

# ACT State of the Environment Report 2011

## THEME: Land and Water

### Indicator cluster: Rivers, lakes and wetlands health

The Rivers, lakes and wetlands health indicator cluster reports on eight indicators, including:

- *Ecological health of streams, wetlands and rivers* (C) - broad measures of stream, wetland and river health;
- *Riparian and aquatic condition* (C) - broad measures of riparian and aquatic condition;
- *Urban wetlands* (C) - number, size, condition and influence of the wetlands on water quality;
- *Surface-water-dependent ecosystems* (C) - broad measures drawing on riparian condition, nature of species and ecological communities;
- *Stormwater discharges* (P) - non-point source discharges, including pervious and impervious surface areas;
- *Water management* (R) - effectiveness of water management for maintaining and enhancing catchment and river health;
- *Riparian management* (R) - effectiveness of riparian management for maintaining and enhancing catchment and river health; and
- *Urban wetland management* (R) - effectiveness of urban wetland management.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

### Summary

During 2007-2011, the condition of the ACT's rivers, lakes and wetlands has been affected by a continuation of the drought observed in the previous reporting period, and more recently by significant rainfall in 2010 and 2011. Rivers in the Canberra area are either severely impaired or moderately impaired in their ecological health, and only those creeks running out of forested areas, and the Murrumbidgee River as it enters the ACT, have ecological health corresponding to their historical condition.

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Management of wetlands health is challenged by the apparent individuality of each wetland (Johnston et al. 2009). Although 13 ACT wetlands are listed in the *Directory of Important Wetlands in Australia* (DSEWPaC 2009), information on the health of these wetlands is patchy. Urban wetlands have been constructed to improve the quality of stormwater by slowing the flow of water, to allow suspended solids to settle and to bind and remove phosphorus and nitrogen before the water is discharged.

Over the last 10 years, Canberra's lakes have been closed increasingly often, because of either faecal contamination or potentially toxic blue-green algae in the water. Greater focus is needed on the management of ACT lakes to improve water quality and lake health. An investigation into the state of the waterways associated with Lake Burley Griffin, recently begun by the Office of the Commissioner for Sustainability and the Environment, is likely to provide some guidance on improving the management of the waterways and catchment health for that lake.

## Introduction

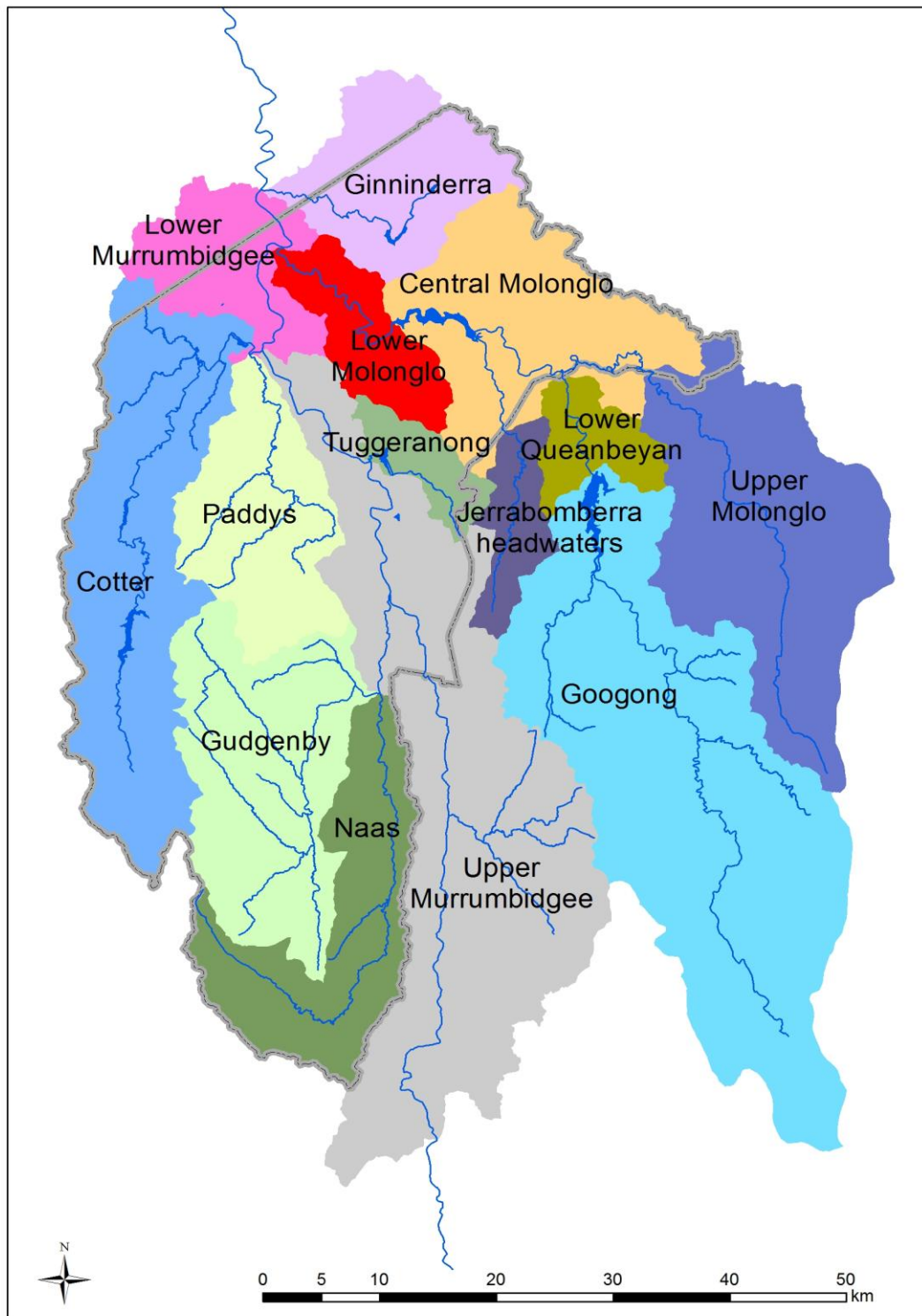
Rivers, lakes and wetlands in the ACT are highly valued for their biodiversity, water supply, recreation, irrigation, aesthetic and cultural values. These waterways and waterbodies support native species and ecosystems, and contribute to community wellbeing and the ACT economy. The ecological condition, or 'health', of these waters can be affected by sediment and nutrients in runoff, chemical pollution, habitat degradation and river regulation. With the exception of river regulation, those pressures are all directly related to land use practices within a catchment. The indicator cluster describes these pressures and the management approaches undertaken in the ACT in response to maintain and enhance catchments and river, lake and wetlands health.

