ACT Water Report

2010–11

ACT Government

Environment and Sustainable Development

Foreword

Canberra's continued health and prosperity depends on the sustainable management of our water resources. It is vital we continue to manage ACT waterways and aquifers so the environment supports sustainable development.

The *ACT Water Report 2010–11* provides important information about our waterways and the impact of urban, rural, forestry and conservation land practices in the ACT.

The report comments on how we use our waterways, from recreation to irrigation, and details water access entitlements and licences to take water during 2010–11.

This year the report examines the way our catchments and waterways are responding to the higher than usual rainfall in spring and summer and consequent flood damage. Ongoing stewardship, in line with the ACT Government policy *Think Water Act Water*, is the responsibility of all Canberrans. That responsibility is demonstrated in the quality of water leaving the Territory being at least as good as that entering it.

The report provides data demonstrating that water quality in the region is meeting acceptable standards. The short-term changes in turbidity, quantity of suspended solids and elevated faecal coliform counts associated with the floods quickly subsided and water quality was within standards by autumn 2011.

It also demonstrates the on-going efficient use of ACT water resource. Water use was at a low 8.6% of total water resources in 2010–11. The data commends the efforts towards water sensitive urban design, where planning delivers improved outcomes for urban waterways.

The report recognises the need for cross-border water management and includes information on waterway health in relation to the demands of both the local and downstream users.

Research continues on catchment management processes. Threatened fish stocks and diversity have continued their recovery in the Murrumbidgee, Cotter and Queanbeyan rivers. Water related community programs such as Waterwatch continue to attract a high level of interest and community support. Increasingly, urban Waterwatchers have adopted local urban wetlands as their point of focus. Community monitoring programs focus on water quality, and assess aquatic fauna such as platypus, frogs, macroinvertebrates and riparian condition. These community groups should be commended for their ongoing dedication to our precious waterways.

I welcome this report and look forward to following the continued improvement of our catchments and waterways as they recover from the difficulties of floods and storms.

Simon Corbell

Minister for the Environment and Sustainable Development

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Front cover photos:

Top:	Naas Creek, near Mt Clear (ESDD)
Middle:	Tharwa Bridge, restoration (ESDD)
Bottom:	Pump at National Arboretum (ESDD)

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Lake Tuggeranong

Executive summary

The Environment and Sustainable Development Directorate (ESDD) manages a water monitoring and assessment program for the Australian Capital Territory that includes water quality, streamflow and biological monitoring. This program is part of maintaining up-to-date information on the water resources of the ACT, a statutory requirement of the *Water Resources Act 2007*. Additionally, this information is used to help determine whether management strategies used to achieve or maintain the aquatic values set for ACT waters are appropriate.

The report provides the community with information about the state of water resource management in the ACT, including quality and quantity. The assessment approach adopted is designed to move towards a more holistic ecosystem health monitoring system as advocated by the Murray–Darling Basin Commission's Sustainable Rivers Audit. It uses biological data to ascertain ecosystem diversity, and water quality data to determine trends that may be present, and compares these results with the designated environmental and use values and standards set out in the Territory Plan and the *Environment Protection Act 1997*, Environment Protection Regulation 2005 and *Water Resources Act 2007*.

Streamflow monitoring provides contextual information and is used to gauge the impact of removing water from the environment for other uses. Water quality is monitored in the major urban lakes and Burrinjuck Reservoir (a NSW responsibility), the first major water body downstream of the ACT. The National Capital Authority conducts a water monitoring program for Lake Burley Griffin, supported by littoral samples taken by Waterwatch volunteers. The major rivers and some urban streams are also monitored. River flow is measured at a number of sites throughout the ACT. The report uses AUSRIVAS biological information to report the biodiversity in the rivers and streams (see p. 40). The individual data points and mean values of water quality parameters for the year are considered, with reference made to the standards set in the Territory Plan and Environment Protection Regulation 2005.

Results for the 12-month reporting period (July 2010–June 2011) showed that rainfall in the urban area was 254 mm more than the previous year and, at 866 mm, well in excess of the long term average rainfall. In 2010–11, stream flow in waterways arising within the ACT increased with good runoff from heavy to flooding rains in October, November, December and February. Run-off persisted across the year as soil moisture in the catchment remained at satisfactory levels.

High rainfall and consequent high flows bring large quantities of silt laden water through our urban waterways. A number of short term changes to water quality occur at such times. Environmental conditions in urban waterways fluctuated across the summer of 2010–11, with faecal coliform counts, turbidity and levels of suspended solids demonstrating the nature of the silt load. Electrical conductivity climbed slowly once flows subsided, and other parameters returned to regulation levels or better in all ACT waterways.


Dickson wetlands

As our large artificial lakes and ponds are part of our storm water collection and retention system, it is no surprise there were disturbances to some parameters as a consequence of the heavy rains. Even so, during the sampling period the urban lakes showed overall water quality close to or within recommended limits. Nutrient rich waters provide the conditions for rapid growth of phytoplankton. While chlorophyll 'a' levels indicate the presence of some high phytoplankton populations in several lakes, only Lake Tuggeranong developed noxious blooms of blue-green algae (cyanobacteria). These blooms persisted from February to almost June in 2011.

The *Water Resources ACT 2007* requires assessment of river flows and licensing of water abstractions. In recent years, particularly during the recent drought, the demand for surface and groundwater rose considerably. Consequently the water abstracted in some sub-catchments reached the sustainable limit. Holders of Water Access Entitlements (WAEs) under this Act are issued with licences to extract water within sustainable volumes. Water extraction in 2010–11 was lower than in previous years as consistent good rainfall maintained good soil moisture and ameliorated the need for extraction.

The ACT Government has 14 groundwater monitoring bores in high demand areas within the ACT. Monitoring continues to assess the aquifer response to abstraction and rainfall. Research continues on catchment processes and threatened fish. Water related community programs, such as Waterwatch, Frogwatch and Platypus Count, continue to attract a high level of interest and support from the community.

2010–11 saw a welcome increase in flows in all our waterways and replenishment of aquifers and soil moisture levels. The fluctuations in water quality reflected the disturbances in the general environment brought about by storms and floods. Water quality parameters returned to standard levels quickly. Groundwater use was down on previous years as would be expected in a year of generous rains. Research in the catchment continue and volunteer interest, especially in urban wetland health and Platypus Count, has again been high.

Introduction

Purpose

The ACT Water Report 2010–11 is intended to provide the Australian Capital Territory community with information on the state of the ACT's water resources for the year 1 July 2010 to 30 June 2011.

The report is divided into four sections. Section 1 examines the water resources in the ACT, including the amount of water and its use. Section 2 discusses water quality condition including the type of indicators used for assessing water quality and biological condition. Results for lakes and rivers are given in the context of water quality standards. Section 3 outlines research and section 4 community activities taking place throughout waterways in the ACT.

Scope

The report focuses on the waterways of the ACT with the exception of Lake Burley Griffin, covering the past year's water management and conditions and referencing historic conditions where appropriate.

Lake Burley Griffin is a Commonwealth responsibility and the condition of the lake is presented in an annual report produced by the National Capital Authority. For information relating to Lake Burley Griffin, contact the National Capital Authority on 6271 2888 or visit nationalcapital.gov.au.

Information relating to drinking water quality of the mains water supply is the responsibility of ACTEW and the Chief Health Officer, and is not included in this report. For information relating to mains water supply, contact ActewAGL on 13 14 93 or visit actewagl.com.au.

Land use

Land use is an important consideration for water use and quality because different land uses have different impacts on water quality (because of rates of soil erosion and sediment transport) and hydrology (impervious surfaces in urban areas increase storm water runoff and may reduce groundwater recharge).

There are four major land uses in the ACT (see Figure 1).

- **Conservation land use** tends to have a minimal negative impact on water quality in normal circumstances. The last two years of high rainfall have allowed post fire restoration to proceed very well, and the soil moisture to approach optimum.
- **Plantation forestry** is now concentrated in the Kowen Forest in the north-east of the ACT and the Pierces Creek plantations along the lower reaches of Paddys River. Until crown width and leaf litter levels mature in plantations there are wide areas of exposed earth in young pine plantations. In such areas ground water demand is high and runoff following storms may impact unfavourably on local water quality. The National Arboretum, also a plantation, will consume water in the establishment phase but has been designed to capture runoff to minimise extraction from external sources.
- **Rural use** can have significant impacts on surface and ground water. Some activities may result in soil erosion. On-farm water retention may reduce surface water in creek lines and locally deplete ground water. The release of agricultural chemicals and animal waste in inappropriate ways or less than fortuitous occasions may add to the nutrient load of a waterway. Alternatively, appropriate paddock revegetation and creek-line restoration may enhance soil moisture and water quality.
- **Urban use** has the greatest potential for negative impact on local water quality. Materials entering urban waterways, which include fertilisers and other chemicals, organic matter, soil, oil and small amounts of sewage effluent, are likely to impact the health of our waterways. Drought impacts include the concentration of waterway chemicals to above normal levels and sand or silt slugs associated with fragile bare soils and storms. Riparian condition for urban waterways is usually severely modified to park-like landscapes. This can reduce biodiversity markedly and unfavourably promote conditions suitable for aquatic weeds and nuisance algae.

Rivers in the ACT region

The major river flowing through the ACT is the Murrumbidgee River, originating in the alpine area to the south of the ACT. However, the Murrumbidgee's headwaters are largely diverted to the Snowy River Scheme from Tantangara Reservoir for irrigation and power generation purposes. Murrumbidgee River waters that do flow through the ACT are further regulated downstream of the ACT border at Burrinjuck Reservoir. All rivers and creeks in the ACT drain to the Murrumbidgee River (see Figure 1: Land use and main rivers of the ACT). The longest, the Molonglo and Queanbeyan Rivers, originate to the south-east of the ACT and drain through Lake Burley Griffin before flowing into the Murrumbidgee River. Water from the upper Queanbeyan catchment contributes greatly to the capacity of Googong Reservoir. The Cotter River is contained wholly within the ACT and provides the water for Corin, Bendora and Cotter reservoirs.

Bushfires

Post fire recovery in the upper Murrumbidgee catchments following the January 2003 fires has been steady but slow. Low soil moisture remained a major constraint on vegetation recovery throughout the region until the above average rainfall in the first half of 2010. Soil moisture levels are the highest for ten years and vegetation recovery is well advanced. Monitoring and research into various ecosystem components, such as riparian vegetation and sediment transport, highlighted in the Environment ACT Bushfire Recovery Plan is continuing (environment.act.gov.au/Files/bushfirerecoveryplan.pdf).

Protection of water resources

The ACT Government seeks to manage catchments and waterways to achieve sustainable and appropriate water conditions. This includes an integrated catchment approach to planning, development controls, controls on water abstracted, the licensing of end-of-pipe discharges and regulation of non-point source discharges through the requirements of erosion and sediment control plans. An increasing emphasis on improved design and management of urban stormwater systems aims to reduce urban impacts on water quality. Urban stormwater infrastructure such as gross pollutant traps, water quality control ponds, wetlands and vegetated flood-ways are designed and managed to ensure that water quality is suitable for designated uses. The WaterWays: Water Sensitive Urban Design General Code in the Territory Plan will help ensure urban development is consistent with sound water resource management (actpla.act.gov.au/tools_resources/legislation_plans_registers/plans/territory_plan).

The Territory Plan environmental and use values

Volume 2 of the Territory Plan, General Code 1.8 *Water Use and Catchment General Codes*, sets the permitted uses and protected environmental values for the waterways in the ACT. The plan identifies three types of catchments: drainage and open space, water supply and conservation. For streams, lakes and rivers within each of these catchment types, the Territory Plan also identifies a set of values e.g. maintenance of ecosystems, recreation and water supply. This set includes a primary value and a range of other permitted uses, which are generally compatible with, but secondary to, the primary value. These permitted uses specified in the Territory Plan can then be used, with the water quality standards, to determine the water quality required for each water body.

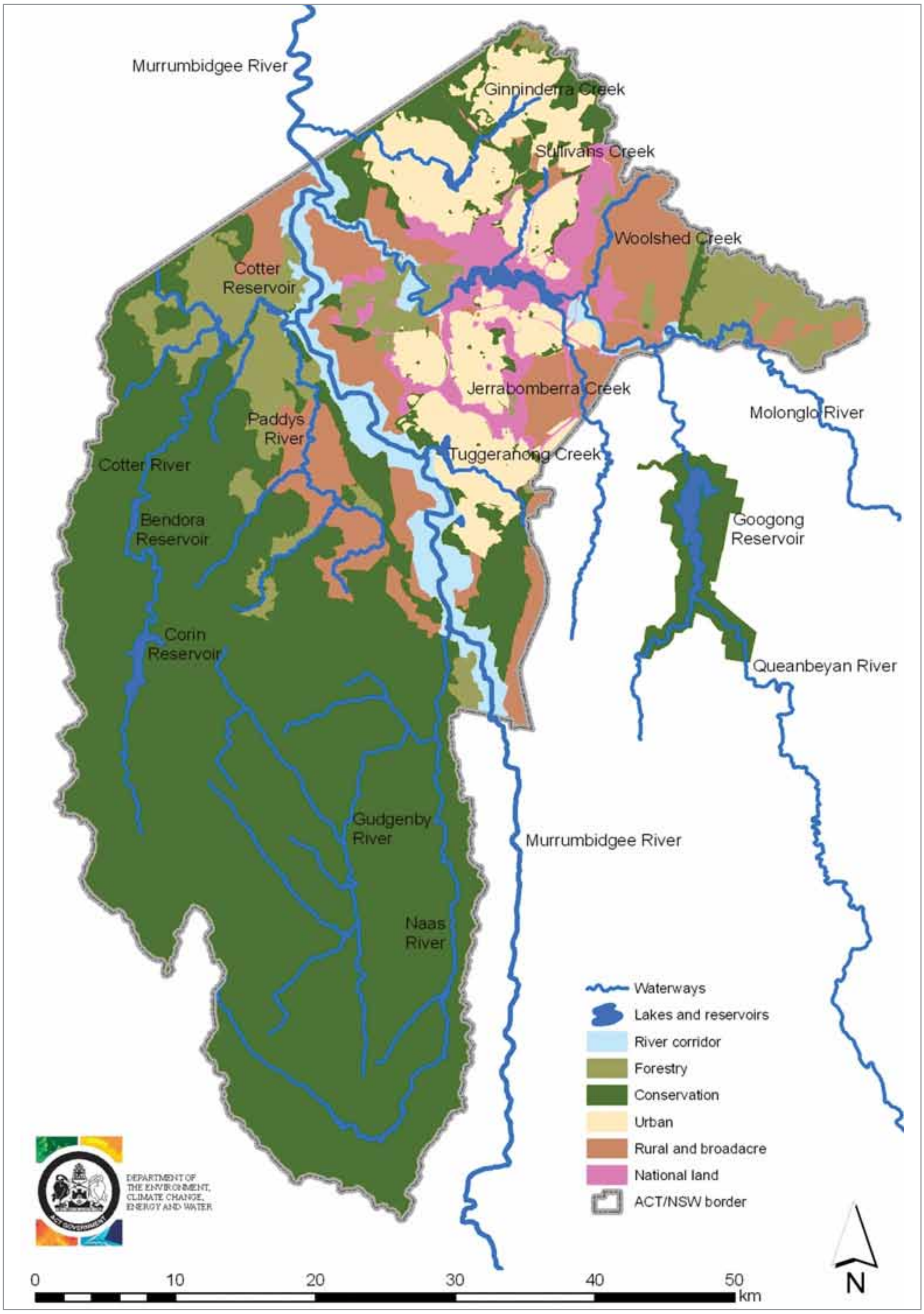
Table 1: Water quality standards (Ref: Environment Protection Regulations 2005)

