Australian Government
Land & Water Australia

Managing flows for ephemeral streams

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Theme: Managing Rivers

Fact Sheet 2

Purpose of Fact Sheet

This fact sheet provides a brief summary of the importance of ephemeral streams and the need to ensure that ephemeral streams receive careful management, even during times of drought. While there is a common perception that biota within ephemeral streams are drought hardy, a large number of species require refuge in rock pools and water holes in order to recolonise streams during flow events.

What is an ephemeral stream?

Ephemeral streams are watercourses that do not have surface water flow for the entire year. They are also called: seasonal streams, intermittent streams, episodic streams or temporary streams.

Within this group of rivers and streams there is a wide variety of flow regimes. Some depend on rain events and may only flow for a few weeks, a year or less often. Others flow reliably for more than six months each year. There are classification schemes for these streams based on flow regime type. However, in reality these streams form a continuum of time spent inundated and may vary greatly in flow regime from year to year. Also, the classification schemes do not necessarily reflect the ecology or use of these systems by plants and animals.

Water sources for ephemeral streams may be groundwater and/or surface run-off. Consequently, developments that rely on groundwater as well as those that use surface water can affect flows in ephemeral streams.

Grahams Creek, an ephemeral stream, Victoria Range, Grampians NP. Photo Ed Chester.

How common are they and where do they occur?

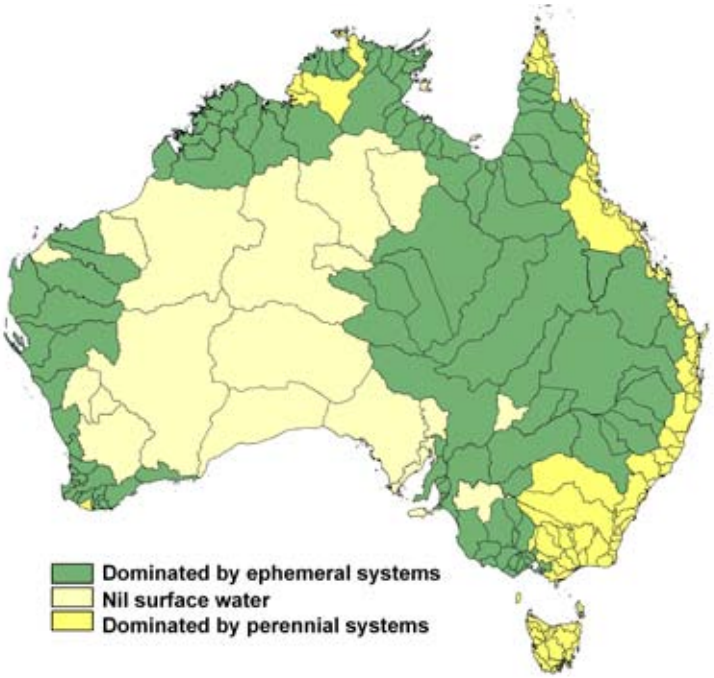
Ephemeral streams are the most common type of stream in Australia. They are dominant throughout, though not limited to, the semi-arid and Mediterranean climate areas, some parts of the arid zone, in the wet-dry tropics and also in the drier temperate areas of Australia. Yet we have a much poorer understanding of them than we do of perennial streams and rivers.

Why are ephemeral streams important?

Ephemeral streams provide a crucial source of water in otherwise dry landscapes and so are of great importance to consumptive, environmental and recreational water users. They are widely used for agricultural and town supplies in inland Australia. For example, large water supply schemes such as the Wimmera-Mallee Stock and Domestic Supply scheme rely on ephemeral streams. Ephemeral streams supply the majority of non-groundwater supplies to Perth. Although often unnoticed, ephemeral streams support millions of dollars of agricultural and other economic activity, as well as domestic supplies. Ephemeral 'losing' streams are important recharge sources for groundwater.

In these dry landscapes, ephemeral streams support significant aquatic and terrestrial biodiversity, including many unique species. The perennial lakes and waterholes of the inland, which support a diverse range of invertebrates and fish, and an abundance of aquatic birds during periods of flooding are maintained by ephemeral rivers such as the Cooper Creek. Although the channels are ephemeral, the wetlands and waterholes of the large inland rivers in the arid and semi-arid zone (such as Cooper Creek, the Diamantina River or the western tributaries of the Murray-Darling Basin) are permanent or semi-permanent, providing habitat for waterbirds and aquatic flora and fauna. Many of these semi-permanent wetlands are recognised as globally significant waterbird habitat (e.g. The Ramsar listed Coongie and Diamantina lakes).

Probable general distribution of ephemeral streams (Source: Belinda Robson)



Healthy ephemeral streams make for healthy catchments

In many Australian catchments, there may be one or two perennial main-stem rivers, but the tributaries supplying these rivers with water are all ephemeral to some degree (see Map). These ephemeral streams range from headwaters to large rivers and cover the majority of the catchment land area. The transfer of material within these streams is pulsed primarily when flow occurs. The pulsing of resources is a key driver of ecosystem processes in such systems. Therefore, they represent a huge surface area of contact between the land and the rivers that transfers sediment, nutrients, salt and organic matter to downstream river systems. Therefore, management practices that degrade ephemeral streams will also affect downstream river systems.