The major rivers flowing through the ACT are the Murrumbidgee River and tributaries of it. The Murrumbidgee originates in the alpine area to the south of the ACT and flows through the southern part of the ACT to eventually meet the River Murray in western NSW. Major tributaries include the Molonglo River (in the east of the ACT), the Cotter River (in the west of the ACT) and the Naas River (in southern ACT). The tributaries and subcatchments of the Molonglo River drain much of northern ACT.

The ACT is entirely in the Murray-Darling Basin (the Basin), and therefore land and water management in the ACT are subject to the stream salinity targets established as a part of the *Murray-Darling Basin Salinity Management Strategy (2001-2015)* (MDBC 2007). The ACT also includes 12 water management areas established under the *ACT Water Resources Act 2007* and Regulations (see Figure 1).

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Figure 1. ACT water management areas



Source: DECCEW 2010

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## Condition indicators

### Ecological health of streams, wetlands and rivers

Ecologically healthy waterways are critical to the maintenance of good water quality. They provide a number of ecosystem services, and they also support recreation, potable water supply and other uses.

During the reporting period there have been two distinct weather phases. The first phase, from 2007 to May 2010, was dominated by continued drought; the second phase, from June 2010 to June 2011, was associated with a break in the drought and above average rainfall (BoM 2011). Both these phases have affected the water quality within the Murrumbidgee catchment (see *Water quality* indicator cluster).

The prolonged drought over the last decade had a significant effect on the ecological health of waterways in ACT. An audit to assess the ecological health of rivers in the Basin during 2004-2007 found the Murrumbidgee River Catchment was generally in “very poor” condition (MDBA 2008). However, significant rainfall in 2010 and 2011 is likely to have had beneficial consequences for waterway health.

The Upper Murrumbidgee River and its tributaries are subject to stresses as a result of:

- diversion of natural flow by Tantangara Dam, upstream of the ACT;
- land clearing for agriculture, which results in increased runoff and erosion during storms;
- increased stormwater flows caused by urban development in Canberra and other municipal centres outside of the ACT, such as Queanbeyan and Cooma;
- bushfires, like the January 2003 bushfire, which result in increased transport of sediment and nutrients in runoff from the catchment;
- drought, which reduces runoff and river flow; and
- predicted long-term impacts from climate change.

### Riparian and aquatic condition

A riparian zone is defined as “the area from the water's edge (under baseflow conditions) to a distance from the bank where the stream still interacts with and influences the type and density of the bank-side vegetation” (Nichols et al. 2000). Riparian vegetation influences the stream and in-stream ecology in a number of ways, including supplying nutrients (e.g. through leaf fall), filtering out sediments from runoff, stabilising the river bank and providing in-stream habitat (e.g. tree

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roots, fallen logs, shaded areas). A healthy riverine system and associated riparian zones provide habitat and food sources for aquatic biodiversity.

In the ACT, the distribution, condition and management needs of riparian vegetation of the Murrumbidgee River have been assessed in two recent reports. These reports have created a condition assessment benchmark and management guidance for the Murrumbidgee (Johnston et al. 2009) and its major tributaries the Naas, Cotter and Molonglo rivers and their tributaries the Gudgenby and Paddys rivers (Ishiyama et al. 2010). The reports found riparian zones across the ACT are diverse, and their ecological health is largely dependent on surrounding land uses.

In summary, these studies identified that:

- the state of the riparian zone vegetation in the ACT section of the Murrumbidgee River was variable but overall assessed as poor, with Gigerline and Red Rocks Gorges containing the best examples of riparian shrubland (Johnston et al. 2009);
- the Ribbon Gum riparian woodland that used to occur between Angle and Point Hut crossings is now almost extinct within the ACT and in urgent need of protection and enhancement (Johnston et al. 2009);
- she-oak riparian woodland downstream of Point Hut Crossing has reduced in area, largely from the effects of the 2003 bushfire, and low soil-moisture conditions during the drought and reduced river flows have probably inhibited she-oak regeneration across the riparian floodplain areas that are not in close proximity to the moist riverbanks (Johnston et al. 2009);
- most of the Murrumbidgee riparian zones, other than where rocky substrates predominate, were found to contain a very high cover and abundance of weeds; the reduction of naturally occurring overhead tree and shrub canopy from land clearing and fire has also allowed many of the weed species to become dominant on the alluvial substrates (Johnston et al. 2009);
- the major portion of the Naas River is protected within Namadgi National Park, and riparian vegetation there is in moderately good condition; in downstream rural areas, native vegetation in riparian and floodplain areas has largely been removed (Ishiyama et al. 2010);
- the upper part of the Gudgenby River has areas with limited human access and is in good condition; the lower reaches of the river are in moderate condition overall, but there are degraded sections with significant management issues such as weed infestation and gully erosion (Ishiyama et al. 2010);