	Water Use				
Indicator	Water based recreation —swimming (REC/1)	Water based recreation —boating (REC/2)	Water supply — stock (STOCK)	Water supply —irrigation (IRRIG)	Aquatic habitat —wetland (AQUA/1 to AQUA/6)
Total Phosphorus (mg/L)	< 0.1	< 0.1			< 0.1
Turbidity (NTU)	Not objectionable				<10 – <30
Suspended Solids (mg/L)					<12.5 – <25
Chlorophyll ‘a’ (µg/L)	< 10	< 10	< 10		<2 – <10
Faecal coliforms (cfu/100mL)	≤ 200	≤ 200	≤ 1000	≤ 1000	
Dissolved Oxygen (mg/L)					>4
Acidity (pH)	6.5–8.5	6.5–8.5	6.5–9.2	4.5–9.0	6–9
Total Dissolved Solids (mg/L)			< 3000	< 500	

Water quality standards

Water quality standards are listed in Schedule 4 of the Environment Protection Regulation 2005. These tables list the necessary ambient water quality to support each of the water uses referred to in the Territory Plan. Table 1 provides examples of some of the water quality standards for certain water uses.

Figure 1: Land use and main rivers of the ACT



Section 1: Water Resources

Water resource use

The Act: The *Water Resources Act 2007* (the Act) provides a framework for the sustainable management of ACT water resources. The Act is the law that controls how people living and working in the ACT use water directly from water bodies, including groundwater aquifers. The Act aims to balance present day household, industrial and agricultural use of water with protection of local ecosystems while conserving the resource to meet the reasonable future needs of the community. The Act endeavours to protect aquatic ecosystems and aquifers from damage and, where possible, reverse damage already done.

The Act and its regulation contain arrangements for the management of the Territory's water resources. They identify, for each water management area in the ACT, how much water is required to maintain river systems and associated ecosystems and how much is available for entitlements for off-stream use.

Environmental flows: The Act requires that water needed to maintain river systems and associated ecosystems is identified and reserved for that purpose. These requirements are generally referred to as environmental flows. Environmental flow requirements apply to all Territory water resources including water in rivers, streams, dams, lakes and groundwater aquifers. The Environmental Flow Guidelines (EFG) identify the ecological values to be protected and the measures to be employed to protect them. In the ACT this is generally by limiting the amount that can be extracted from a water way in a way that protects flow variability and low flows. In selected high use catchments the EFG specify actual flows that must be maintained in certain conditions and their review through an adaptive management regime. The guidelines recognise the highly connected nature of surface and groundwater and the contribution groundwater makes to the stream base flow during drier times. The EFG will be revised during 2011–12. The EFG can be accessed at environment.act.gov.au/water/act_water_resources.

The instruments: Under the Act, the document Water Resources (Water management areas) Determination 2007 (No 1) details the areas used for water management in the ACT. They are either single sub-catchments or a group of adjacent, hydraulically connected sub-catchments. The areas are used for the management of both surface and groundwater.

Water Resources (Water available from areas) Determination 2007 (No 1) puts the principles and controls contained in the EFG into practice by detailing the surface water and groundwater available for taking from each Water Management Area (WMA). It recognises the highly connected nature of surface and groundwater and includes water reserved for future use. These measures ensure the Territory's water resources are managed sustainably. Water management area boundaries used for this purpose are set out in Figure 2.

These two instruments currently comprise the ACT Water Sharing Plan. In parallel with the review of the EFG in early 2011–12, development of a more expansive water plan will commence in 2011–12. It is intended the plan will also meet the needs of the *Water Act 2007* (Commonwealth) and the Murray-Darling Basin Plan.

Extraction regulations: The Act makes it clear that control of all water use in the Territory, including from streams, dams or groundwater, is vested in the Territory. Under the Act it is a requirement to hold a Water Access Entitlement (WAE) before a Licence to take Water can be issued. A WAE is a right to an amount of surface water or groundwater within a Water Management Area. It is generally a tradable commodity. A Licence to take Water is required to physically extract the water specified by a WAE. The licence states the location and conditions for taking and using water. The licence is not a tradable instrument in the ACT.

Because ACTEW holds a licence to take water, its customers are not required to hold a licence when using water supplied by ACTEW. The taking of surface water for stock and domestic purposes, where water is collected from the lessee's property or where their property directly abuts a waterway, does not require a licence. A licence is not required for the use of water collected in rainwater tanks or the on-site use of waste water.

Information: Details of legislation, environmental flows and fact sheets on specific water allocation uses can be obtained from the ESDD website environment.act.gov.au/home or by calling Canberra Connect on 13 22 81.

Inter-jurisdictional arrangements

The ACT is a signatory to the National Water Initiative (NWI), which aims to bring water planning, regulation and trading to a nationally compatible standard to optimise economic, social and environmental outcomes in the management of water. Section 23 of the NWI sets out ten specific objectives. The ACT, through its legislation and its planning process, meets all ten objectives. See the NWI at the National Water Commission website nwc.gov.au/www/html/116-introduction-to-water-reform.asp.

As a signatory to the Murray–Darling Basin Agreement, the ACT has agreed to remain within a cap on surface water extraction. By ensuring all extraction and return flows are metered, the ACT determines its net extraction and ensures licensed extraction is limited to the extent necessary to remain within this cap. The development and implementation of a Murray-Darling Basin Plan and associated sustainable diversion limit that will replace the cap will require the ACT to develop a water resource plan that deals with both surface water and groundwater as well as the interception of surface water by plantation forestry and farm dams. ACT legislation and planning process make it well placed to develop a compliant water resource plan for accreditation against the basin plan requirements within the expected timeframe.

The one limiting factor to full implementation of NWI reforms in the ACT is a lack of interstate water trading protocols. The absence of protocols results in an inability to trade with other jurisdictions. The development of protocols requires the cooperation of other Murray-Darling Basin jurisdictions, which has not yet been achieved. Until trading protocols are agreed, the ACT will continue to issue new Water Access Entitlements to meet demand for new water use provided it falls within ACT legislative and planning requirements.

Fostering sustainable water resource use through regulation

The Act vests power in the Minister for the Environment and Sustainable Development (Minister) and the Environment Protection Authority (EPA). WAEs may only be acquired by purchase from an existing holder (trading) or by grant by the Minister. The EPA issues Licences to Take Water (Table 3), Bore Works Licences and Waterway Works Licences (needed for construction of dams) subject to conditions and volume considerations. It also approves application to trade WAEs both within the ACT and with other jurisdictions. Together these controls allow the EPA to manage the use of water resources in an environmentally sensitive manner.

The Act requires that water be set aside for the environment before extractive use is considered. Table 2a sets out the total average volume of water available in each water management area in the ACT, the volume set aside for the environment, the volume available for extraction, the amount allowed for extraction (entitlements issued) and the volumes extracted in 2010–11. The totals for the whole ACT and the portion of the total resource of each component are set out at the bottom of the Table.

Figure 2: Boundaries of Water Management Areas under the *Water Resources Act 2007*

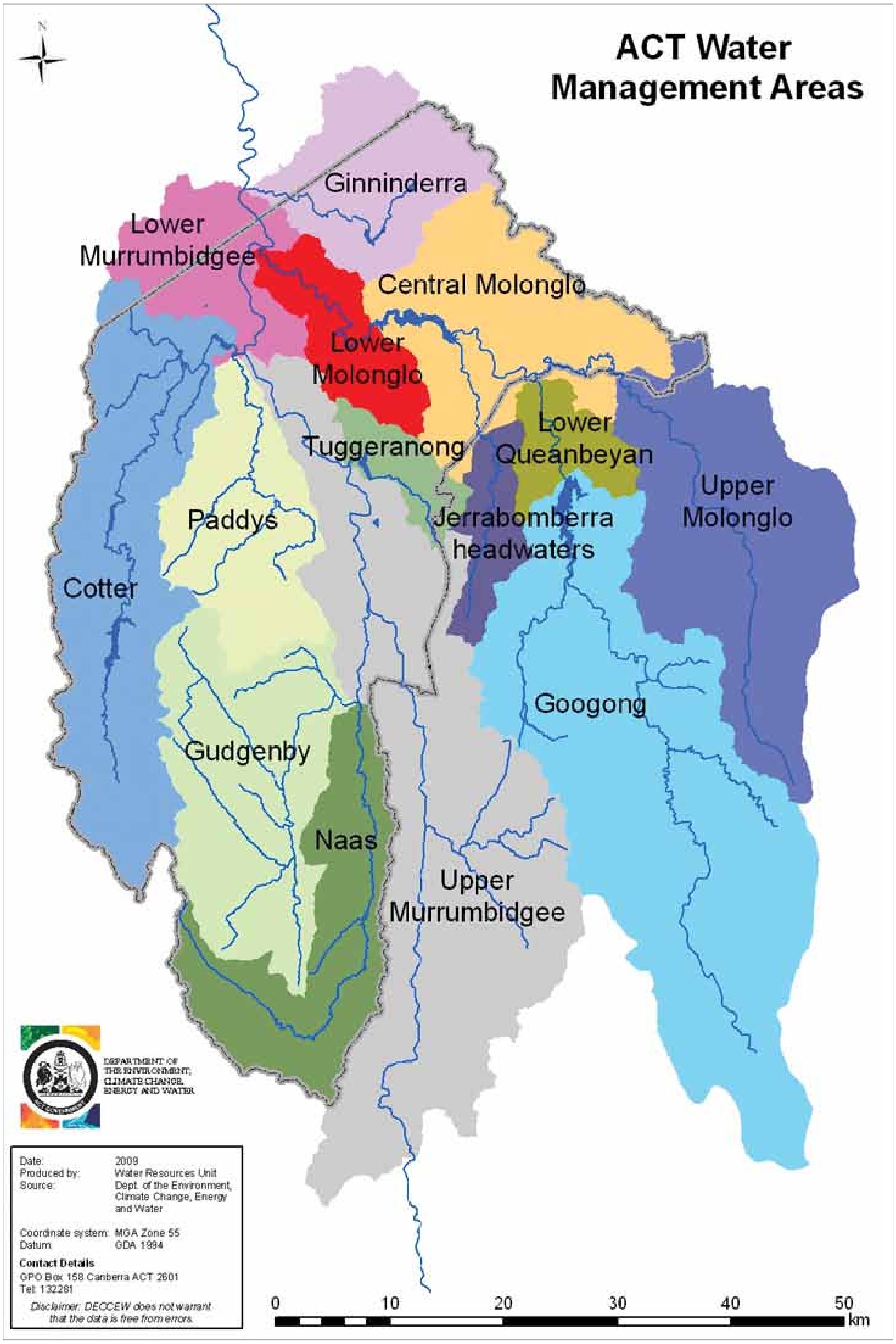


Table 2a: Water resources, entitlements and use, 2010–11

Water management area	Total water resource (ML)	Environmental allocation (ML)	Total water available for extraction (ML)	Total water entitlements issued (ML)	Water extracted during 2010–11 (ML)	Number of entitlements
Central Molonglo	24489	18609	7832	2480.5	580	139
Cotter	145702	34294	111408	58000	37681	3
Ginninderra	19895	11746	5352	1944.5	264	35
Googong	103164	4250	98914	12896.5	3264	6
Gudgenby	50522	46569	3558	11	1	3
Jerrabomberra headwaters	0	0	0	0	0	0
Lower Molonglo	15932	10594	3304	2089	101	15
Lower Murrumbidgee	17223	15728	29925	132.5	9	5
Lower Queanbeyan	22	15	7	0	0	0
Naas	38554	35619	2641	2	1	1
Paddys	39799	36571	2905	83	15	5
Tuggeranong	7909	4860	1461	853.5	64	8
Upper Molonglo	1274	1160	102	2	1	1
Upper Murrumbidgee	27482	24408	2517	1693.5	146	32
Total	491967	244422	272927	80188	42128	253
Total resource %	**100%**	**50%**	**55%**[1]	**16%**	**8.6%**	**N/A**

Notes: This figure includes returns from sewage treatment plants not included in the total water resource.

Full details of water related entitlements and licences issued by the Authority are available for inspection in the Water Resource Act Register. Appointments for inspection can be made by contacting the EPA on 13 22 81.

Water trading

Water trading is a key aspect of national water reforms. Only trade within the ACT is currently available. Trade with other jurisdictions is dependent on the development of interstate water trading protocols. There was little demand for water trading during 2010–11, with only four entitlements traded and no allocation trading. Details of 2010–11 water trading are set out in Table 2b. This data is updated monthly on the ACT Government website and can be viewed at environment.act.gov.au/water/act_water_resources/water_trading.

Table 2b: Water trades 2010–11

Type of trade	Number of trades	Volume of trades (ML)
Intrastate entitlement trade	4	77.5
Interstate entitlement trade	0	0
Intrastate allocation trade	0	0
Interstate allocation trade	0	0

Water trade processing times

The Council of Australian Governments and the Natural Resource Management Ministerial Council have developed service and reporting standards for trade processing times by jurisdictions within the Murray Darling Basin (MDB) for both entitlement and allocation trades. The ACT Government is committed to meeting those standards. The standards can be viewed at nationalwatermarket.gov.au/about/trade-processing.html

Licences on issue

As at 30 June 2011 there were 183 licences to take water on issue. Of these, seven were newly issued during 2010–11 (Table 3). A licence holder must have a WAE and may hold multiple WAEs, but not all WAEs may have active licences in the reporting period. The ACT Government only issues licences in the ACT and the Googong Dam area. Areas within the WMA illustrated in Figure 2 but outside the ACT and the Googong Dam area are administered by New South Wales.

