and 2004 results, taking into account the changed methodologies, revealed no consistent change in these scores. However, while the 1999 scores can be recalculated to reflect the 2004 method, the actual sites where the macroinvertebrates were collected were not the same for both years and therefore may not always be directly comparable at the reach scale.

In terms of water quality, there appears to have been some improvement since 1999 in total phosphorus and turbidity results, particularly in cleared agricultural areas. This is largely attributed to ongoing drought conditions – low runoff results in fewer nutrients and sediments entering waterways and consequently total phosphorus and turbidity levels have improved. Once the drought breaks, these levels could be expected to increase.

A more detailed analysis of statewide water quality trends will be available with the release later this year of DSE's next water quality analysis trend report.

2004 River Basin Condition

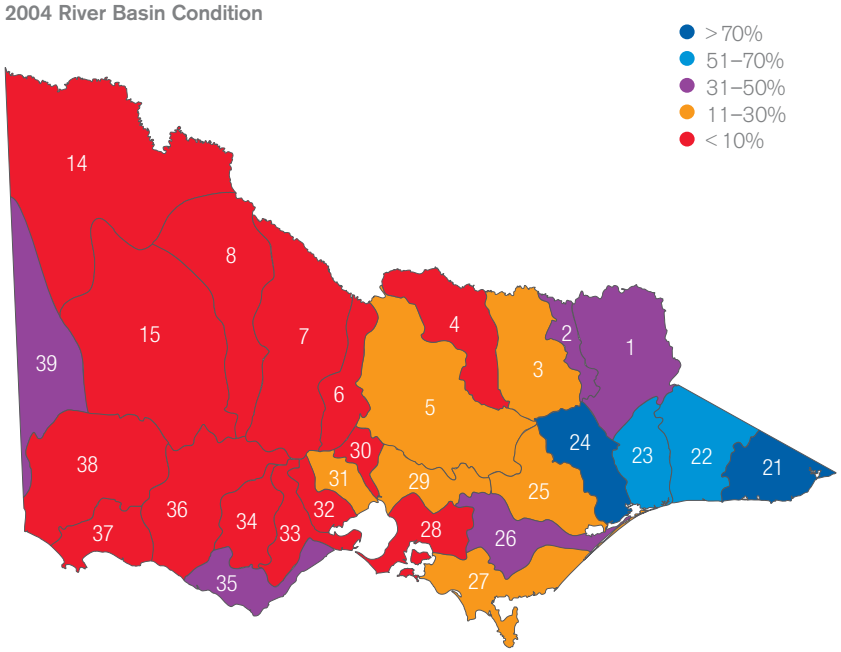


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Figure 4
Percentage length of major rivers and tributaries in each river basin in good or excellent condition (a score above 37 out of 50 results in a condition rating of good or excellent)

Reference Condition

The term 'reference condition' is used throughout this report and in literature about the ISC. The term refers to the presumed natural, or pristine, condition of a site, in this case a stream.

The ISC essentially compares two measurements – the field or current condition measurement and the reference condition measurement. The field measurement is compared with reference condition to measure the departure from reference or natural condition. For example, if there is very little difference or change between current condition and natural condition, then a reach is deemed to be in good condition. Where there is a large difference between current and natural condition, then the reach is deemed to be in poor condition.

Viewing or measuring natural condition is not always possible because of extensive development or alterations to the land. Where this has occurred, a combination of approaches are taken to establish the best possible representation of reference condition. These approaches include the use of expert opinion, historical records and computer modelling.

In lowland river reaches where there was little or no unmodified habitat, reference sites were selected to represent the "best available" habitat in the region. This was particularly the case for the aquatic life and water quality components.

The use of reference condition as a point of measurement – or, in other words, focusing on the degree of change from natural to current condition – allows comparison of different sites or reaches from anywhere in Victoria. Therefore, comparisons are not restricted to streams in the same geographical zones; more general comparisons about overall improvement or deterioration of riverine health can be made between catchments. This ease of comparison is an important feature of the ISC.

Reach data and interpretation

The basin results for condition class provide a useful snapshot of river health, but it is the results of the sub-indices for each reach that reveal the actual changes in stream condition. As described in the introductory section, the ISC is a composite of five sub-indices, weighted to reflect the individual components of river health (see Figure 1).