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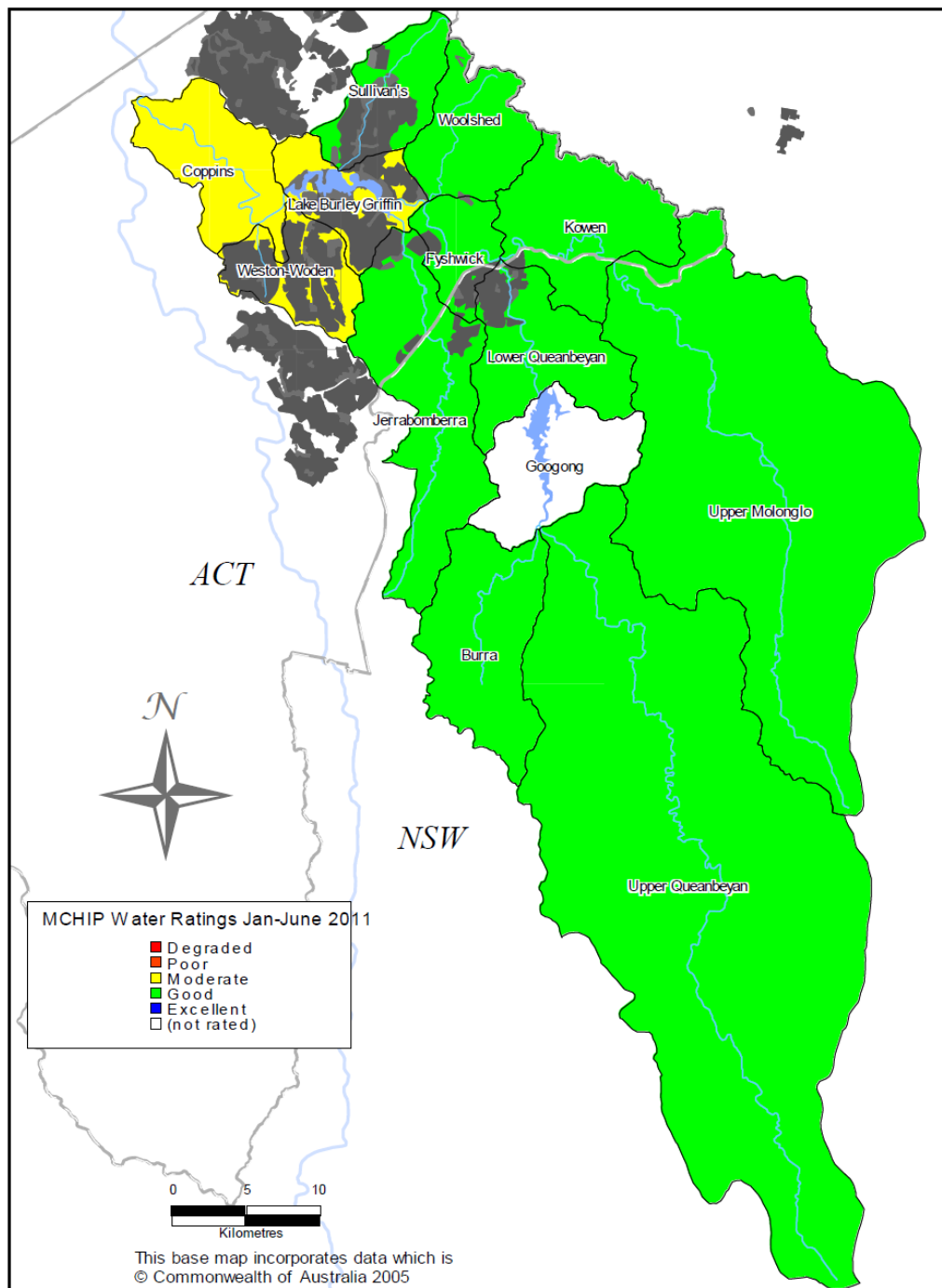
- overall, the vegetation communities of the Paddys River were in moderate to poor condition, and have been heavily affected by rural land use, plantation forestry, recreational use, drought, and the 2003 bushfire (Ishiyama et al. 2010);
- the condition of the Cotter River was extremely good in Namadgi National Park, but poorer in the former softwood plantation area of the lower Cotter (Ishiyama et al. 2010);
- the Molonglo River has been substantially modified since European settlement and there is no, or minimal, native vegetation in the most degraded areas (Ishiyama et al. 2010).

Complementing those reports is the latest (January-June 2011) catchment health assessment by Waterwatch volunteers for the Molonglo River catchment, reported in the *Molonglo Catchment Health indicator Program (MCHiP) Report* (Skinner 2011). The assessments are derived from sampling of the river waters and observations of the catchment land uses, rather than from its riparian zones.

Figure 2 shows that the ecological health of nearly all the Molonglo sub-catchments was in the 'good' range when assessed, and that catchment health overall is heading towards the moderate range (Figure 2). This assessment is based on the group's own 'MCHiP' rating, which determines a long-term average score for pH, electrical conductivity, turbidity, dissolved oxygen, phosphorus, nitrate, macroinvertebrate samples and landscape attributes, at a number of sites (Skinner 2011).

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Figure 2. Catchment health for the Molonglo Catchment, January-June 2011 MCHiP ratings



Source: Skinner 2011

## River health

The health of ACT surface waters is generally determined through assessments of the waters' biotic condition, using the Australian River Assessment System (AUSRIVAS). Via AUSRIVAS, samples of riverine aquatic macroinvertebrates (mainly insect larvae that live in rivers) are examined using nationally standardised methods and analysis protocols to provide information about river health (Gray 2004).

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Macroinvertebrates are sensitive to water quality, habitat degradation and other changes in the aquatic environments, and therefore provide an 'integrated' indicator of human effects on the stream ecosystem.

Samples of macroinvertebrates are collected from riffles and stream edges, and the organisms are identified. The range of macroinvertebrates found at the site is compared with the indicator macroinvertebrate families expected to be found there (reference condition). The rating system for AUSRIVAS is shown in Annex 1, Table A1.