Table 3: Licences issued in reporting period 2010–11

Instrument type	Total numbers
Bore construction 2010–11	7
Driller's licence 2010–11	19
Waterway works 2010–11	33
Water use licence 2010–11	9
Water use licences total	183*

*This figure includes all licences, newly issued or renewal of existing licences.

While the table above is definitive in its depiction of total entitlement volume of water in the ACT, it is recognised that there may still be bores without entitlement in use and existing entitlement holders may exceed their entitlement volume. The EPA conducts a compliance program to monitor volumes extracted and detect unauthorised extraction (Table 4).

Table 4: Compliance actions in the ACT, 2010–11.

Year	2010–11
Alleged compliance breaches reported	9
Advisory letters issued	6
Formal warning (specifying section and Act)	3
Admin sanctions (specifying section and Act)	0
Criminal charges and proceedings brought (specifying section and Act)	0
Civil enforcement actions in courts and outcomes	1*
Licence suspensions (specify section and Act)	0
Statistical comparison with preceding years.	N/A first year of reporting

* Appeal of EPA Direction heard in ACT Civil and Administrative Tribunal and Supreme Court – ongoing.

Climate and water resources

The availability of the ACT's water resources is strongly influenced by rainfall. Groundwater recharge in the ACT's low yield fractured rock aquifers is closely linked to recent rainfall history, unlike some other groundwater sources that contain stored rainfall from millions of years ago. In 2010–11 stream flow in waterways arising within the ACT increased with good runoff from heavy to flooding rains in October, November, December and February. Soil moisture in the catchment remained at satisfactory levels. Stream flow in the Murrumbidgee and Molonglo rivers crossing the ACT includes additional contributions from substantial areas of their catchment outside the ACT.

Rainfall in the ACT is strongly affected by the landform of the Territory. In the mountainous region to the west of the Murrumbidgee River, annual average rainfall ranges from 800–1000 mm. In the flatter tablelands on which Canberra is built, the annual rainfall reaches 600–700 mm. In the present 12-month reporting period, Canberra's annual rainfall was 866 mm, 254 mm above the 612 mm in 2009–2010 and 141% of the long-term average for Canberra Airport of 616.4 mm.

Rainfall in an urban area (Charnwood Road in Belconnen) and in a water supply catchment area (Cotter Hut, above Corin Reservoir) is depicted in Figure 3. These two sites, where rainfall measured is directly correlated with stream flow in the ACT, demonstrate the rainfall and landform interaction. Both the long-term average monthly rainfall from data collected since 1990, and the monthly rainfall for the 2010–11 reporting period are presented.


David Street wetland

Rainfall at both the Cotter Hut and Charnwood Road stations was well above average for all but three months in 2010–11. Annual rainfall at the Charnwood Road site in Belconnen was 936 mm, 145% of long term annual rainfall. This was more than 200mm greater than 2009–10, with good falls in the spring, summer and March. The 1522 mm of rain recorded at Cotter Hut was 158% above average rainfall with above average rain from September to April and 200mm or more in November and March. The water supply reservoirs received good flows throughout the year and were above capacity by December 2010. They have remained at better than 95% capacity to the present.

Patterns in the stream hydrograph for the urban area (Figure 4) closely reflected rainfall patterns at Belconnen (Figure 3). Ginninderra Creek, which drains a highly urbanised catchment with large areas of impervious surfaces, showed quick response to the high rainfalls occurring between August and December and in February (Figure 3). The December floods are clearly seen in the peak well above the average summer flows. The below average flows in the dry autumn of 2011 are also marked.

Figure 3: Comparison of 2010–11 monthly rainfalls in Belconnen near Charnwood Road and Cotter Hut in the Corin Reservoir Catchment with the long term average monthly rainfall

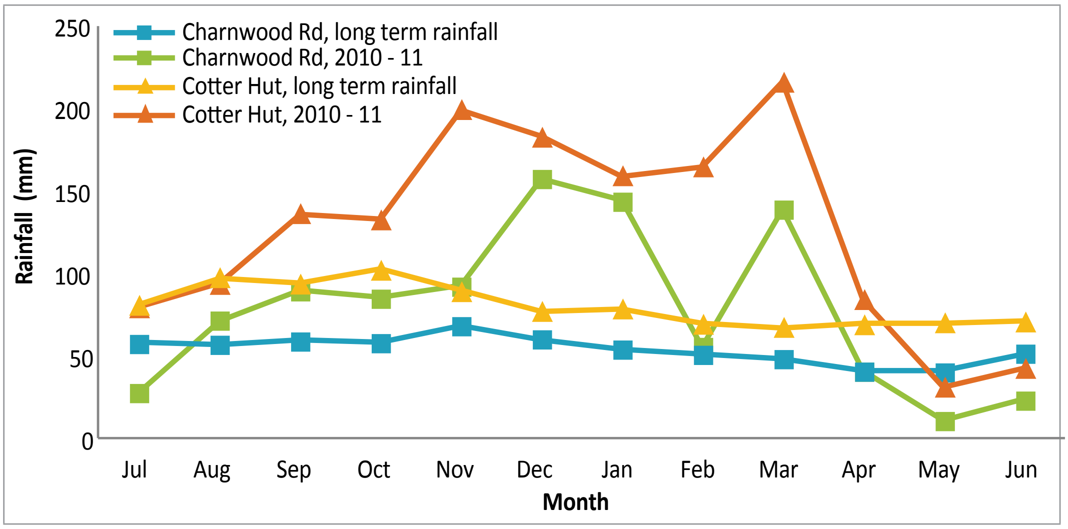


Figure 4: Average monthly flow July 2010 to June 2011 in Ginninderra Creek (410750) upstream of Charnwood Road compared with the long-term average monthly flow for that site

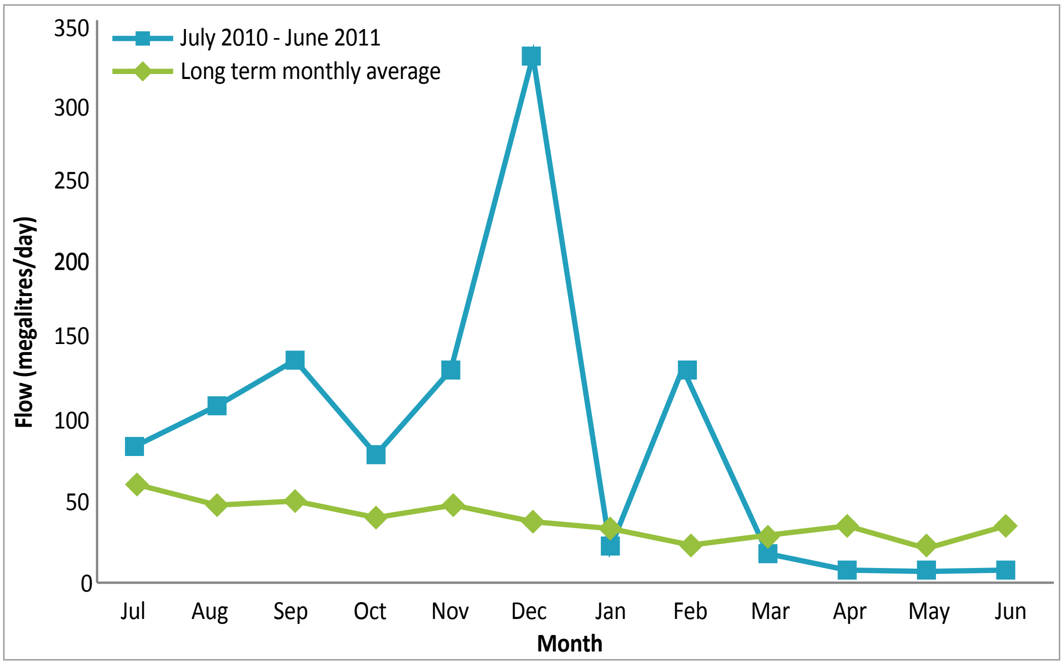
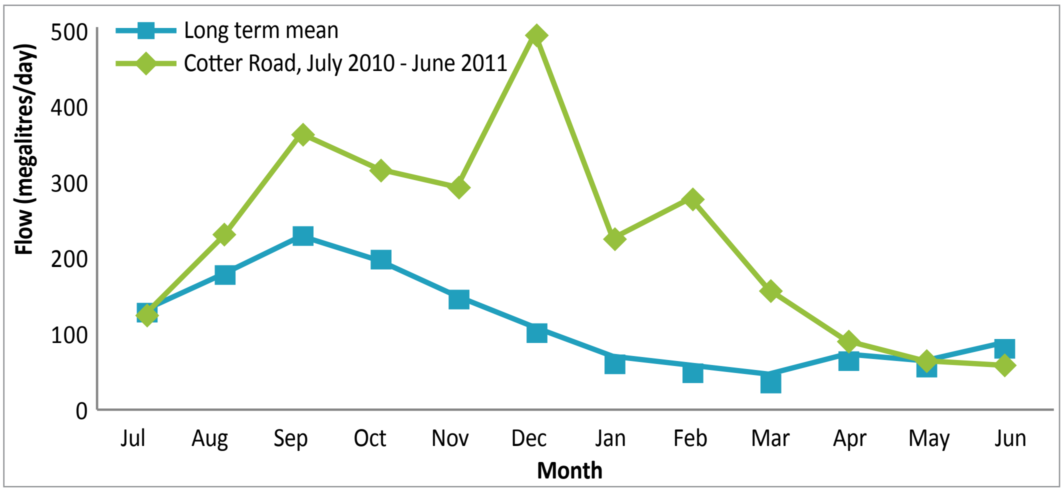


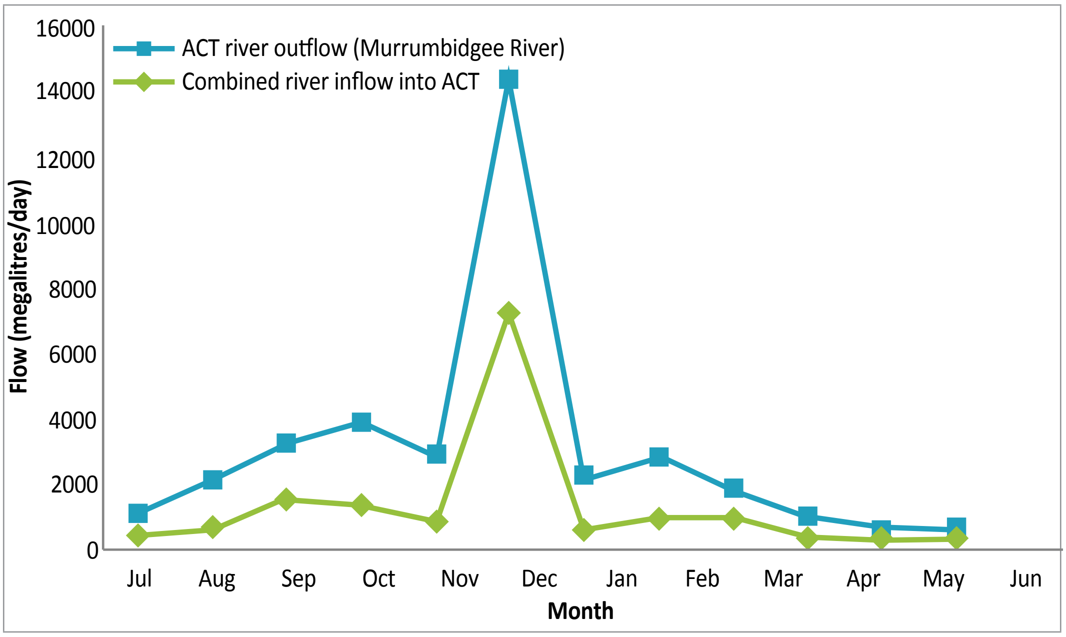
Figure 5: A comparison of the average monthly flow (July 2010–June 2011) to the long-term average monthly flow in the Cotter River for a site upstream of Corin Reservoir



The pattern for the Cotter River shows high peaks that coincide with the wet periods of September, December and February. This led to both Corin and Bendora reservoirs being at or over capacity for most of the year (Figure 5).

The ACT remains a net exporter of water into the Murrumbidgee River. A comparison of the volume of water flowing (including the Queanbeyan River water that collects behind Googong Dam) into the ACT with the volume of water leaving the ACT is shown in Figure 6. The Murrumbidgee River at the Lobbs Hole gauge experienced average daily flows of greater than 200 ML/day in all months, reaching a maximum mean daily flow of 4077 ML/day in December 2010. The Molonglo River at the Burbong bridge gauge contributed more than 40 ML/day on average from July 2010 to March 2011 while the Queanbeyan River at the gauge above Googong reservoir had readings of greater than 150 ML/day between September and March. Flow-based samples covering the percentile bands (Table 4) were taken in 2010–11 in spring and again after the December floods had subsided. Flows in the Murrumbidgee River were supplemented by the returns from sewage treatment and extensive urban area flooding, especially in December. The 6000ML difference between inflow and outflow in December represents urban runoff and water from the lower Cotter catchment.

Figure 6: A comparison of the average monthly inflows into the ACT (combined monthly data for the Murrumbidgee, Molonglo and Queanbeyan rivers) with the average monthly outflows from the ACT (Murrumbidgee River, just after the downstream exit of the ACT border, at Hall Crossing) for the July 2010–June 2011 period



Section 2: Water Quality Condition

Water quality monitoring program

The EPA manages a monitoring program for the ACT's water resources that includes the collection of water quality, stream flow and biological data. The monitoring program is based on regular sampling of lakes and rivers. The information is used to determine whether waters flowing through the ACT are of appropriate quality and if the management strategies used to achieve or maintain such water quality are adequate. The information is not intended to identify specific pollution incidents but to provide information about changes to water quality over time.

Water quality data collected by volunteers of the Upper Murrumbidgee Waterwatch are used as subsidiary data and may be used as primary data where the monitoring data are missing. Water quality data is collected by other government agencies, research institutions and authorised dischargers such as ACTEW (Lower Molonglo Water Quality Control Centre, water supply reservoirs) and the Queanbeyan City Council (Queanbeyan Sewage Treatment Plant). Although the EPA may use this data for assessing compliance with licence conditions and the Environment Protection Regulations 2005, the data collected by those organisations is not reported in this document.

Sampling Sites

Sites are located so as to be representative of stream and lake conditions in the ACT (Figure 7). It is not possible to monitor all sites and all parameters of interest and consequently those considered most representative of environmental conditions are selected as examples for similar areas.