Caution is required when comparing the 1999 and 2004 results at the reach level. This is due to the combination of changes made to the methodology, the re-randomisation of field sites, and the addition of newly assessed streams. Any proper comparison of individual reaches requires the effect of each of these changes to be understood, so that any real change in condition can be identified.

The individual ISC results for all reaches, for both 1999 and 2004, are available on the Internet, as part of the Victorian Water Resources Data Warehouse (www.vicwaterdata.net). Information for each reach includes the scores for each sub-index, photographs of the sample sites and all the raw data. An example follows that demonstrates what information is available from the web site for an individual reach:

Basin 35 reach 16 Gellibrand River
– Good condition

Basin 23 reach 9 Tambo River
– Poor condition

6 6 8 9 9	7 7 3 1 4
Hydrology is modified with increased periods of low flow	**Hydrology** is slightly modified with increased periods of summer low flow
Physical form generally good but score lowered by downstream barrier to fish migration	**Physical form** is moderate with low levels of instream wood and some bank instability
Streamside Zone in near reference condition	**Streamside Zone** is highly modified with many willows lining the banks
Water Quality is good but with elevated total phosphorus	**Water Quality** is very poor with elevated levels of total phosphorus, turbidity and salinity
Aquatic life at reference condition	**Aquatic life** is showing a modified environment

Conclusion and the way forward

The results of the 1999 and 2004 ISC benchmarking have provided an enormously valuable information resource, critical for setting long-term management objectives, developing priorities for action and evaluating the effectiveness of past efforts.

The 2004 ISC results provide an opportunity to review the impact of both human and natural intervention in river health. Comparing the 1999 and 2004 results shows that the condition of waterways appears to have stabilised, at least at the statewide scale. Streams in good or excellent condition have been identified and protected and those in poor or very poor condition – with only a few exceptions – do not appear to have deteriorated further.

As the ISC results suggest, there are no quick or easy solutions to solving river health problems. Instead, long-term management objectives, clear priorities for on-ground works and continued investment and commitment by government and natural resource management agencies are required for long-term improvements in river health.

This has been recognised by the Victorian Government in its long-term action plan for sustainable water management – the White Paper *Our Water Our Future* released in June 2004. The Government recognises the importance of healthy rivers and groundwater aquifers as the major underpinning to achieve sustainable water management. The Government has set a target to significantly improve the condition of Victoria's rivers and streams by 2010 and has provided the tools to achieve it. These include:

- Establishing an Environmental Water Reserve (a share of water to maintain environmental values) for all rivers and groundwater aquifers.
- Establishing significant water recovery programs to increase flows in priority regulated rivers – the Thomson, Macalister, Wimmera, Glenelg, Broken, Goulburn, Loddon, Campaspe, Snowy and Murray Rivers.
- Achieving agreed improvements in Environmental Water Reserves in 21 priority unregulated rivers in five years.
- Providing an additional $100 million over four years to improve water management and restore and protect rivers and aquifers through an environmental contribution from water authorities. This will provide funds for activities including:
  - metering of water extractions
  - improved monitoring of water resources including a statewide survey of fish communities
  - improved management of groundwater and unregulated rivers
  - large scale river restoration works
  - managing Environmental Water Reserves.

Many of these activities are aimed at protecting rivers in good condition and restoring those where there is a significant environmental benefit. As these activities are implemented, Victoria will continue to monitor river health and assess the impact of these major river restoration programs using the ISC and other assessment programs. The ISC will continue to evolve as the science behind it evolves. Further changes will need to be tempered to allow for the detection of trends in condition.

The ISC and other assessment tools provide Victoria with a unique capability – to implement a truly adaptive approach to river management. Victoria can measure changes to our rivers and streams, improve our understanding of these complex natural systems and refine our management programs over the long-term, providing Victorians with the best investment programs to restore rivers and secure our water resources for the future.

Glossary

Generic Terms

Basin
The catchment of a large river or group of rivers. There are 29 basins within Victoria.

Catchment Management Authority (CMA)
Every region in Victoria has a Catchment Management Authority. These authorities are the community caretakers of river health, responsible for regional and catchment planning and coordination, and waterway, floodplain, salinity and water quality management.

Estuary
A semi-enclosed coastal water body where salt from the open sea mixes with freshwater in a river.