In the ACT, AUSRIVAS sampling is biannual, in spring and autumn of each year. DECCEW (2010) reports on 3 baseline assessment sites (shown in bold italics in Annex 1, Table A2) and 10 other assessment sites within the ACT. Each of these sites was selected based on the potentials for impact from the surrounding catchment, such as rural or urban runoff, discharge from sewage treatment plants, habitat degradation and river regulation (DECCEW 2010).

The condition of waterways in the Canberra area is evenly split between severely impaired (rated C or D in Table A2) and moderately impaired (rated B), with only the creeks running out of the forested areas, and the Murrumbidgee itself as it enters the ACT, having health corresponding to the reference condition. Nowhere in the ACT do the waterways exceed the reference condition.

Changes in fish populations can also be assessed as an indicator of river health. The populations of Two-spined Blackfish (*Gadopsis bispinosus*) and Macquarie Perch (*Macquaria australasica*) in the lower Cotter River (below Bendora Dam) appear to be recovering, indicating improvements in habitat quality at regulated sites following the 2003 fires. This is likely to result from environmental flow releases mitigating the effects of the drought (DECCEW 2010). The population of Macquarie Perch in the Queanbeyan River has dropped to below detectable limits, possibly as a result of the drought and the potentially poor genetic health of the population. For more information on fish status see the *Fauna* indicator cluster paper (*Biodiversity* theme). Despite the good biodiversity of native fish species, European Carp (*Cyprinus carpio*) continue to make up 80-90% of fish biomass in the Murrumbidgee River within the ACT (DECCEW 2010).

## Lake health

The drought over the past decade, as well as the significant rainfall since mid 2010, has also affected the water quality in the lakes of the ACT. Over the last 10 years, Canberra's lakes have been closed increasingly often, because of either faecal contamination or potentially toxic blue-green algae in the water. The contamination



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may be related to Canberra's growth which has enlarged the urban areas draining into the lakes.

During the reporting period, ACT lakes and waterways experienced a number of outbreaks of blue-green algae, resulting in lake closures in order to minimise risks to the health of recreational users. Lake Tuggeranong has had a high-level or extreme-level alert every summer from 2007 to 2011, while Lake Ginninderra and the Molonglo Water Ski Area have experienced algal blooms less frequently. In most cases in the ACT during the reporting period, the high to extreme alerts occurred in the summer months. This is when recreation would be expected to be highest.

Algal blooms can have an impact on the ecosystem health of ACT's waterways, which also provide a number of important ecosystem values, wildlife habitat (see *Fauna* indicator cluster) and visual and recreational amenity. More information on algal blooms is provided in the *Water quality* indicator cluster.

## Wetland health

Wetlands can provide many important benefits to the surrounding environment, including:

- improved water quality;
- flood protection;
- aquatic habitat; and
- stormwater harvesting.

## Natural wetlands

Thirteen wetlands in the ACT are listed in the *Directory of Important Wetlands in Australia* (DSEWPaC 2009). Of these, the Ginini Flats Wetland Complex (made up of a series of interconnected flats known as Ginini Flats and Cheyenne Flats) in Namadgi National Park is listed as a Ramsar site. Ramsar wetlands are internationally recognised under the *Convention on Wetlands of International Importance* (DSEWPaC 2011a) for the conservation and sustainable utilisation of wetlands. Information on the health of these wetlands is patchy with few projects surveying their riparian health and water quality.

The ACT *Sphagnum* bogs, such as those at Ginini and Cheyenne Flats in upstream parts of the Cotter River catchment, are important because they provide water filtering, groundwater storage and release of water to maintain stream flow into Canberra's domestic supply (Macdonald 2009). These bog communities are also critical habitats for species such as the endangered Northern Corroboree Frog and

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rare Broad-toothed Rat. Rehabilitation of a number of the *Sphagnum* bogs burnt in the 2003 fires has been carried out (Macdonald 2009). Previous rehabilitation assessments suggest that it may take 20-30 years for full recovery of bog functionality to occur (Macdonald 2009). Overall, it has been observed that the *Sphagnum* bogs are showing good post-fire recovery. This is particularly evident where restoration efforts have been targeted. The recovery is being recorded through an ongoing photo-monitoring program in selected bog systems.

The larger urban wetlands, such as Point Hut Pond, Gungahlin Pond, Yerrabi Pond and Flemington Road Pond are regularly monitored by the ACT Government. As with other lakes and ponds, data indicates high chlorophyll 'a' levels especially in warmer months. Chlorophyll 'a' is an indicator for all of the algal organisms present in aquatic ecosystems. Of these algal organisms, the organisms of most concern are blue-green algae, or *cyanobacteria*. See the *Water quality* indicator cluster for more information.

The ACT Murrumbidgee River Corridor contains three significant groups of wetlands (Johnston et al. 2009):

- perched off-stream wetlands in the Gigerline Gorge ;
- smaller specialised perched wetlands in Red Rocks Gorge; and
- a wetlands complex at Woodstock Reserve.

These wetlands are important habitats for aquatic and semi-aquatic vegetation assemblages either found only in those areas or with limited distribution in the ACT (Johnston et al. 2009). The main threats to the health of these wetlands ecosystems are flow management and invasion by exotic and native plant species.

## Constructed wetlands

Canberra's large urban wetlands, such as Point Hut Pond, Gungahlin Pond, Yerrabi Pond and Flemington Road Pond, are regularly monitored by ACT Government staff. As with other lakes and ponds, data indicate high chlorophyll 'a' levels especially in warm months. Chlorophyll 'a' is an indicator for all of the algal organisms present in aquatic ecosystems. Of these algal organisms, the organisms of most concern are blue-green algae, or *cyanobacteria*. See the *Water quality* indicator cluster for more information.