Lakes

With the exception of Lake Burley Griffin, which is a Commonwealth responsibility, the major urban lakes are sampled eight months of the year during August, October to March, and May. The ACT Government also monitors Burrinjuck Reservoir as activities in the ACT could potentially impact on this reservoir. Monitoring of blue-green algae in Canberra's lakes – undertaken mostly, but not exclusively, during the summer months by EPA officers –encompasses the recreation zones of the lakes and the Molonglo River. The ACT Health Protection Service undertakes bacterial monitoring of lake and river recreation areas during peak use times.

Molonglo River

Rivers

Stream flow is measured continuously at a number of sites throughout the ACT at hydrographic stations. This information is valuable for interpreting water quality data as most pollutants entering our waterways do so during storms. Consequently, streams are sampled for water quality at different flow levels, rather than at fixed times, to better characterise the pollutant loads. The aim of the sampling strategy is to provide a fully representative assessment of river health over time by taking account of the impact of flow on water quality. Samples are collected within four flow levels, measured by the flow percentile (5–29%, 30–49%, 50–69% and 70–89%). The 5th percentile flow is the flow exceeded only 5% of the time and represents very high flow; conversely the 90th percentile flow indicates very low flow.

Table 4: Flow percentiles for river sampling

Flow percentile group	Description	Number of samples
0-4	Very high flow	-
5–29	High flow	2
30–49	Moderate, increasing flow	2
50–69	Moderate, decreasing flow	2
70–89	Low to basal flow	2
90-100	Negligible flow	-

Flow based sampling operates well in years of average rainfall, with rain and run-off at well spaced intervals across the whole year. Five river water quality samples were taken in September 2010, and February, April, May and June 2011 with at least one sample in each percentile band between base flow and high flow. The optimum number of samples, two at each percentile band, was not reached again this year. The reduced opportunities to sample across the range of flow percentiles, and the below optimum number of samples taken annually, reflect the long period of drought from 2002 to 2008 in the catchment followed by sustained high flows in 2009–10 (Table 5). A review of sampling frequency may be required in the future, based on climate change scenarios and related observations, if conditions remain difficult for taking the full number of samples.

Waterwatch sampling may be used to provide background when sampling conditions (flood) prevented the collection of data by the monitoring service.

Table 5: Flow based samples taken since 2003

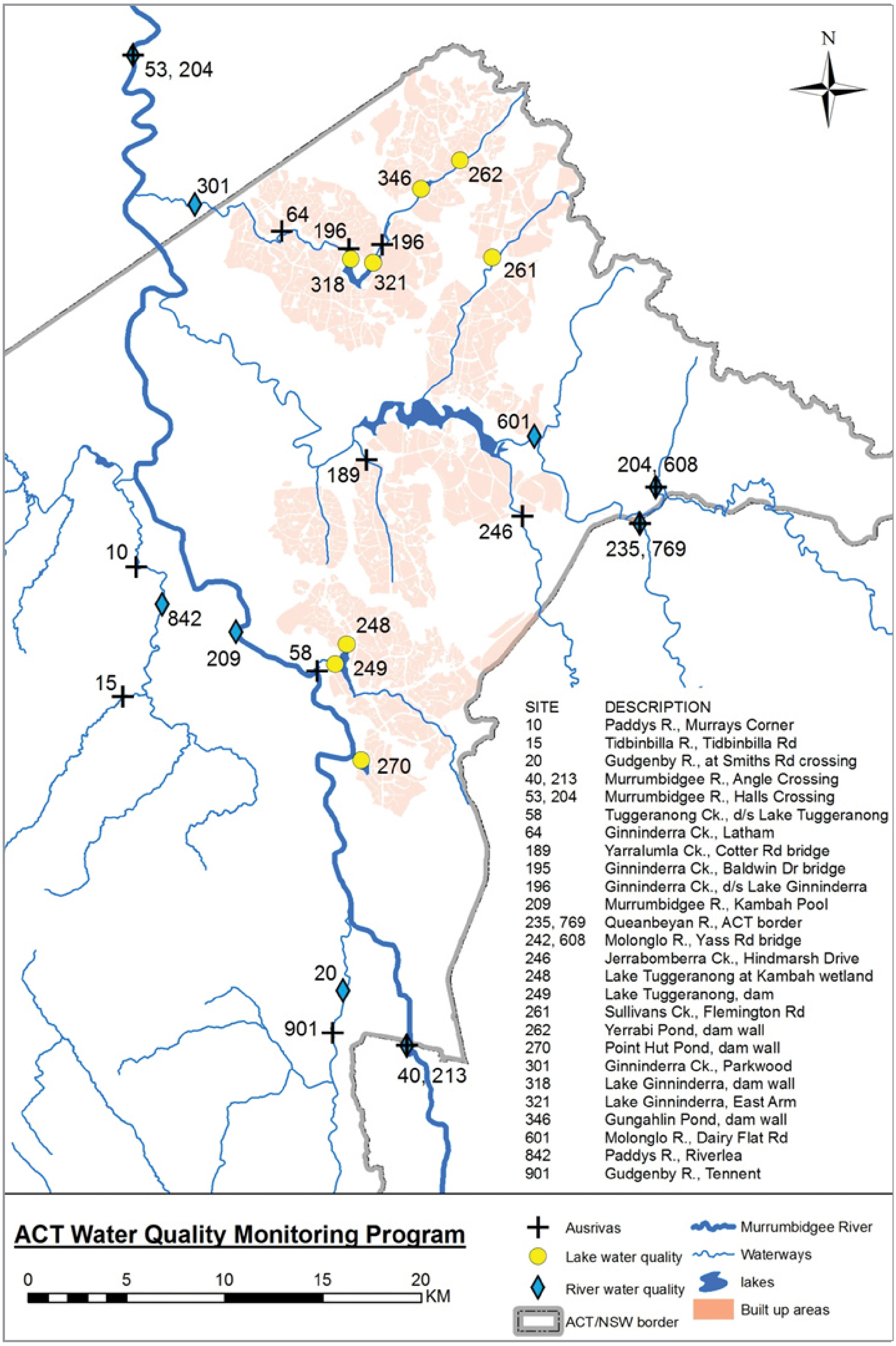
Sampling period	2003–04	2004–05	2005–06	2006–07	2007–08	2008-09	2009–10	2010–11
No. samples	5	5	5	4	4	3	5	5

Biological assessment of ecosystem condition

In addition to monitoring the physical and chemical condition of the ACT's waters, the status of the aquatic ecosystem is assessed. Assessment of ecosystem health is based on the macroinvertebrate monitoring undertaken using the AUSRIVAS protocol (see p. 39). It involves collecting samples of stream invertebrates from stream edge sites in the ACT region during spring and autumn.

An AUSRIVAS predictive model is used to assess these sites. The condition of the site, as determined by the model, provides a measure of a stream's biological health. Thirteen sites are sampled, selected as either reference or test sites. Ten test sites were selected for their potential and known impacts from rural degradation, urban runoff, discharge of treated sewage effluent, trace wmetal contamination, habitat degradation, sedimentation events and river regulation. The three reference sites were selected from those sampled during development of the ACT component of the National River Health Program. The ten test sites and three reference sites were sampled on 13 and 14 October 2010 and 28 and 29 March 2011.

Figure 7: Locations of water quality and biological (AUSRIVAS) sampling sites in the ACT Water Quality Monitoring Program



Condition of ACT waters

Over the long term, the water quality in ACT streams and lakes has tended to be good when assessed against the water quality standards (Table 1). However, in recent years rivers and streams have been stressed by the extreme events of drought and fire. Compared to sites in the urban area, sites outside the urban area have displayed resilience to these events. They appear to have recovered from the impacts of the 2003 bushfires and are accommodating the ongoing periods of low flow.

Prolonged drought affects the whole of our catchment. As the drought deepens, trees and shrubs have access to less and less soil moisture and do not carry as much foliage. The grasses and herbs thin out beneath and between the tree canopy. Mosses and lichens that once held the soil in place turn to dust. More sunlight reaches the soil and evaporates what little moisture is left in the crumbling leaf litter on top. The soil becomes water repellent and easily disturbed.

In those waterways that do continue to have water, there is insufficient flow to keep suspended solids moving. The deeper pools accumulate fine sediment with rotting material in them. The bacteria that thrive in these sediments increase in numbers but are not thinned by being flushed down stream. River pools develop patches of dead water. This process also happens in urban lakes and, significantly, in the basins of gross pollution traps.

The very welcome rains in September, December and from February to the present have revitalised the waterways in the catchment.

When the reliable rains return, the loose and water repellent surface of the soil is washed off in the first flush. This leads to spikes in Turbidity, Suspended Solids levels, Phosphorus and usually Nitrogen levels in water quality monitoring. Once the ground begins to absorb the water, the soil moisture right through to the ground water aquifers gradually returns to favourable levels. Mosses and lichens quickly re-establish the protective soil crust. Grasses and herbs germinate again and spread a new layer of ground cover and spongy root systems. Together these plants help the soil continue to absorb water and protect it from erosion by the rain run-off. The trees and shrubs put out new leaves and reinvigorate their root systems and the soil is, once again, is sufficiently shaded and porous.

As all this happens, the groundwater aquifers flow and direct run-off into creeks and rivers increases. The reservoirs gradually fill. The run-off is chemically close to rainwater and so pH, electrical conductivity and nutrient loadings across the catchment all approach most favourable reference levels. Increased persistent flows stir up the dead water from river pools and lake bottoms and flush the gross pollutant traps. This flushing is seen in water quality data as elevations in Nitrogen and Faecal Coliform levels. Although dramatic, these are short duration events, usually a matter of days. All these phenomena were seen in our catchment this year.

Our water quality should remain well within regulatory expectations as flows persist in waterways, aquifers reach capacity, and the water table is connected from the soil surface to below the roots of the trees. The whole catchment benefits from such environmentally sustaining flows. In recent months, streams that deteriorated post-bushfire have improved from moderate to good condition and will continue to improve with more consistent flow regimes.

Urban sites are commonly impacted by human actions such as altered flow regimes, nutrient enrichment, weed infestation and increased pollutants. Until last year's rains urban water quality remained relatively poor because, with drought conditions, stream flows were generally low and any pollutants entering waterways were not diluted. Storm flushing of urban waterways has led to improvements in overall water quality. Some silt movement has occurred but good follow-up rains have, in general, allowed large deposits to be dispersed. Parameters of water quality, including pH, Electrical Conductivity and Dissolved Oxygen values, have returned to levels indicating good catchment health following the February rains. The coincidence of fresh nutrient suspensions and warm weather following the February rain has resulted in phytoplankton populations, often dominated by cyanobacteria (blue-green algae), reaching high levels in urban lakes and remaining high for several months. Such algal blooms are the natural way of mopping up nutrients and distributing them down stream. The follow-up rains have done this gradually with the June rains clearing the system.

The condition of water quality at the monitoring sites may be assessed by comparing actual concentrations with concentrations listed in the water quality standards (Table 1).

Summary of water quality observations for reporting period 2010–11

Table 7: Summary of water quality in the ACT, 2010–11

Parameter	Reg. Limit	Sources	Consequences of exceeding limits	Incidents in reporting period
Total Phosphorus	<0.1mg/mL	Soil and humus	With high Total Nitrogen, turbidity, water temperature and low flow, may lead to cyanobacterial bloom.	High levels with floods.
Total Nitrogen	N.A. [<150 µg/L]	Organic matter breakdown, and biological nitrogen fixation	With high Total Phosphorus, turbidity, water temperature and low flow, may lead to cyanobacterial bloom.	Within expectations all year.
Suspended Solids	<25mg/L	Disturbance of soil by storm damage, human activity causing catchment disturbance, and in upland rivers, watercourse creep	Silt slugs; bank scouring; burial of riffles or aquatic vegetation; increased (long-term) turbidity.	High levels with floods.
Turbidity	<10 NTU, flowing <30 NTU, standing	Soil and country rock clay fraction; humic 'tea'	Modification of biological light regime; poor aesthetics.	High levels with floods.
Faecal Coliforms	<150 cfu (primary contact) 1000 cfu /mL (secondary contact)	Rural and urban animal waste, fertilizers (sewage)	Closure of recreational waters because of health risk from associated (hard to monitor) pathogens.	High levels with floods.
Conductivity	N.A.	Salts in country rock and ground water; sewage treatment plants	Salinity or corrosion problems, where water is used.	Lower levels with floods.
pH	6–9	Catchment geology	Changes to biodynamics; may release toxic metals.	Within expectations all year.
Dissolved Oxygen	> 4.0 mg/L	Normal plant (including algal) activity and physical exchange with atmosphere through wind and water movement	Hot weather and low flows drive O2 out of water, leading to biological stress, with fish kills being the worst outcome.	Poor levels related to hot weather and phytoplankton numbers.
Chlorophyll 'a'	< 10 µg/L	phytoplankton	Poor aesthetics; scums; unpleasant smells (geosmin); blooms outside of normal population fluctuation.	Blooms, especially Lake Tuggeranong, after floods.

Nutrient levels

Nutrients are natural components of all water bodies, but increases in supply often have undesirable effects, including the eutrophication of aquatic ecosystems. Eutrophication is the presence of an abnormally high quantity of plant nutrients and can lead to excess algal growth including toxic algal blooms. Blooms may also produce other unwanted side effects including plummeting levels of dissolved oxygen, with dire consequences for aquatic organisms of all sizes. The two most important plant nutrients for aquatic ecosystems are phosphorus and nitrogen.

Total Phosphorus

Total phosphorus is the sum of dissolved and particulate phosphorus in the water. The standard is 0.1 mg/L for both aquatic health and recreational use. In ACT water bodies, total phosphorus availability is what commonly determines the kind and aggressiveness of planktonic algal activity.

Nutrients such as phosphorus are bound within soil/sediment particles. This means the movement of phosphorus through the landscape and waterways is closely linked to soil erosion and sediment transport dynamics.

Elevated phosphorus in Lake Tuggeranong persisted through the whole of summer and into autumn. Other water bodies showed a narrow range of the nutrient, within regulation limits. In the rivers, phosphorous levels were strongly aligned to flow. In the high flows of the spring-summer rains, when much silt and organic debris was transported into the water, the maximum phosphorus levels of the period were recorded. During the declining flows approaching winter 2011, the phosphorous levels also fell, being lowest in June.