Hydrology

Amended Annual Proportional Flow Deviation (AAPFD)
An estimate of the change in monthly flows between natural and existing conditions.

Catchment permeability
The level of artificial impervious surfaces in a catchment.

Environmental flow
The flow regime required to maintain rivers in a healthy condition. Includes components of the flow regime such as minimum flows, floods and flushes.

Environmental Water Reserve
The share of water resources set aside to maintain the environmental values of a water system and other water services which are dependent on the environmental condition of the system.

Ephemeral stream
A stream with temporary surface flow that varies between seasons and years. Will usually be dry for part of the year.

Flood plain
A flat area adjacent to a stream that is covered by floods every year or two.

Flow regime
The pattern of the flow of water in a river over time. All elements of a river's pattern of flow are important – timing (when), duration (how long) and flow frequency (how often).

High flow
The two highest monthly flows in a year.

Hydrology
The occurrence, distribution, and movement of water in rivers.

Low flow
The two lowest monthly flows in a year.

Presence of hydro-electric power stations
Hydro-electric stations operate to supply electricity peak demand can create water surges on a daily basis. These surges can have a significant influence on stream ecology.

Regulated stream
A stream where flows are controlled by releases from a dam.

Seasonality index
The month of the lowest flow and highest flow.

Sustainable diversion limit
The maximum volume of water that can be diverted from a catchment during winter while still protecting the environment.

Variability index
The difference between the flow in the month with the lowest and highest flows.

Zero flows index
The period of time when the stream is dry (or nearly so).

Water Quality

Electrical conductivity (EC)
A measure of salinity. The higher the electrical conductivity of a stream the greater the salinity.

pH
A measure of acidity or alkalinity of water (based on the concentration of hydrogen ions).

Sedimentation
The deposition or settling of soil particles suspended in water.

Total phosphorus
The sum of the concentrations of soluble and in-soluble phosphorus.

Turbidity
Cloudiness or haziness of the water caused by individual particles that are too small to be seen without magnification.

Streamside Zone

Large trees
The number of large trees (dead or alive) that are larger than a prescribed diameter (usually greater than 80 cm).

Logs
Timber that has fallen on the ground which has a diameter greater than 10 cm.

Longitudinal continuity
A measure of how much of the stream bank is covered in vegetation.

Organic Litter
Organic material such as fallen leaves, twigs and small branches less than 10 cm diameter present at ground level.

Recruitment
A measure of the number of immature plants that show no evidence of flowering or fruiting.

Regeneration
The amount of native woody vegetation less than 1m high.

Riparian
The vegetation along the stream bank.

Structural intactness
A measure of the percentage cover of 3 strata of vegetation – trees, shrubs and ground cover.

Tree Canopy
Upper-most stratum of woody vegetation usually consisting of trees greater than 5 m tall that contributes to or forms the vegetation 'canopy'.

Understorey life forms
Native plants that are not part of the tree canopy. A Life form is a grouping of plants that share a similar three-dimensional structure (height, shape and cover).

Weeds/Cover of exotic vegetation
The percentage cover of exotic (ie. non-native) plants in three strata – trees, shrubs and ground cover.

Physical Form

Bank
The generally steep part of a stream channel cross-section, generally considered as being above the usual water level.

Bank Stability
A measure of how stable a stream bank is. Considers factors such as amount of vegetative cover, bare banks, exposed roots and undercut banks.

Billabong
A section of cutoff stream channel (e.g. an oxbow lake) usually on a floodplain.

Desnagging
Removing large trees (usually willows and river red gum) from the bed and banks of streams.

Fish barrier
An artificial obstacle in a stream (e.g. a dam wall, weir, culvert or causeway) that affects (halts or delays) fish migration.

Large wood
A tree, branch or root system that has fallen into or is immersed (totally or partially) in a stream. Often referred to as 'snags'.

Aquatic Life

AUSRIVAS
Australian River Assessment System – an indicator of the quality of instream habitat based on the presence of particular macroinvertebrate species.

Macroinvertebrate
An invertebrate (animal without a backbone) that is visible to the naked eye.

SIGNAL
A measure of the effect of pollution on macroinvertebrates. SIGNAL is an acronym for Stream Invertebrate Grade Number-Average Level.