A number of new artificial wetlands have been constructed over the reporting period as a part of the urban stormwater drainage system in the ACT, including:

- Flemington Road Ponds, Mitchell (constructed 2009);

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- Banksia St, O'Connor (constructed 2010); and
- Dickson and Lyneham wetlands (construction commenced September 2010).

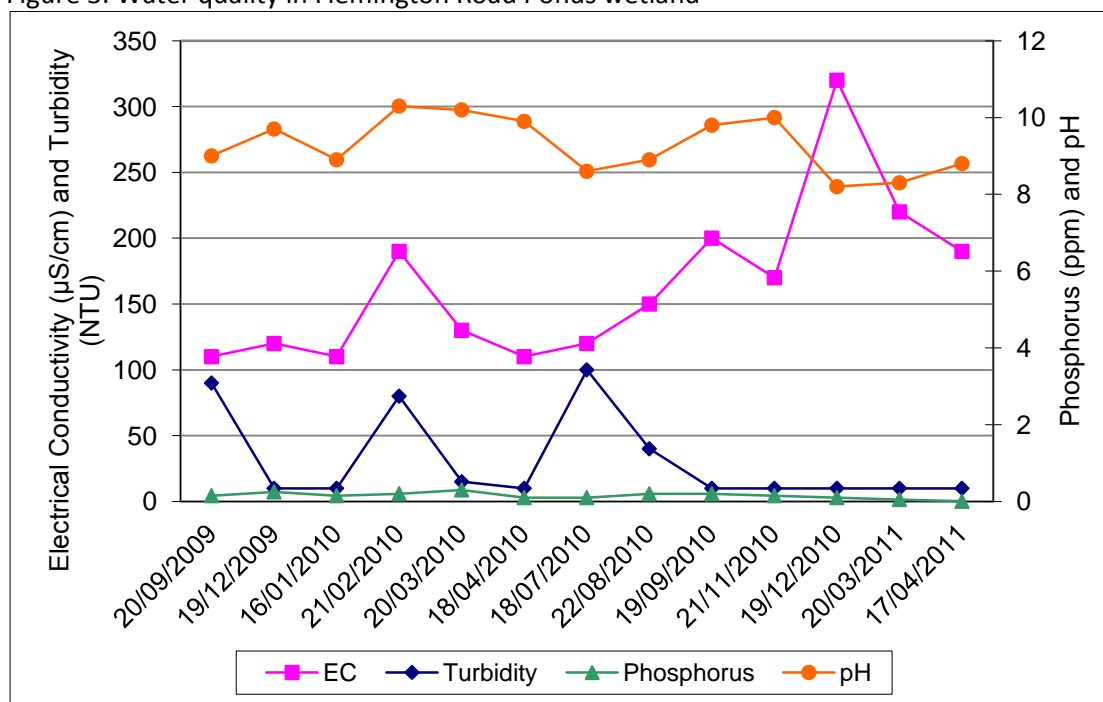
Urban wetlands have been constructed to improve the quality of stormwater by slowing the flow of water (relative to its pace in concrete channels) to allow suspended solids to settle. Wetlands plants also bind phosphorus and nitrogen in the stormwater, removing these contaminants before the water is discharged (DECCEW 2011). As a result, the stormwater has better quality when it leaves the wetlands than when it entered.

Recently constructed wetlands are part of a project to enhance the ecosystem health and water quality of the Sullivans Creek concrete channel, which flows into Lake Burley Griffin. As yet, there is limited information available on the condition of these wetlands and their impact on water quality within the ACT. Further constructed wetlands are planned for Gungahlin in 2010-2012. Water quality in Sullivan's Creek was reported, in the latest *Molonglo Catchment Health indicator Program Report* (January-June 2011, Skinner 2011), as remaining poor because of either weather or the on-going construction of the Lyneham ponds. The percentage saturation of dissolved oxygen rarely approached levels that would encourage the reappearance of historically-good frog populations (Skinner 2011).

At the Flemington Road Ponds wetland, the Molonglo Catchment Waterwatch teams have sampled water quality since their construction in 2009. The measured water quality characteristics are shown in Figure 3. The large variations in the pH, electrical conductivity and turbidity of the water were attributed to the wetland base settling after construction, and to significant inflows of stormwater into the wetland (DECCEW 2010). There have been reports of algal growth in the wetlands in November 2009, February 2010 and early 2011.

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Figure 3. Water quality in Flemington Road Ponds wetland



Source: MCG 2011

Note: Legislated water quality standards for these parameters are: Phosphorus 0.1 mg/L; Turbidity below 30 NTU; pH between 6 and 9. There are no standards set for electrical conductivity.

## Pressure indicators

### Stormwater discharges

River, lake and wetland health can come under pressure from non-point source pollution and discharges into the waterways. Non-point source pollution is discharge to a waterway that does not come from one identifiable location: for example, runoff from diffuse agricultural and urban sources, rather than from a single outlet.

In the ACT the land uses include forestry plantations, agriculture, urban and industrial, and conservation. Land use influences the types of substances that are transported and discharged into waterways by runoff following rain events. For example, in native forested mountain catchments, runoff generally contains small amounts of sediment and nutrients, whereas the runoff from agricultural, industrial or urban land contains relatively large amounts of sediment and nutrients, as well as other contaminants such as heavy metals and hydrocarbons.

There are limited data available on the quantity and quality of non-point source discharges into the ACT's waterways. However, as a result of the drought and water conservation measures, there has been a decrease in runoff generated from various

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land uses in the ACT. This is likely to have reduced the volume of water discharged into the waterways over the reporting period.

## Impact indicators

There are no specific impact indicators for the Rivers, lakes and wetlands health indicator cluster. However, this indicator cluster highlights the importance of good catchment management both for the enhancement and protection of species and ecosystems, and for the use of waterways for recreation and production.