Table 8: Total Phosphorus (mg/L) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	0.048	0.083	0.062	0.012	0.10
248	Lake Tuggeranong at Kambah Wetland	0.092	0.190	0.131	0.042	0.10
249	Lake Tuggeranong at dam	0.074	0.190	0.127	0.048	0.10
261	Flemington Road Pond	0.022	0.073	0.049	0.019	0.10
262	Yerrabi Pond, dam wall	0.020	0.061	0.043	0.012	0.10
270	Point Hut Pond at dam wall	0.051	0.130	0.080	0.032	0.10
318	Lake Ginninderra at dam	0.036	0.053	0.047	0.005	0.10
321	Lake Ginninderra at East Arm	0.038	0.090	0.060	0.016	0.10
346	Gungahlin Pond at dam wall	0.036	0.067	0.055	0.012	0.10
204	Murrumbidgee River at Halls Crossing	0.028	0.095	0.047	0.028	0.10
209	Murrumbidgee River at Kambah Pool	0.027	0.120	0.049	0.038	0.10
213	Murrumbidgee River at Angle Crossing	0.024	0.064	0.038	0.018	0.10
301	Ginninderra Creek at Parkwood	0.020	0.086	0.044	0.027	0.10
601	Molonglo River at Dairy Flat Bridge	0.057	0.150	0.078	0.037	0.10
608	Molonglo River at Yass Road Bridge	0.014	0.089	0.036	0.030	0.10
769	Queanbeyan River at ACT border	0.049	0.100	0.057	0.022	0.10
842	Paddys River at Riverlea	0.014	0.071	0.032	0.027	0.10
901	Gudgenby River at Tennent	0.025	0.110	0.048	0.037	0.10

Total Nitrogen

There is no regulation limit for total nitrogen for the ACT. Nitrogen is not generally a limiting factor in algal growth in regional waters and is not toxic to organisms. Nitrogen values normally are consistently the highest at two sampling sites (601 and 204) downstream of the Queanbeyan and Canberra sewage treatment plants. These higher levels generally decrease rapidly along the stream. International standards for discharged wastewater recommend 15 mg/L or less. Research into nitrogen fixing blue-green algae, including the potentially toxic *Anabaena* species, indicates that low or limiting concentrations of nitrogen favour their growth over other, more benign phytoplankton. In such situations, the discharge of nitrogen in sewage effluent may discourage the over-population of nitrogen fixers. For these reasons, management and discharge authorisation arrangements in the ACT concentrate on minimising the input of phosphorus to waterways as a priority, with nitrogen reduction encouraged as a second priority.

As noted already, the two places where nitrogen can be expected to be generally higher than corresponding sites (204 and 601) again show both the highest maximum and the highest mean levels in the reporting period. There is no site, riverine or lacustrine, that approaches 15mg/L.

Table 9: Total Nitrogen (mg/L) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	1.10	1.80	1.30	0.22	N/A
248	Lake Tuggeranong at Kambah Wetland	1.10	2.40	1.66	0.47	N/A
249	Lake Tuggeranong at dam	1.20	2.40	1.61	0.49	N/A
261	Flemington Road Pond	1.10	2.20	1.45	0.44	N/A
262	Yerrabi Pond, dam wall	0.90	1.90	1.32	0.34	N/A
270	Point Hut Pond at dam wall	0.91	2.40	1.60	0.54	N/A
318	Lake Ginninderra at dam	0.93	1.60	1.20	0.25	N/A
321	Lake Ginninderra at East Arm	0.89	1.70	1.27	0.31	N/A
346	Gungahlin Pond at dam wall	1.10	1.90	1.48	0.32	N/A
204	Murrumbidgee River at Halls Crossing	1.20	3.60	2.39	1.20	N/A[15]
209	Murrumbidgee River at Kambah Pool	0.26	0.62	0.52	0.47	N/A
213	Murrumbidgee River at Angle Crossing	0.24	0.84	0.41	0.24	N/A
301	Ginninderra Creek at Parkwood	0.91	2.10	1.09	0.50	N/A
601	Molonglo River at Dairy Flat Bridge	1.20	3.30	2.00	0.79	N/A[15]
608	Molonglo River at Yass Road Bridge	0.26	1.80	0.59	0.64	N/A
769	Queanbeyan River at ACT border	1.00	1.50	1.37	0.21	N/A
842	Paddys River at Riverlea	0.17	1.10	0.36	0.40	N/A
901	Gudgenby River at Tennent	0.20	1.00	0.40	0.36	N/A

Suspended Solids

All streams and rivers naturally carry some suspended material as organic and inorganic particles of varying sizes. Most land uses and activities have the potential to increase the concentrations of suspended solids in streams. An increase in the concentration of suspended solids can have two major impacts on aquatic ecosystems.

Firstly, higher concentrations of suspended solids reduce the light penetration of water, slowing plant growth and changing the kinds of algae present. Secondly, larger amounts of suspended solids ultimately result in increased sedimentation in streams and lakes. The sand and silt may choke habitats for bottom dwelling organisms while increasing the potential for elevated phosphorus levels arriving as part of silt slugs or fine sediment coatings.

Flow based sampling highlights storm effects, while the long term average may indicate closer general conformity to regulation limits. In ACT rivers and more than half the lakes, the maximum readings occurred in spring, when flows were high. There is very little pattern in the minimum recorded levels of suspended solids. The maximum records for Lake Ginninderra (East Arm) and the Molonglo River at Dairy Flat bridge both show a very high maximum load of suspended solids associated with the first of last year's floods.

Table 10: Suspended Solids (mg/L) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	2	21	13.6	7.05	25
248	Lake Tuggeranong at Kambah Wetland	11	25	17.0	4.31	25
249	Lake Tuggeranong at dam	8	29	15.9	6.01	25
261	Flemington Road Pond	4	15	12.5	11.19	25
262	Yerrabi Pond, dam wall	5	69	31.6	22.68	25
270	Point Hut Pond at dam wall	7	38	19.0	9.41	25
318	Lake Ginninderra at dam	4	20	10.4	5.63	25
321	Lake Ginninderra at East Arm	14	130	38.1	40.73	25
346	Gungahlin Pond at dam wall	5	85	32.3	28.19	25
204	Murrumbidgee River at Halls Crossing	9	64	20.4	23.14	25
209	Murrumbidgee River at Kambah Pool	11	61	20.6	21.30	25
213	Murrumbidgee River at Angle Crossing	9	46	19.0	17.18	25
301	Ginninderra Creek at Parkwood	7	52	20.6	18.68	25
601	Molonglo River at Dairy Flat Bridge	9	130	29.1	52.54	25
608	Molonglo River at Yass Road Bridge	6	27	13.3	8.93	25
769	Queanbeyan River at ACT border	8	51	16.1	18.17	25
842	Paddys River at Riverlea	3	40	12.6	16.99	25
901	Gudgenby River at Tennent	4	29	11.0	13.25	25

Turbidity

Turbidity determines the depth to which light penetrates the water, an important ecological phenomenon that affects plant growth and changes the kinds of algae present. Turbidity of a water body is related to the concentration of suspended solids but also includes colouration. A stream may have very low levels of suspended material but be strongly coloured, for example the tannin rich streams in Namadgi National Park. Water that is richly coloured allows light to penetrate it to a lesser depth.

Canberra has soils with very fine clay particles that can cause high turbidity levels even though the actual amount of material suspended in the water column is not significant. The small clay particles remain suspended in the water long after the heavier sediments have settled on the bottom.

There are clear similarities between the turbidity figures and the suspended solids figures in this reporting period. The mean turbidities for the river systems reflect the wide variation in flow conditions across 2010–11. The more lake-like figures for the Molonglo River as it enters Lake Burley Griffin at Dairy Flat Road fit the picture of a site responding to sudden and large changes in prevailing conditions. This is also the case with flooding in the lakes and wetlands of the Ginninderra Creek system, adding to the relatively unstable bottom sediments of young water bodies.

Table 11: Turbidity (NTU) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 10-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	9.1	43	20.6	13.56	30
248	Lake Tuggeranong at Kambah Wetland	16	61	28.0	14.60	30
249	Lake Tuggeranong at dam	16	72	29.0	18.80	30
261	Flemington Road Pond	4.8	49	15.2	14.16	30
262	Yerrabi Pond, dam wall.	16	120	59.4	36.93	30
270	Point Hut Pond at dam wall	15	80	35.9	23.40	30
318	Lake Ginninderra at dam	13	37	23.6	9.43	30
321	Lake Ginninderra at East Arm	13	140	44.4	40.10	30
346	Gungahlin Pond at dam wall	6.1	120	47.9	36.59	30
204	Murrumbidgee River at Halls Crossing	9.3	60	18.2	21.52	10
209	Murrumbidgee River at Kambah Pool	8.6	60	17.4	21.14	10
213	Murrumbidgee River at Angle Crossing	8.0	30	13.2	10.46	10
301	Ginninderra Creek at Parkwood	9.7	51	18.2	17.98	10
601	Molonglo River at Dairy Flat Bridge	9.0	110	24.8	44.40	10
608	Molonglo River at Yass Road Bridge	7.2	27	12.9	8.38	10
769	Queanbeyan River at ACT border	12.0	71	22.1	25.11	10
842	Paddys River at Riverlea	1.5	35	11.9	14.82	10
901	Gudgenby River at Tennent	3.8	36	10.9	14.46	10

Conductivity

Conductivity, the ability of electricity to pass through water, is a measure of the salts and ions present in the water body. Pure de-ionised water does not conduct electricity. Organic compounds like oil, alcohol and charcoal are poor conductors whereas salts (sodium, potassium, calcium ions) and metals (aluminium, iron) conduct electricity well.

Unless there is an unusual occurrence, conductivity measures provide good indication of the amount of salt in the water. Urban runoff can be high in salts as many cleaning agents, fertilisers and surfaces (paint, concrete, and road surfaces) contain salts that are washed into streams during rainfall. Salts can also come from naturally occurring minerals in soils and be mobilised by erosion and ground water seepages in drought periods.

Continual measurement of stream salinity is now performed at key ACT locations to enable determination of potential problems zones and provide a robust dataset to validate salinity modelling.

Electrical conductivity in the lakes is generally low, and varies little across the year. In the rivers there is a markedly wider range of readings in the Molonglo and Ginninderra creeks than in other waterways. The low level readings are from periods of high flow, while the elevated readings are from declining flow times, when water levels are also low and the minerals become concentrated. No site, riverine or lacustrine, showed aberrant readings.

Although there are no regulated standards for electrical conductivity of water for the ACT, readings that reflect the local geology are preferred. The regularly elevated levels at Halls Crossing (204) that include bicarbonate ions from the water treatment plants, although not noted this year, are the subject of on-going study.

Table 12: Conductivity (uS/cm) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	100	180	140.0	25.07	N/A
248	Lake Tuggeranong at Kambah Wetland	120	190	148.8	23.32	N/A
249	Lake Tuggeranong at dam	120	180	142.5	19.10	N/A
261	Flemington Road Pond	240	340	290.0	37.00	N/A
262	Yerrabi Pond, dam wall	140	250	200.0	30.90	N/A
270	Point Hut Pond at dam wall	140	230	176.3	29.73	N/A
318	Lake Ginninderra at dam	160	190	180.0	10.69	N/A
321	Lake Ginninderra at East Arm	180	210	193.8	10.61	N/A
346	Gungahlin Pond at dam wall	190	290	235.0	31.62	N/A
204	Murrumbidgee River at Halls Crossing	130	230	174.3	42.07	N/A
209	Murrumbidgee River at Kambah Pool	73	110	98.3	13.76	N/A
213	Murrumbidgee River at Angle Crossing	86	100	98.6	5.959	N/A
301	Ginninderra Creek at Parkwood	180	610	371.4	199.68	N/A
601	Molonglo River at Dairy Flat Bridge	93	310	214.7	79.75	N/A
608	Molonglo River at Yass Road Bridge	24	330	213.4	115.89	N/A
769	Queanbeyan River at ACT border	87	150	136.7	24.73	N/A
842	Paddys River at Riverlea	54	68	63.9	5.505	N/A
901	Gudgenby River at Tennent	50	77	70.1	11.30	N/A

pH (acidity)

The pH refers to the degree of acidity or alkalinity of the water. A pH of 7 is neutral. A value above 7 indicates the water is alkaline, and a pH below 7 indicates acidic conditions (see figure to left).

If the pH of water is altered substantially, there can be changes to chemical processes, which could release nutrients or toxic metals that were previously bound safely in lake or river sediments.

Where there is biological equilibrium in standing water, the pH trend is towards the alkaline end of the scale.

All sites reported the lowest pH readings in the wet spring, in association with high flow and volume. The dilution brought pH readings well within the levels considered to indicate good waterway health. With one exception, the pH range for sites showed a less than ten-fold change (or 1.0 pH increment) across the year, thus remaining close to that high standard. Flemington Pond collects water draining from alkaline groundwater stored in limestone as well as storm run-off and so had the widest range in pH.

Table 13: pH summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010–11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	7.3	7.8	7.6	0.15	6-9
248	Lake Tuggeranong at Kambah Wetland	7.1	7.6	7.3	0.17	6-9
249	Lake Tuggeranong at dam	7.2	7.7	7.4	0.18	6-9
261	Flemington Road Pond	6.8	8.4	7.7	0.54	6-9
262	Yerrabi Pond, dam wall	7.4	8.0	7.6	0.20	6-9
270	Point Hut Pond at dam wall	7.5	7.9	7.7	0.15	6-9
318	Lake Ginninderra at dam	7.3	8.0	7.6	0.21	6-9
321	Lake Ginninderra at East Arm	7.5	8.0	7.7	0.19	6-9
346	Gungahlin Pond at dam wall	7.4	7.9	7.7	0.20	6-9
204	Murrumbidgee River at Halls Crossing	7.1	7.7	7.5	0.23	6-9
209	Murrumbidgee River at Kambah Pool	6.7	7.6	7.3	0.36	6-9
213	Murrumbidgee River at Angle Crossing	6.8	7.5	7.2	0.25	6-9
301	Ginninderra Creek at Parkwood	6.9	7.3	7.1	0.16	6-9
601	Molonglo River at Dairy Flat Bridge	6.8	7.3	7.0	0.19	6-9
608	Molonglo River at Yass Road Bridge	6.7	7.3	7.1	0.22	6-9
769	Queanbeyan River at ACT border	6.7	7.1	6.9	0.17	6-9
842	Paddys River at Riverlea	6.5	7.0	7.0	0.19	6-9
901	Gudgenby River at Tennent	6.4	7.3	7.0	0.33	6-9

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the oxygen in the water available to aquatic organisms. It is important for the maintenance of aquatic organisms as changes in DO can affect the species present. Low DO levels can stress fish, which can lead to fungal infections and disease or result directly in fish kills. Levels of DO are affected by turbulence, temperature (colder water can hold more dissolved oxygen), photosynthesis (during periods of sunlight algae and other water plants produce oxygen, while in darkness they consume oxygen) and the level of biological oxygen demand. Biological oxygen demand (BOD) is an indication of the rate of oxygen use in the system, restricting oxygen availability for fish and other aquatic animals.