Ephemeral streams also provide recreational opportunities and water supply for humans and livestock. Being the only surface water sources, ephemeral streams are often important to indigenous peoples with sacred sites and other culturally important requirements.

How do plants and animals survive stream drying?

Aquatic plants and animals in ephemeral streams use drought refuges to survive stream drying. This is the ecological feature that distinguishes them from perennial watercourses and the management of refuges must be included in any water resources planning and management.

For freshwater algae, these include perennial pools on streams and also desiccation tolerant dry biofilm on the streambed. Stream regulation increases algal dependence on dry biofilm but perennial pools are not required for successful recovery of algae after dry periods.

Ephemeral stream systems support high biodiversity values

Some less developed systems, such as the Lake Eyre Basin (LEB), support large populations of waterbirds. Some species, such as magpie geese and radjah shelduck are now rare in more developed systems such as the Murray-Darling Basin, but still occur in the LEB. There are also unique species to be found in ephemeral systems, such as the Cooper Creek Turtle, the Cooper Creek Tandan (fish) and the Desert Rainbowfish (LEB), and the giant isopod (Grampians) and Grampians mayfly. New species are continually being found in ephemeral streams.

Freshwater plants rely on a desiccation resistant seed bank that can be quite long-lived (decades). Some riparian plants and trees depend on groundwater, but, as saline groundwater is a problem in many areas, these plants may show stress if fresh surface water is absent for long periods. Red gum deaths in some areas are an example of this.

Freshwater animals use refuges such as: perennial pools, aestivation (summer hibernation), adult flight and desiccation resistant eggs. One commonality among these streams, regardless of location, is that perennial pools or sections of perennial flow sustain the majority of biodiversity. Relatively few species are specialised to use the other refuge types.

Will further modifications really affect these ecosystems?

There are three significant water quantity threats to these ecosystems: climate change, increased surface water extraction and increased groundwater extraction. All three threats will prolong periods of drying in these systems and may also turn perennial streams into ephemeral streams. In particular, the loss or extended drying of perennial pools or sections, which are often groundwater or spring-fed, would devastate the animal biodiversity of these streams. There is also considerable evidence that regulation increases the abundance of blue-green algae, which may affect the rest of the food web through unpalatability and potential toxicity.

During dry times, this crayfish aestivates (a state of dormancy) in a subsurface shallow, sealed burrow to avoid desiccation. Photo: Belinda Robson

What do we know of the water needs of ephemeral streams?

Because ephemeral streams are very variable in their flow regimes from year to year, it is meaningless to prescribe an 'ideal' flow regime. Additionally, the absence of gauging for most of these streams makes monitoring flows difficult. However, we now have good and increasing evidence that the preservation of drought refuges is crucial to sustain their animal biodiversity. In addition, although stream algae are robust to stream drying, increased blue-green algal densities arising from regulation are undesirable. Environmental flow strategies are therefore required to preserve surface water drought refuges, to preserve population processes and reduce algal dependence on dry biofilm refuges.

Drought refuges in streams in the Grampians National Park

Streams in the GNP supply water to towns and the Wimmera-Mallee SDS, but they nearly all dry out in most years. Perennial pools are the drought refuge used by the majority of invertebrate animals in these streams, as well as by native fish. Few species use other refuges, although some crayfish and dragonfly larvae rest under stones in dry creek beds over summer. A few insect species such as some stoneflies and blackflies also have desiccation resistant eggs. In severe drought, some streams may only have a single refuge pool that lasts through the dry season, so these refuges are potentially very vulnerable to disturbances such as water extraction.

A framework to protect these streams

There are three main themes comprising a framework for protecting ephemeral streams:

1 Controlling existing behaviour

The lack of recognition of water needs for ephemeral streams means that many are presently subject to heavy and uncontrolled extraction pressures, or subject to greater inundation than would naturally occur through increased regularity of irrigation flows for example. Therefore:

- Surface water extraction needs to be controlled
- Environmental flow strategies are required to sustain surface-water refuges
- Groundwater extraction needs to be controlled or prevented to protect refuges
- Monitoring of biodiversity is required to ensure preservation through appropriate management actions
- Monitoring of surface flows for compliance, including overly regular unnatural flows is recommended

2 Increase understanding of ecological dependence on water in ephemeral streams

While we have a good understanding of some ephemeral systems (e.g. Lake Eyre Basin and Grampians streams), knowledge of the ecological function of ephemeral streams is still very limited compared to perennial systems. In particular, we have little understanding of the water needs of these systems and how they vary among climate zones (tropical vs arid vs semi-arid/Mediterranean). We also have little understanding of the capacity of species to adapt to increased drying or altered flow regimes. These knowledge gaps require further research.

3 Planning for future change (especially climate change)

- Environmental flow strategies will need to be adjusted as the climate changes to ensure that there continues to be sufficient water to sustain drought refuges.
- Identification of regions where increased climate drying is likely to cause perennial streams to become ephemeral and planning environmental flow strategies to deal with this.

Concluding message

While the biota of ephemeral ecosystems are resilient to natural loss of water and harsh conditions, they are highly susceptible to human impacts especially in arid and semi-arid areas where ephemeral streams dominate. Thus, ecological management of ephemeral streams, as for perennial streams, is also required.

For more information on ephemeral streams, download the research report: *Quantifying the Health of Ephemeral Rivers* by Justin Costello and Fran Sheldon available from **www.lwa.gov.au**

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