Contaminants from human activities impact negatively on river health. Pollutants, including phosphorus, nitrogen, sediment, salt, heavy metals and pesticides, can enter rivers with stormwater runoff and affect the short-term or long-term health of a river, lake or wetland. For example, in Lake Burley Griffin, water quality can be significantly impaired by urban land uses that provide large amounts of sediment and nutrients to the water body. These nutrients can lead to an increased risk of algal blooms within the lake. For further information see the *Water quality* indicator cluster. The Lower Molonglo Water Quality Control Centre is the largest potential point source of pollutants to the Territory's rivers, and the Queanbeyan Sewage Treatment Plant is also a potential point source (see *Water quality* indicator cluster for more information).

As in the previous reporting period, increasing urban development of greenfield sites continues to alter the hydrology of these areas, with impacts on associated sub-catchments and catchments. The Australian Natural Resource Atlas (2009) suggests that over 4 million tonnes of sediment annually is delivered to the Murrumbidgee River from its catchment, which includes the ACT. Most of this sediment entering the Murrumbidgee is contributed from gully erosion (51%), much of which occurs upstream of the ACT (ANRA 2009).

Climate change is predicted to have a substantial impact on river, lake and wetland health, through increasing temperatures, decreasing stream flows and causing more extreme events, such as bushfires (Climate Commission 2011). These can potentially have a profound impact on waterway health. For further information on predicted climate change impacts refer to the *Climate vulnerability* indicator cluster.

## Response indicators

### Water management

Catchments and waterways in the ACT are managed by Government agencies through catchment management that incorporates planning, development controls,

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restrictions and regulations on water extraction, licensing discharges, and managing erosion and sediment. The success of the integrated approach relies on the cooperation and coordination of community groups and of the differing agencies responsible for specific components of water management. This can be problematic.

Over the previous reporting period, to June 2007, catchment and river health were still affected by the 2003 bushfires. For the ACT catchments, recovery from fire effects has been a priority. However, low soil moisture content as a result of the drought was a major constraint to the re-establishment of vegetation, until the significant rainfall that occurred during 2010 and 2011. Vegetation recovery within the catchments has been enhanced by the rain and will contribute to improving catchment and river health within the ACT.

A number of projects have been undertaken over the reporting period 2007-2011 to improve catchment and river health. Restoration of the Lower Cotter Catchment, a project which began in 2008 with the aim of achieving clean water and a healthy vegetated landscape in the Lower Cotter Catchment, has so far made a substantial improvement to the lower catchment. The project incorporates a number of actions to improve waterway health, including planting native trees and removing pine tree saplings from the ex-plantation areas, erosion control works, and creation and restoration of recreation areas (DECCEW 2010). A number of stakeholders are delivering these projects through partnerships between agencies and community groups.

Community-based catchment groups in the ACT are funded by the ACT NRM Council, the regional Natural Resource Management body. The funds allow each group to employ a catchment coordinator and a part-time Waterwatch coordinator, and also cover program and administration expenses. These groups coordinate the community-based water-quality monitoring for each catchment, as a part of the Waterwatch program. The Waterwatch program is an environmental education and awareness program that encourages and supports the local community to take responsibility for improving the quality of water throughout the upper Murrumbidgee catchment.

This funding has also helped to implement a number of catchment-management and waterway-protection projects over the reporting period (see the *Community engagement* indicator cluster for more information). For example, the Molonglo Catchment Group, in partnership with other agencies, implemented a Molonglo River Rescue project, which seeks to improve critical aquatic habitats in the Molonglo River and limit threats to the ecosystem (MCG 2010). The project was implemented as a part of the Australian Government's Caring for Our Country program.

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A number of other catchment-management projects were funded in the ACT as a part of the Caring for Our Country program. These projects are outlined in the *Land health* indicator cluster. All these projects are diverse in nature; most importantly, they engage the local community in the environment and waterway health. The projects help to improve the overall waterway and catchment health in the ACT and collect information that is incorporated into the annual *ACT Water Reports*.

The *Source Water Protection Program (SWPP)* is a 5-year program funded by ACTEW Corporation. It aims to raise awareness that protecting water supply catchments is an important and efficient means of minimising the risk to drinking water quality. The SWPP supports activities, policies and programs that will assist in achieving these goals, and includes an education and awareness component and a grants and incentive scheme (ACTEW 2011).

The first two years of the program have improved understanding of current catchment health. Research has been documenting the condition, status, hazards and risks across the major catchments. These include potential sources of contamination, land use activities, and areas of environmental degradation that may contribute sediment and turbidity to the waterways (ActewAGL 2010).

A number of turbidity events in 2008 and 2009 in reaches of the upper Murrumbidgee River were the catalyst for various organisations to come together to discuss how the health of the river can be improved. The Upper Murrumbidgee Catchment Coordinating Committee (UMCCC) hosted a meeting of organisations with an interest in the Murrumbidgee River in April 2009. The partner organisations are: Australian and NSW Governments, Murrumbidgee Catchment Management Authority, ActewAGL, ACTEW Corporation, ACT NRM Council, UMCCC and Upper Murrumbidgee Waterwatch.

This group of organisations pooled resources and funding in 2011 to commence the development of the Actions for Clean Water (ACWa) Project. The ACWa Project, to be completed by March 2012, will identify strategies to enhance surface water quality and reduce turbidity in the Murrumbidgee River upstream of the confluence of the Murrumbidgee and Cotter rivers, across NSW and the ACT. The collaborative project will undertake all work necessary to develop a plan of action in 1-, 3- and 10-year time frames. Actions may include on-ground works, education, promotion, and development of policy and programs by the private sector, government organisations and individuals (MCMA 2011).

An investigation into the state of Lake Burley Griffin's waterways, by the Office of the Commissioner for Sustainability and the Environment commenced in June 2011.

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This investigation is likely to have an impact on the management of the waterways and catchment health for Lake Burley Griffin for improved water quality.