The distinctly depleted DO events reported for Lake Tuggeranong at the Kambah Wetland, and in Yerrabi Pond, were associated with hot weather in January and March respectively. Such significant events may be associated with algal blooms or fish stress events, but were very short term occurrences in 2010–11. The other reported readings were within regulation limits.

Table 14: DO (mg/L) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010–11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	6.7	11.6	9.3	1.65	> 4
248	Lake Tuggeranong at Kambah Wetland	3.8	10.7	6.6	2.59	> 4
249	Lake Tuggeranong at dam	6.4	10.7	8.6	1.55	> 4
261	Flemington Rd Pond					>4
262	Yerrabi Pond, dam wall	4.1	12.1	7.9	2.31	>4
270	Point Hut Pond at dam wall	6.7	9.8	8.2	1.16	> 4
318	Lake Ginninderra at dam	6.6	11.7	8.8	2.15	> 4
321	Lake Ginninderra at East Arm	5.7	11.3	8.1	2.32	> 4
346	Gungahlin Pond at dam wall	6.5	11.2	8.8	1.89	> 4
204	Murrumbidgee River at Halls Crossing	8.5	11.9	10.7	1.32	> 4
209	Murrumbidgee River at Kambah Pool	7.8	11.1	9.6	1.48	> 4
213	Murrumbidgee River at Angle Crossing	7.5	10.5	9.6	1.28	> 4
301	Ginninderra Creek at Parkwood	6.9	11.5	9.5	1.84	> 4
601	Molonglo River at Dairy Flat Bridge	8.2	10.1	8.5	0.74	> 4
608	Molonglo River at Yass Road Bridge	7.5	10.6	9.3	1.32	> 4
769	Queanbeyan River at ACT border	7.7	9.9	9.0	1.02	> 4
842	Paddys River at Riverlea	8.4	12.8	10.3	1.87	> 4
901	Gudgenby River at Tennent	8.6	11.8	10.2	1.38	> 4

Faecal coliform bacteria

Bacteria occur naturally in all water bodies. The presence of faecal coliforms in a water sample may be an indication that human or animal faeces have contaminated the water and that harmful, less easily detectable pathogens such as *Cryptosporidium* or *Giardia* may be present. High levels of faecal coliforms are not necessarily a problem for aquatic ecosystems as they generally may serve as a food source for aquatic organisms without causing them harm. The presence of high numbers of faecal coliforms is a problem for some human uses of water bodies, particularly water supply and recreation involving bodily contact. This report looks at bacterial levels in water used for primary and secondary contact recreational use (see Table 6), but does not deal with the quality of drinking water.

Results are expressed as colony forming units (cfu) per 100 mL. Regulation of waterway use by the public is outlined in the ACT Guidelines for Recreational Water Quality issued by ACT Health. The standard for water-based recreation is 200 cfu/100 mL. This refers to primary contact activities only. This standard is applied at individual sites depending on whether they are classed for swimming or secondary contact recreation in the Territory Plan. A shallow urban wetland such as Flemington Road Pond in Sullivans Creek is designed for storm water retention and so water quality standards for bacteria have not been monitored to date.

This year the rivers had high coliform counts in the wet months and showed very low numbers in the summer and autumn. The lakes, with the exception of the Ginninderra Creek systems, showed low numbers in autumn, with little or no pattern for high count timing. Average counts in the lakes, where there is much recreational activity, were well within standards. Numbers in the Murrumbidgee River were generally within regulatory limits, but the ski reach on the Molonglo River, closed because of snags following the floods, also experienced very high coliform counts in spring. These had dispersed by February.

Table 15: Faecal Coliforms (cfu/100mL) summary results for ACT Water Quality Monitoring Sites – Lakes and Rivers 2010–11.

Site	Site name	Minimum	Maximum	Mean 10-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	1	260	48.0	87.00	N/A
248	Lake Tuggeranong at Kambah Wetland	4	150	74.0	52.10	200
249	Lake Tuggeranong at dam	4	320	68.6	104.38	200
261	Flemington Road Pond					N/A
262	Yerrabi Pond, dam wall.	2	320	130.5	110.84	200
270	Point Hut Pond at dam wall	4	110	67.0	31.53	200
318	Lake Ginninderra at dam	2	240	46.0	80.41	200
321	Lake Ginninderra at East Arm	10	400	72.0	132.88	200
346	Gungahlin Pond at dam wall	4	40	17.0	13.60	200
204	Murrumbidgee River at Halls Crossing	10	440	146.0	208.53	200
209	Murrumbidgee River at Kambah Pool	6	540	107.4	229.26	200
213	Murrumbidgee River at Angle Crossing	4	100	34.9	45.68	200
301	Ginninderra Creek at Parkwood	91	1000	384.4	399.26	200
601	Molonglo River at Dairy Flat Bridge	12	2500	405.3	1088.63	200
608	Molonglo River at Yass Road Bridge	26	1500	252.1	649.07	200
769	Queanbeyan River at ACT border	85	1100	325.0	421.78	200
842	Paddys River at Riverlea	92	1400	343.1	552.18	200
901	Gudgenby River at Tennent	30	520	193.1	201.52	200

Chlorophyll ‘a’

Chlorophyll ‘a’, the plant pigment that gives algae their green colour, is commonly used as a measure of the quantity of algae present (algal biomass). All phytoplanktonic organisms, including cyanobacteria (blue-green algae), use Chlorophyll ‘a’, so the reading indicates whole population dynamics not any single organism population. This measure can therefore serve as a useful indicator of the extent to which an ecosystem has been affected by nutrient inputs. There are also normal seasonal fluctuations in planktonic algal biomass that may appear in the figures, independent of flow rates or exceptional nutrient loads.

Chlorophyll ‘a’ is measured in micrograms per litre (µg/L). To provide a sense of scale, water with a Chlorophyll ‘a’ concentration of 1 µg/L will be clear, a concentration of 20 µg/L will be slightly green, and 100 µg/L very green possibly with algal scum on the surface. There is no standard for streams and rivers in the ACT, while a standard of less than 10 µg/L applies for urban lakes and ponds.

The maximum totals reported in the lakes were significantly different from the means and well above regulation, indicating bloom-like populations of phytoplankton. The maxima were reported from November to May and were generally composed of mixed organisms. The maxima in Lake Ginninderra were the only ones correlated directly to observed cyanobacterial blooms, in May, and benign organisms. Such results emphasise the importance of weekly surveillance of lake shores across the summer, as the water quality samplings missed the *Anabaena* and *Microcystis* blooms seen in Lake Tuggeranong from February to June.

While the bloom organism producing high Chlorophyll ‘a’ readings in Ginninderra Creek in May is not documented, it is probable it was the same as Lake Ginninderra, cyanobacterial but benign.

Table 16: Chlorophyll-a (µg/L) summary results for ACT Water Quality Monitoring Sites - La kes and Rivers 2010–11

Site	Site name	Minimum	Maximum	Mean 2010–11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	0.81	28.00	7.90	10.23	10
248	Lake Tuggeranong at Kambah Wetland	4.30	31.00	16.20	11.32	10
249	Lake Tuggeranong at dam	0.88	36.00	14.00	13.20	10
261	Flemington Rd Pond	1.70	27.00	7.90	8.05	N/A
262	Yerrabi Pond, dam wall	2.20	25.00	11.10	8.88	10
270	Point Hut Pond at dam wall	0.48	24.00	10.10	8.28	10
318	Lake Ginninderra at dam	0.34	23.00	6.60	7.66	10
321	Lake Ginninderra at East Arm	1.50	21.00	8.50	6.33	10
346	Gungahlin Pond at dam wall	4.00	65.00	18.90	22.75	10
204	Murrumbidgee River at Halls Crossing	6.00	8.80	8.77	2.14	N/A
209	Murrumbidgee River at Kambah Pool	3.60	13.00	5.86	4.01	N/A
213	Murrumbidgee River at Angle Crossing	3.40	8.50	4.56	2.05	N/A
301	Ginninderra Creek at Parkwood	3.80	50.00	11.77	20.02	N/A
601	Molonglo River at Dairy Flat Bridge	7.00	26.00	15.00	8.24	N/A
608	Molonglo River at Yass Road Bridge	3.30	0.50	4.70	1.45	N/A
769	Queanbeyan River at ACT border	1.50	5.30	2.97	1.88	N/A
842	Paddys River at Riverlea	1.10	3.30	1.43	1.11	N/A
901	Gudgenby River at Tennent	0.40	2.50	1.11	0.81	N/A

Algal monitoring of lake recreation areas

Algae are simple, usually microscopic plants that live either in water or damp areas. Dense growths of algae can impact on water quality and aesthetics by causing bad smells and strange colours and forming thick scums. When planktonic algal numbers increase dramatically and change the colour of the water, the phenomenon is called an algal bloom. Rotting algae will use up oxygen in the water. Severe blooms cause large fluctuations in dissolved oxygen, with high levels during the day and low levels at night. The oxygen drop may cause fish to die. Some members of a certain class of algae, the Cyanoprokaryota (cyanobacteria or blue-green algae), can in some situations generate toxins which may be poisonous to animals and people.

Blue-green algae occur naturally in most ACT water bodies, but usually in low numbers and in biological balance with other aquatic life. However, given the right environmental conditions, including warm weather, low rainfall and the right mix of nutrient levels, planktonic blue-green algae, usually *Microcystis, Anabaena* or *Tyconema* in the ACT, may multiply rapidly to high levels, dominate all other algae and pose a health risk. When the total nitrogen over total phosphorus ratio is >10, and turbidity decreases, a blue-green algal bloom becomes likely. The activity of populations of tiny, colonial blue-green algae, like the frequently toxic *Microcystis* and the more benign *Aphanocapsa*, is best indicated by the space they occupy in the water column. Calculation of biovolume (the displacement caused by the colony) provides a useful tool in both identifying and characterising blue-green algal bloom formers. In Figure 8 the cyanobacterial colonies are the amorphous masses suspended in the water column, in front of the aquatic plant debris and pontoon of green algae.

Weekly monitoring of visible planktonic algal conditions (especially for blue-green *Anabaena* and *Microcystis*) is performed by EPA and Health Protection Service officers from September to May. Actions on alerts, warnings or lake closures are determined when certain levels of blue-green algae are present (Table 16).

Blue-green algae (planktonic cyanobacteria)

The phytoplankton, the myriad of single celled or colonial floating photosynthetic organisms, perform two vital roles in aquatic systems — they mop up free/excess nutrients, particularly nitrogen and phosphorous, and they release large quantities of oxygen into the water column. Phytoplankton are constantly on the move in flowing systems and monitoring these small and erratic populations is of academic interest only. In closed systems such as lakes and artificial wetlands the significant phytoplankton population rises and falls in seasonal pulses and as a response to nutrient levels. While those populations have several other components (diatoms, dinoflagellates, green and golden-green algae) the cyanobacterial or blue-green algal fraction is the most likely to produce offensive and potentially toxic population explosions – blooms. These responses are further indications of water quality.

The conditions that support the occurrence of algal blooms can be circumvented in small water bodies by stabilising basement sediment. In large water bodies such stabilisation is more difficult. Aeration of the water column to minimise temperature stratification, and consequent changes in pH and nutrient availability may provide some remediation. On-going actions to improve the health of the catchment including in-stream and riparian revegetation and pollution reduction are much more effective in the long term.

Phytoplankton are reported in numbers per millilitre (cells/mL). The standard for cyanobacteria for lakes in the ACT is based on danger to human health through contact. Populations of *Microcystis, Anabaena* or other known toxin producing cyanobacteria greater than 20,000 cells/mL bring about the closure of that water body to primary contact activities.

The absence among the monthly samples of a 'closure' population at either Lake Tuggeranong (where only one monitoring site registered an above regulation population in one month) or Lake Ginninderra supports the practice of Environment Protection Officers conducting weekly and fortnightly inspections of water bodies used for recreation. The high population in Point Hut Pond occurred in March and may not have been of a potentially toxin-producing organism.

A bloom of began in Lake Tuggeranong in January 2011 and was monitored by inspection until mid February when the lake was closed for primary contact sport and recreation. *Microcystis* and *Anabaena* were both detected in large numbers throughout March and April, and precautionary samples were sent for toxicology in April. The results indicated that saxitoxin, associated in freshwater systems with *Anabaena* blooms, was present in low but significant levels and the closure was upgraded to secondary contact. While the *Anabaena* population had dropped out by late May, traces of *Microcystis* remained until early June. The closure from mid February to early May was the longest experienced for some years. The circumstances leading to this unusual bloom may have been the transport of substantial nutrients and sediments into the lake during spring and summer floods followed by a very dry autumn.

Blue-green algal bloom, Kambah Wetland, Lake Tuggeranong, March 2011

Table 17: Planktonic cyanobacteria (cells/mL) summary results for ACT Water Quality Monitoring Sites – Lakes only, 2010–11

Site	Site name	Minimum	Maximum	Mean 10-11	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	0	1940	559.6	718.19	NA
248	Lake Tuggeranong at Kambah Wetland	54	45331	8621.9	15095.5	<20000
249	Lake Tuggeranong at dam	0	9407	5375.3	3566.6	<20000
261	Flemington Road Pond	0	2740	785	879.3	<20000
262	Yerrabi Pond, dam wall	0	1929	577.5	710.08	<20000
270	Point Hut Pond at dam wall	0	57233	8570.9	19793.7	<20000
318	Lake Ginninderra at dam	0	14927	2154.3	5170.54	<20000
321	Lake Ginninderra at East Arm	0	15018	2259.4	5166.7	<20000
346	Gungahlin Pond at dam wall	0	2622	888.5	1155.14	<20000

Table 18: Algal alert levels for ACT urban lakes

Level	Blue-green algal cells/mL	Biovolume Equivalent	Response
Low	>500 to <5,000	>0.04–<0.4 mm^3/L	At this level, there is generally no major health risk. The EPA carries out routine monitoring, which includes weekly visual inspections.
Medium	≥5, 000 to <50,000 >20,000	≥0.4–<4.0 mm^3/L >1.6 mm^3/L	At this level there is a greater risk of potential health problems. The EPA increases the visual sampling to twice a week and undertakes water sampling weekly. If algal counts are > 20,000 cells/mL then on-site signs are erected to warn potential water users against risk of skin irritation, headache, nausea, and gastrointestinal illness.
High	≥50,000	≥4.0 mm^3/L	At this alert level the EPA maintains a twice-weekly visual inspection and weekly water sampling regime. In addition on-site signs are changed to 'Lake Closed' signs for primary contact* users.
Extreme	≥125,000 (40,000 cells/mL Anabaena circinalis) or scums are consistently present	≥10 mm^3/L	EPA continues twice weekly visual inspection, and water samples are taken as required. On-site signs are erected to advise secondary contact users that contact with the water increases the risk of harm, and that secondary contact** users' protocols must be followed.