## Riparian management

In 2007 the ACT Government implemented the *ACT Aquatic Species and Riparian Zone Conservation Strategy* (TAMS 2007), which is intended to take an integrated approach to the management and protection of rivers and riparian zones. The Strategy seeks to maintain and improve the integrity of the rivers and riparian zones and acts as the statutory action plan for riparian and aquatic threatened species. Key considerations include:

- the need for improvements in the knowledge of vegetation and habitat in riparian zones;
- recovery of riparian areas severely affected by the January 2003 bushfires;
- protection of the river corridors from the effects of existing and proposed urban development, possible expansion of recreational infrastructure, and other threats such as inappropriate grazing regimes;
- restoration of riparian habitat including control of weed species such as willows;
- maintenance and improvement of in-stream habitat (including stream flow) and where feasible, rehabilitation of native fish populations;
- maintenance of wildlife corridors; and
- maintenance and protection of aquatic ecosystem processes and water quality.

The upper Murrumbidgee River is a high conservation value ecosystem containing critical aquatic habitats of several nationally-listed threatened species (notably Trout Cod, Murray Cod and Macquarie Perch); for example, see Table 1. Along the Murrumbidgee River, a 2009 survey of key riparian zones recommended a number of actions to enhance riparian vegetation and biodiversity. They included monitoring, protection and re-establishment of native vegetation, weed management, full wetland appraisals, and management and careful planning of water resource allocations (Johnston et al. 2009). These recommendations should be integrated into management of the Murrumbidgee River corridor and the *ACT Aquatic Species and Riparian Zone Conservation Strategy*.



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Table 1. Six declared threatened aquatic and riparian species in ACT

Species / Ecological community	Status
Two-spined Blackfish ( <i>Gadopsis bispinosus</i> )	Vulnerable
Trout Cod ( <i>Maccullochella macquariensis</i> )	Endangered (Special Protection Status)
Macquarie Perch ( <i>Macquaria australasica</i> )	Endangered (Special Protection Status)
Murray River Crayfish ( <i>Euastacus armatus</i> )	Vulnerable
Silver Perch ( <i>Bidyanus bidyanus</i> )	Endangered
Tuggeranong Lignum ( <i>Muehlenbeckia tuggeranong</i> )	Endangered (Special Protection Status)

Source: DECCEW 2010

An initiative that began in November 2010 aims to provide the community with a visible demonstration that multiple improvements to a stretch of river can have a positive impact on river biota, particularly fish. The Upper Murrumbidgee Demonstration Reach (UMDR) initiative focuses on a reach approximately 100 km in length, extending from the rural township of Bredbo in south-eastern NSW downstream to Casuarina Sands in the ACT. The UMDR initiative involves a suite of river rehabilitation methods and complements other plans and activities that are ongoing under other programs (ACT Government 2010).

In the Cotter River catchment a number of actions have been undertaken with the aim of improving water health. The Cotter River has been recognised as a High Ecological Value Aquatic Ecosystem (HEVAE), to assist the Australian Federal Government to prioritise funding by the Caring for Our Country program. The Cotter River was recognised because it is fed by *Sphagnum* bog wetlands recognised under the Ramsar Convention and the *Environment Protection and Biodiversity Conservation Act 1999* (DSEWPac 2011b), and it is habitat for endangered animals and plant species. The Cotter also has diverse aquatic ecosystems, and is an excellent representation of a Murray-Darling Basin upland aquatic ecosystem, with its upland bogs and fens, and small sub-alpine creeks. It is a moderate size permanent upland river with both regulated and unregulated reaches, and medium and large water-storage reservoirs.

In the lower Cotter catchment, since 2006 when the draft Strategic Management Plan for the Lower Cotter Catchment was created, a major restoration project has been rehabilitating and restoring native vegetation. The project is one of the largest land rehabilitation projects undertaken in Australia and involves the rehabilitation of over 3500 hectares of land formerly under pine plantations that were destroyed by the 2003 bushfires (see *Land health* indicator cluster for more information). Reduction of the extensive forest road network (which was identified as being a

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significant contributor to stream turbidity) has been completed. Revegetation works are ongoing in areas where natural regeneration was low. There has been significant improvement in the vegetation cover of the catchment since 2003, which will contribute to reducing in-stream turbidity. Monitoring over at least a few more years should continue to detect the general trend of reduced turbidity.

## Wetland management

### Natural wetland management

The most significant management challenge for wetlands is the apparent individuality of each wetland (Johnston et al. 2009). Assessment of early *Sphagnum* bog recovery work indicated that previous rehabilitation of the bogs appeared to aid recovery in the vegetation at many sites; however, the integration of vegetation and subsurface peat was such that it did not withstand the 2003 fires at all sites (Macdonald 2009). Rehabilitation of a number of the *Sphagnum* bogs burnt in the 2003 fires has been carried out to prevent stream entrenchment and subsequent drainage and loss of these bogs. Trials to assess other bog rehabilitation techniques were also carried out (Macdonald 2009).

Restoring and maintaining functional bogs is not simple and is not achievable through revegetation alone. Assessment needs to focus on monitoring of recovery of bog function, not just vegetation recovery (Macdonald 2009). While current observations indicate that the *Sphagnum* bogs are showing good post-fire recovery, previous rehabilitation assessments suggest that it may take 20-30 years for full recovery of bog function (Macdonald 2009). The recovery is being recorded through an ongoing photo monitoring program in selected bog systems.

For wetlands along the Murrumbidgee River in ACT, the main issues for management are river flows and invasion by exotic and native plant species, as well as climatic conditions (Johnston et al. 2009). Environmental flows should be designed to allow the river to show both seasonal and incidental variations in flow, at a level and intensity or duration that meet the requirements of off-stream wetlands. Flows close to the calculated minimum just to keep the system alive will not allow the system to thrive, let alone refresh itself after a major perturbation, and will encourage species depletion (Johnston et al. 2009).

In the Molonglo River catchment, significant work has occurred at the Jerrabomberra Wetlands during the reporting period. The ACT Government has completed the *Jerrabomberra Wetlands Nature Reserve Plan of Management 2010*, which sets out management zones, goals, objectives and actions for the next 10 years (TAMS 2010). Work is also being undertaken to control willows and woody weeds and to follow-up revegetation works along Jerrabomberra Creek.

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Recently the ACT Government has taken a new approach to conservation management. The Capital Woodland and Wetlands Conservation Trust is being established to support projects in Jerrabomberra Wetlands Nature Reserve and Mulligans Flat Woodland Sanctuary. This partnership between Government and the community has the aim of integrating private sector and community funding into conservation projects. The Trust is intended to supplement rather than replace annual government support for normal ongoing management of these areas (OCSE 2011). For more information see the *Fauna* indicator cluster paper (*Biodiversity* theme).

## Constructed wetland management

In 2008, the ACT Government implemented a revised *Territory Plan* (ACT Government 2008) that includes a *WaterWays: Water Sensitive Urban Design General Code*. The code seeks to develop and manage stormwater infrastructure and water quality, including gross pollutant traps, water quality control ponds, wetlands and vegetated overland flowpaths (ACT Government 2008). The continuing implementation of Water Sensitive Urban Design within the ACT urban landscape will help improve and enhance the quality of water within the urban wetlands.

Extensive research, particularly in Canberra and Melbourne, during the 1990s, determined the principles for constructing urban wetlands that are generally effective in removing stormwater pollutants, such as suspended solids and nutrients. A major factor in determining this effectiveness is the detention time of water within the wetlands, which itself depends on the volume of water flowing into the wetland (Wong et al. 1999).

During the reporting period, the significant drought between 2007 and June 2010 (BoM 2011) resulted in limited inflows into the constructed wetlands and the likelihood of a long detention time. Since June 2010, the ACT has experienced high rainfall and a number of extreme rainfall events (BoM 2011), which are likely to have decreased the detention time and the effectiveness of these wetlands in removing sediments and nutrients from the urban stormwater (Wong et al. 1999).

## Glossary

**AUSRIVAS (Australian River Assessment System):** a classification system that uses riverine aquatic macroinvertebrates to provide information about river health

**Macroinvertebrates:** animals without backbones (largely insect larvae) that are larger than ½ millimetre and live on or under rocks, logs, sediment, debris and aquatic plants

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**MCHiP:** The Molonglo Catchment Health indicator Program (MCHIP) uses and builds on existing data sources and community-based resource assessment techniques, to enable informed decisions and a framework for future monitoring of catchment health

**Riffle:** in a stream, a rapid, formed by shallow broken water running over a stony bed

**Turbidity:** a measure of water clarity or the cloudiness of water because of the presence of suspended material, such as silt and clay

**Water Sensitive Urban Design:** the integration of urban planning with the management, protection and conservation of the urban water cycle that ensures urban water management is sensitive to natural hydrological and ecological processes

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## **Other data sources**

In addition to these published reports, data for this paper were also sourced from:

ACT Department of Territory and Municipal Services (TAMS) – now Territory and Municipal Services Directorate (TAMSD)

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## Annex 1: AUSRIVAS results for the ACT

Table A1. AUSRIVAS classifications for assessment of aquatic condition

Band	Condition	Taxa interpretations
X	More Biologically Diverse than Reference	More families found than expected Potential biodiversity “hotspot” Loss of pollution tolerant taxa
A	Similar to Reference	Expected number of families
B	Significantly Impaired	Fewer families than expected - Potential impact on aquatic condition or riparian zone (habitat) resulting in a loss of families
C	Severely Impaired	Many fewer families than expected - Loss of families from substantial degradation of the aquatic condition and riparian habitat
D	Extremely Impaired	Few of the expected families - pollution tolerant families remain

Source: DECCEW 2010

Note: “Taxa interpretations” shortened



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Table A2. Summary of AUSRIVAS assessment for the ACT

Site name	Spring 2005	Autumn 2006	Spring 2006	Autumn 2007	Spring 2007	Autumn 2008	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010
<i>Murrumbidgee River at Angle Crossing</i>	<i>B</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>A</i>	<i>A</i>	<i>A</i>	<i>B</i>	<i>A</i>
<i>Tidbinbilla River at Paddys River Road</i>	<i>B</i>	<i>B</i>	<i>A</i>	<i>A</i>	<i>A</i>	<i>A</i>	<i>A</i>	<i>A</i>	<i>A</i>	<i>A</i>
<i>Paddys River at Murray's Corner</i>	<i>A</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>A</i>	<i>B</i>	<i>A</i>	<i>C</i>	<i>A</i>
Gudgenby River at Smiths Road	A	A	A	B	C	B	A	B	B	B
Tuggeranong Creek Drive	C	B	B	B	C	A	C	B	C	B
Molonglo River at Yass Road	B	B	B	B	D	B	A	B	C	B
Queanbeyan River at ACT border	C	C	C	C	C	C	D	C	B	C
Jerrabomberra Creek at Hindmarsh Drive	D	B	B	C	B	C	C	B	C	C
Yarralumla Creek at Cotter Road bridge	C	C	C	C	B	C	C	C	B	C
Ginninderra Creek at Latham	D	B	C	B	D	C	D	C	C	C
Ginninderra Creek at Baldwin Drive	D	C	C	C	C	C	C	C	C	C
Ginninderra Creek Drive	C	B	C	C	C	C	C	C	C	B
Murrumbidgee River at Halls Crossing	B	A	A	B	B	B	A	B	B	B

Source: adapted from DECCEW 2010

Note - Baseline sites are bold, italic and shaded in grey