* Primary contact users are those whose sporting activities involve their partial or total immersion in the water. Examples include swimming, snorkelling or scuba diving, water skiing, wind surfing or parasailing over water.

** Secondary contact users are those whose sporting activities are conducted on or near the water but involve water contact such as splashing or occasional immersion of extremities. Examples include rowing, dragon boat racing, yachting or kayaking. When signs have been erected, experienced members of clubs proceed at their own risk and must follow the protocols.

The algal cell counts and biovolumes above are based on those for Microcystis aeruginosa unless otherwise specified.

Full details of the ACT Guidelines for Recreational water Quality, covering both bacteria and cyanobacteria, can be found at the ACT Health website at health.act.gov.au

Collecting water bugs to assess water quality and habitat conditions

AUSRIVAS (Biological assessment using benthic macroinvertebrates)

Water chemistry analysis such as pH, total phosphorus and dissolved oxygen provides a snapshot of the water quality at the time when the sample is taken. Biological assessment, in this case the sampling of waterbugs (benthic macroinvertebrates), can indicate much about the water quality over time and show what kind of environment the water and its waterways provide for animals to live in.

Macroinvertebrate biological assessment is based on a comparison between a tally of the range of waterbugs found at a site with those predicted to occur there. If all animals expected at a site actually occur there, the site is judged to be in good condition. Conversely, the absence of expected animals indicates a site has been disturbed. The rating scale for AUSRIVAS outputs is presented in Table 19. A full explanation of the AUSRIVAS biological assessment method for the ACT is available from ausrivas.canberra.edu.au and the full biological assessment reports are available on request from ACT Water Resources.

Reference site 15 has remained at reference standard since 2006, while 10 and 213 have fluctuated in response to drought and changes in water flow. Reference site 10 regained reference standard in autumn 2010 and has remained at this level for the reporting period as the Paddys River has continued to flow. There are major construction works above the causeway in the Murrumbidgee at reference site 213. The macroinvertebrate fauna has responded to the disturbance in a predictable pattern, with a dramatic increase in the abundance of worms and bloodworms, although the diversity of more sensitive organisms had returned by March 2011.

The biological communities in urban sites are under considerable stress from habitat degradation, altered flow regimes, pollutant inputs or pest species (especially the plague minnow Gambusia). They are not as resilient to natural stresses like repeated flooding as non-urban sites may be. The C rating, which refers to severely impaired areas, over long periods at the urban sites (189, 64) illustrate this.

Sampling in spring 2010 was done in October, around the time the spring rains increased flows, but the sampling was before the flooding rains of December and February. The AUSRIVAS report highlights high turbidity and poor site condition, with sand, little riparian vegetation and conspicuous periphyton at many sites. The drop in organism diversity is not surprising given the wet winter and the conditions developing at sampling time.

Comparing the spring 2009 and 2010 scores, only the Murrumbidgee River at Halls Crossing and the Gudgenby River crossing at Sunshine Road showed improvement, from B to A. While most sites were found to be in a similar condition, Yarralumla Creek and the Queanbeyan River dropped from B to C, and Jerrabomberra Creek slipped to D or extremely impaired.

With a distinctly wet February, autumn 2011 water conditions were generally favourable for animal life. The urban sites were similar to autumn 2010 except that conditions at Ginninderra Creek (196) and the Queanbeyan River improved from C to B. Among the rural sites flooding damaged life in the Molonglo River at Yass Road, the grading dropping to a C, while in the Jerrabomberra Creek at Hindmarsh Drive, grading rose to B.

Table 19: AUSRIVAS Bands and their Observed/Expected Taxa scores for the ACT autumn edge model and some interpretations for reporting (Ball et al. 2001)

Band	Condition	Taxa interpretations
X	More biologically diverse than reference	More families found than expected. Potential biodiversity 'hot-spot' or mild organic enrichment. Continuous irrigation flow in a normally intermittent stream. Differential loss of pollution-tolerant taxa (potential impact unrelated to water quality).
A	Similar to Reference	Expected number of families within the range found at 80% of the reference sites.
B	Significantly Impaired	Fewer families than expected. Potential impact either on water and/or habitat resulting in a loss of families.
C	Severely Impaired	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
D	Extremely Impaired	Few of the expected families and only the hardy, pollution tolerant families remain. Severe impairment.

Table 20: Summary of AUSRIVAS Band scores for sites in the ACT from spring 2005 to autumn 2010. Note: there is no regulation limit for this parameter (although the ideal would be an A for each site).

Site	Site Name	Spring 06	Autumn 07	Spring 07	Autumn 08	Spring 08	Autumn 09	Spring 09	Autumn 10	Spring 10	Autumn 11
213	Murrumbidgee River at Angle Crossing	C	A	B	A	A	B	B	A	B	B
15	Tidbinbilla River at Paddys River Road	A	A	A	A	A	A	A	A	A	A
10	Paddys River at Murray's Corner	B	B	B	A	B	A	C	A	A	A
20	Gudgenby River at Smiths Road	A	B	C	B	A	B	B	B	A	B
58	Tuggeranong Creek downstream of lake	B	B	C	A	C	B	C	B	C	B
608	Molonglo River at Yass Road	B	B	D	B	A	B	C	B	C	C
769	Queanbeyan River at ACT border	C	C	C	C	D	C	B	C	C	B
246	Jerrabomberra Creek at Hindmarsh Drive	B	C	B	C	C	B	C	C	D	B
189	Yarralumla Creek at Cotter Road bridge	C	C	B	C	C	C	B	C	C	C
64	Ginninderra Creek at Latham	C	B	D	C	D	C	C	C	C	C
195	Ginninderra Creek Baldwin Drive	C	C	C	C	C	C	C	C	C	B
196	Ginninderra Creek downstream of lake	C	C	C	C	C	C	C	B	C	B
204	Murrumbidgee River at Halls Crossing	A	B	B	B	A	B	B	B	A	B

Lakes

Point Hut Pond

Water quality in Point Hut Pond (Site 270) has been historically poor compared with the standards set for its designated uses in the Territory Plan and by comparison with other lake sites in the ACT. The watershed is almost entirely urban and the floor of the pond is silt-like. Elevated turbidity in August, October and December was associated with storms, and this correlated with higher than usual Suspended Solids for August and moderately elevated phosphorus in October and December. Now that Conder, Gordon and Banks are largely developed, the phosphorus may come from gardening and minor works. The gradual rise in chlorophyll 'a' and cyanobacteria in summer and autumn reflects the incorporation of the nutrients made available by the storms into the biology of the pond. No algal bloom was reported.

Table 21: Site 270 Point Hut Pond

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9	7.93	7.67	7.5	7.5	7.7	7.6	7.9	7.6	7.8	7.8
Chlorophyll 'a'	ug/L	10	11.55	10.11	4.1	0.48	9.1	4.6	4.6	24	18	16
Conductivity	uS/cm	N/A	223.98	176.25	140	160	160	170	210	160	180	230
Cyanobacteria	Cells/mL	<20000		8570.88	2012	0	236	0	1335	6932	57233	819
Dissolved oxygen	mg/L	>4	8.01	8.21	9.8		7.7	7.5	7.8	6.7		9.2
Faecal coliforms – confirmed	cfu/ 100mL	200	129.25	66.88	80	80	86	70	55	50	110	4
Suspended solids	mg/L	25	31.59	19.00	38	14	12	25	7	20	19	17
Total nitrogen	mg/L N	N/A	1.16	1.60	1.5	2.3	1.7	2.4	1.6	1.4	0.91	1.0
Total phosphorus	mg/L P	0.1	0.08	0.08	0.075	0.13	0.069	0.13	0.051	0.068	0.055	0.058
Turbidity	NTU	30	75.93	35.88	57	49	23	80	15	20	21	22

Lake Tuggeranong

Two sites are monitored in Lake Tuggeranong; at the Kambah Wetland (Site 248) near the northern inflow of Village and Wanniassa Creeks, and above the dam wall (Site 249). The lake also captures all inflows from the suburbs on either side of Tuggeranong Creek above Isabella Pond, the stormwater from Greenway (including the Hyperdome) and Oxley.

The storm inflows in July, October, December and February led to persistent yet moderately elevated phosphorus loadings and moderate quantities of nitrogen in Lake Tuggeranong.

These conditions favoured summer-autumn development of blue-green algal blooms. A spring flush of various phytoplankton was followed by a persistent bloom of *Microcystis* and *Anabaena* from late March until June. This resulted in closure of the lake to both primary and secondary contact recreation for some time this year. Although mildly elevated levels of saxitoxin from *Anabaena* sp. were detected in weekly samples taken in April by Environmental Protection officers, the closures already in place were deemed to be sufficient.

Table 22: Site 248 Lake Tuggeranong Kambah Wetland

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9	7.71	7.34	7.2	7.2	7.6	7.4	7.4	7.1	7.3	7.5
Chlorophyll ‘a’	ug/L	10	13.12	16.19	5.4	6.4	31	4.3	23	28	7.4	24
Conductivity	uS/cm	N/A	180.47	148.75	120	130	150	150	190	140	140	170
Cyanobacteria	Cells/mL	<20000		8621.88	6579	2154	8173	54	1537	4088	1059	45331
Dissolved Oxygen	mg/L	>4	7.37	6.63	10.7	*	8.8	7.9	3.8	5	*	8.7
Faecal oliforms – confirmed	cfu/ 100mL	200	11707.12	73.75	20	150	94	50	120	42	110	4
Suspended Solids	mg/L	25	21.17	17.00	25	15	13	19	11	19	18	16
Total Nitrogen	mg/L N	N/A	1.06	1.66	1.6	2.3	1.6	2.4	1.5	1.2	1.1	1.6
Total Phosphorus	mg/L P	0.1	0.09	0.13	0.08	0.18	0.09	0.19	0.15	0.15	0.096	0.11
Turbidity	NTU	30	31.86	28.00	31	32	16	61	21	23	16	24

Table 23: Site 249 Lake Tuggeranong Dam Wall

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9	7.68	7.44	7.3	7.2	7.4	7.3	7.4	7.7	7.6	7.6
Chlorophyll ‘a’	ug/L	10	10.65	13.99	7.4	5.1	32	0.88	5.6	36	17	7.9
Conductivity	uS/cm	N/A	173.94	142.50	120	130	140	140	180	130	140	160
Cyanobacteria	Cells/mL	<20000		5375.25	9132	5029	7173	599	0	7096	9407	4566
Dissolved Oxygen	mg/L	>4	6.96	8.64	10.7	*	9	7.1	6.4	7.4	*	8.5
Faecal Coliforms – confirmed	cfu/ 100mL	200	273.41	68.63	320	80	40	10	40	15	40	4
Suspended Solids	mg/L	25	17.37	15.88	14	15	14	29	8	17	17	13
Total Nitrogen	mg/L N	N/A	1.03	1.61	1.3	2.3	1.6	2.4	1.7	1.2	1.2	1.2
Total Phosphorus	mg/L P	0.1	0.08	0.12	0.07	0.18	0.10	0.19	0.17	0.13	0.11	0.07
Turbidity	NTU	30	33.48	29.00	21	39	17	72	24	24	16	19

* Data not available for month

Flemington Road Pond

Flemington Road Pond (Site 261) is a recently constructed storm water retention pondage system in Sullivans Creek. Above the Barton Highway, the creek-line is incised through cleared grazing land. Although this wetland is not suited to active recreation it is hoped that Dissolved Oxygen and Faecal Coliform data will be collected in the future.

The water quality reflects the youth of the water body, with wide fluctuations in pH, conductivity and turbidity. Waterwatch data collected above the inflow and at the outflow indicate this wetland is functioning as an efficient water quality improvement device. Water entering the pond frequently has alkaline pH and electrical conductivity readings of greater than 600 uS/cm, often accompanied by high turbidity. Waterwatch data for water leaving the pond is similar to that given in Table 24 indicating that water flowing through the wetland loses much of its mineral load to the wetland ecosystem.

The three northern pondages along the upper end of Ginninderra Creek form a series of water capture and natural filtration devices allowing the precipitation of sediments and filtration of nutrients. Yerrabi Pond picks up run-off from the developing north-eastern suburbs; next, Gungahlin Pond, in its parkland setting, continues the capture and cleaning of storm water. When the water reaches Lake Ginninderra it travels in a broad loop and rejoins the creek-line at Ginninderra Drive. The quality of the water leaving the lake is generally better than that entering Yerrabi Pond.

Table 24: Site 261 Flemington Road Pond

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9		7.74	6.8	7.5	7.3	7.6	8.4	7.9	8.1	8.3
Chlorophyll ‘a’	ug/L	10		7.86	4.2	2.9	1.7	6.8	27	7.2	8.4	4.7
Conductivity	uS/cm	N/A		290	270	340	270	310	340	240	260	290
Cyanobacteria	Cells/mL	<20000		785	2740	0	992	882	552	286	828	0
Dissolved Oxygen	mg/L	>4										
Faecal Coliforms – confirmed	cfu/ 100mL	200										
Suspended Solids	mg/L	25		12.50	39	7	7	15	11	8	9	4
Total Nitrogen	mg/L N	N/A		1.45	1.2	1.1	1.2	2.2	2.1	1.4	1.3	1.1
Total Phosphorus	mg/L P	0.1		0.05	0.06	0.03	0.04	0.07	0.07	0.05	0.04	0.02
Turbidity	NTU	30		15.19	49	13	16	8.3	8.5	7.9	14	4.8

Yerrabi Pond

While Yerrabi Pond (Site 262) has been part of the urban waterways of Canberra for several years, its importance as an indicator of water quality is now being realised as the infrastructure for the suburbs in its catchment approach maturity.

Turbidity in Yerrabi Pond did not settle across 2010–11. The strong correlation of Turbidity with levels of Suspended Solids indicates that water inputs were related to storms and other rainfall events. The drop in Dissolved Oxygen may be an indication of oxygen use by faecal coliform bacteria resulting in a population spike in March.

Table 25: Site 262 Yerrabi Pond

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9		7.73	7.6	7.6	7.5	7.4	7.8	7.9	7.7	8.0
Chlorophyll ‘a’	ug/L	10		11.06	1.6	2.3	12	3	18	25	3.8	2.2
Conductivity	uS/cm	N/A		202.73	200	200	210	140	190	200	220	250
Cyanobacteria	Cells/ mL	<20000		577.55	1166	0	471	0	0	286	1929	0
Dissolved Oxygen	mg/L	>4		7.90	12.1	8.5	8	6.5	8.1	7.2	4.1	9.5
Faecal Coliforms – confirmed	cfu/ 100mL	200		130.55	6	10	58	60	90	190	320	2
Suspended Solids	mg/L	25		31.55	69	35	33	63	5	24	30	10
Total Nitrogen	mg/L N	N/A		1.33	1.4	1.8	1.5	1.9	1.3	1.2	1.1	0.9
Total Phosphorus	mg/L P	0.1		0.043	0.05	0.04	0.04	0.06	0.04	0.05	0.04	0.02
Turbidity	NTU	30		59.36	120	85	76	100	28	52	36	16

Gungahlin Pond

Water quality in Gungahlin Pond (Site 346) meets regulations. While the water is occasionally slightly more alkaline than guidelines recommend, biological activity, as indicated by faecal coliform and cyanobacterial counts as well as chlorophyll 'a' records, is within expectations. The higher chlorophyll 'a' reading in November was associated with a spring flush of various phytoplankton, and that in February with an elevated nanoplankton population. As with Yerrabi Pond upstream, elevated turbidity and associated suspended solids readings are correlated with storms and flooding.

Table 26: Site 346 Gungahlin Pond

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9	8.21	7.70	7.5	7.5	7.8	7.4	7.9	7.8	7.8	7.9
Chlorophyll 'a'	ug/L	10	5.97	18.94	5.4	6.8	65	11	8.8	44	6.5	4
Conductivity	uS/cm	N/A	310.73	235	220	220	230	190	290	220	240	270
Cyanobacteria	Cells /mL	<20000		888.50	2622	2036	2129	0	0	321	0	0
Dissolved Oxygen	mg/L	>4	8.13	8.83	10.4	*	11.2	10.2	6.5	7.2		9.6
Faecal Coliforms – confirmed	cfu/ 100mL	200	23.96	17.29	20	*	10	13	4	40	30	4
Suspended Solids	mg/L	25	17.53	32.25	68	22	18	19	5	21	85	20
Total Nitrogen	mg/L N	N/A	0.96	1.48	1.9	1.7	1.3	1.9	1.4	1.2	1.3	1.1
Total Phosphorus	mg/L P	0.1	0.04	0.06	0.06	0.05	0.06	0.07	0.04	0.05	0.06	0.04
Turbidity	NTU	30	27.90	47.89	120	58	25	36	6.1	27	79	32

Lake Ginninderra

Two sites are monitored in Lake Ginninderra, one near the inflow in the East Arm (Site 321) and the other above the outflow dam wall, or West Arm (Site 318).

Water quality in the lake was good and generally better than the other lakes monitored. The run-off induced turbidity in August has travelled through the three lakes, but the impact on water quality has lessened at each sampling point. There was a localised spike in numbers of bacterial colonies in the Site 318 sample in May.

Table 27: Site 321 Lake Ginninderra East Arm

Indicator	Units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9	8.00	7.65	7.5	7.6	7.9	7.5	7.5	7.6	7.6	8.0
Chlorophyll 'a'	ug/L	10	9.95	8.53	1.5	11	9.6	2.9	5.9	12	4.3	21
Conductivity	uS/cm	N/A	289.71	193.75	190	210	210	180	190	190	190	190
Cyanobacteria	Cells/mL	<20000		2259.38	846	886	738	171	226	190	0	15018
Dissolved Oxygen	mg/L	>4	7.97	8.15	11.3	*	8.1	6.9	5.7	6.9	*	11
Faecal Coliforms – confirmed	cfu/ 100mL	200	240.08	72.25	400	20	38	10	34	20	40	16
Suspended Solids	mg/L	25	24.08	38.13	130	17	16	17	16	31	64	14
Total Nitrogen	mg/L N	N/A	0.78	1.27	1.7	1.4	0.97	1.7	1.3	1.1	1.1	0.89
Total Phosphorus	mg/L P	0.1	0.05	0.06	0.09	0.05	0.04	0.06	0.06	0.07	0.07	0.04
Turbidity	NTU	30	26.55	44.38	140	41	23	28	28	34	48	13

Table 28: Site 318 Lake Ginninderra Dam Wall

Indicator	units	Reg limits	Long term average	Mean	Aug 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	May 2011
Acidity	pH	6-9	7.93	7.56	7.5	7.6	7.6	7.3	7.4	7.6	7.5	8.0
Chlorophyll 'a'	ug/L	10	5.54	6.59	2.5	13	4.6	0.34	1.7	4.5	3.1	23
Conductivity	uS/cm	N/A	278.34	180.	170	190	190	160	180	180	180	190
Cyanobacteria	Cells /mL	<20000		2154.25	707	632	0	278	0	690	0	14927
Dissolved Oxygen	mg/L	>4	7.24	8.77	11.7	*	7.8	7.6	6.6	6.6	*	10.6
Faecal coliforms – Confirmed	cfu/ 100mL	200	81.73	46.00	10	60	18	2	14	18	240	6
Suspended Solids	mg/L	25	11.72	10.38	20	14	6	4	5	11	8	15
Total Nitrogen	mg/L N	N/A	0.72	1.20	0.97	1.4	1.2	1.6	1.4	1.1	1	0.93
Total Phosphorus	mg/L P	0.1	0.03	0.047	0.043	0.05	0.047	0.05	0.053	0.052	0.043	0.036
Turbidity	NTU	30	14.08	23.63	37	37	25	25	19	20	13	13

* Data not available for month

Rivers

ACT rivers are sampled at different flow levels. Ideally there are a minimum of six flow-based samples in a reporting period, with at least one from each flow percentile band (Table 5) but this is not often achieved. In 2010–11 four of the five samples were taken in the second half of the year because of high and unpredictable flows during the mid-year floods all in the 0–4 percentile band.

Sampling Date	September 2010	February 2011	April 2011	May 2011	June 2011
Flow percentile	4	14	34	56	57

Murrumbidgee River (Sites 204, 209 and 213)

The Murrumbidgee River flows through the ACT, entering at Angle Crossing (213) in the south, and is sampled at three locations: Angle Crossing, Kambah Pool (209) and Halls Crossing (204) in NSW, just downstream of the ACT. As the main river in the ACT, the Murrumbidgee is on the receiving end of most material transported throughout ACT waterways.

There are rarely reports of aberrant reading for any parameter at the Murrumbidgee sites. As in 2009–2010 the influence of catchment wide drainage following heavy rains in winter can be seen in elevated levels for Suspended Solids, Faecal Coliforms and Turbidity for October. At Halls Crossing the spring and summer flows have lowered the pH and conductivity readings to well within regulation, while the pattern, at least for conductivity, of higher readings with lower flows continues. Urban run-off, return of treated sewage and a change in geology would account for these differences. The minor elevation in chlorophyll 'a' at Kambah Pool in February may reflect the combination of nutrients brought in by the December floods and the warm weather in January. The slightly depressed AUSRIVAS scores for Angle Crossing are associated with disturbance made by construction work for the Murrumbidgee to Googong Pipeline and reflect well regulated in-river works.

Murrumbidgee River, Angle Crossing, August 2009

Table 29: Values of indicators sampled on Site 204 on the Murrumbidgee River at Halls Crossing

Indicator	Units	Regulation limits	Long term average	Average 2010-11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	8.30	7.50	7.1	7.4	7.7	7.6	7.5
Chlorophyll 'a'	ug/L	10	14.59	8.77	8.4	12	6	8.6	8.8
Conductivity	uS/cm	N/A	197.29	174.29	140	130	160	200	230
Dissolved Oxygen	mg/L	>4	10.09	10.73	11.9	8.5	10	11.3	10.8
Faecal Coliforms – confirmed	cfu/ 100mL	200	407.37	146	440	400	130	10	12
Suspended Solids	mg/L	25	17.12	20.43	64	26	11	12	9
Total Nitrogen	mg/L N	N/A	3.65	2.39	1.5	1.2	1.8	3.6	3.7
Total Phosphorus	mg/L P	0.1	0.11	0.05	0.095	0.069	0.043	0.031	0.028
Turbidity	NTU	30	13.07	18.23	60	20	12	9.3	10
		2009–10				Oct 2010			Mar 2011
AUSRIVAS score	A,B,C,D	B;B				A			B

Table 30: Values of Indicators sampled on Site 209 on the Murrumbidgee River at Kambah Pool

Indicator	Units	Regulation limits	Long term average	Average 2010-11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.95	7.30	6.7	7.5	7.6	7.2	7.1
Chlorophyll 'a'	ug/L	10	5.85	5.86	7.1	13	4	3.6	3.8
Conductivity	uS/cm	N/A	137.90	98.29	73	100	95	100	110
Dissolved Oxygen	mg/L	>4	9.45	9.63	10.5	7.8	8.4	10.6	11.1
Faecal Coliforms – confirmed	cfu/100mL	200	291.87	107.43	540	150	16	10	6
Suspended Solids	mg/L	25	20.81	20.57	61	28	13	11	12
Total Nitrogen	mg/L N	N/A	0.56	0.52	1.4	0.62	0.46	0.27	0.26
Total Phosphorus	mg/L P	0.1	0.05	0.05	0.12	0.063	0.041	0.03	0.027
Turbidity	NTU	30	17.99	17.39	60	18	11	8.6	8.7

* Data not available for this month

Table 31: Values of Indicators sampled on Site 213 on the Murrumbidgee River at Angle Crossing

Indicator	Units	Regulation limits	Long term average	Average 2010-11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.78	7.21	6.8	7.2	7.5	7.2	7.1
Chlorophyll 'a'	ug/L	10	3.91	4.56	8.5	4.8	3.4	3.9	4.1
Conductivity	uS/cm	N/A	127.44	98.57	86	95	99	100	100
Dissolved Oxygen	mg/L	>4	9.28	9.59	8.4	7.5	8.5	10.5	10.2
Faecal Coliforms - Confirmed	cfu/ 100mL	200	254.92	34.86	100	90	22	12	4
Suspended Solids	mg/L	25	13.86	19	38	46	9	15	10
Total Nitrogen	mg/L N	N/A	0.50	0.41	0.84	0.48	0.46	0.29	0.24
Total Phosphorus	mg/L P	0.1	0.05	0.04	0.061	0.064	0.038	0.031	0.024
Turbidity	NTU	30	9.75	13.17	30	25	8.9	9.2	8
		2009-10				Oct 2010			Mar 2011
AUSRIVAS score	A, B, C, D	B;A				B			B

Ginninderra Creek (Site 301 and Sites 195, 196 and 64)

Ginninderra Creek runs through a highly urbanised catchment with intensive development occurring in the upper parts of Gungahlin. The monitoring site for water quality in Ginninderra Creek is at Parkwood (Site 301), below the confluence with Gooromon Ponds Creek downstream of the northern and western suburbs. The biological monitoring sites in Ginninderra Creek are Baldwin Drive Bridge (Site 195), downstream of Lake Ginninderra (Site 196), and Latham (Site 64). The run-off between Lake Ginninderra and the sampling site at Parkwood comes out of numerous suburbs. The creek reserve, while managed, is parkland with woody exotics and non-native grasses. With the exception of suspended solids and turbidity, average readings for water quality parameters this year remained below the long term average, and inside recommended standards. However the elevated faecal coliform counts, significantly elevated in February, reflect accumulation and subsequent flushing of gross pollution traps in the drainage lines leading to the creek. The water in urban catchments, with major and minor development and increases in hard surfaces, often shows elevation in electrical conductivity as flows decrease.

Table 32: Values of indicators sampled at sites 301, 195, 196 and 64 along Ginninderra Creek

Indicator	Units	Regulation limits	Long term average	Average 2010-11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.76	7.11	6.9	7.0	7.0	7.2	7.3
Chlorophyll ‘a’	ug/L	10	14.47	11.77	3.8	5.9	5.1	50	6.3
Conductivity	uS/cm	N/A	411.35	371.43	180	210	340	610	570
Dissolved Oxygen	mg/L	>4	8.21	9.49	9.1	6.9	8.7	10.9	11.5
Faecal Coliforms – confirmed	cfu/ 100mL	200	1343.91	384.43	700	1000	260	91	120
Suspended Solids	mg/L	25	15.98	20.57	52	35	13	15	7
Total Nitrogen	mg/L N	N/A	1.15	1.09	2.1	0.97	0.94	1.2	0.91
Total Phosphorus	mg/L P	0.1	0.93	0.04	0.086	0.066	0.03	0.041	0.02
Turbidity	NTU	30	12.06	18.19	51	28	10	9.7	11
		2009–10				Oct 2010			Mar 2011
AUSRIVAS score (195)	A, B, C, D	C;C				C			B
AUSRIVAS score (196)	A, B, C, D	C;B				C			B
AUSRIVAS score (64)	A, B, C, D	C;C				C			C

Molonglo River (Sites 601 and 608)

After the Molonglo River leaves the Molonglo Gorge, it flows along the periphery of the urban/industrial areas of Queanbeyan and continues through intensive land use into Lake Burley Griffin. The Molonglo River is sampled at two sites above Lake Burley Griffin, near where the river enters the ACT at Dairy Flat Road/Bridge (Site 601) and Yass Road Bridge (Site 608) downstream of the Molonglo Gorge. The Lower Molonglo Water Quality Control Centre, Canberra's main sewage treatment plant, discharges into the Molonglo River well below Lake Burley Griffin, near its confluence with the Murrumbidgee River. Additional sampling (not reported here) is done by ACTEW as part of monitoring the impact the discharge may have on downstream waters.

The higher than expected readings for Chlorophyll 'a' at Dairy Flat Rd in February, April and May 2011 indicate the extent of the *Anabaena/Microcystis* algal bloom in Lake Burley Griffin. While the highest cell counts were in the western end of the lake, there were visible populations in East Basin, peaking in late February but continuing into March. In September the elevated Faecal Coliform counts with associated Turbidity and Suspended Solids at both sites give a picture of post-flood water conditions. It is likely that much of the bacteria were associated with animal manure as the Yass Road count is similar in magnitude to the Dairy Flat Rd count.

Yass Road Bridge AUSRIVAS scores for 2010–11, indicating severe impairment, still show a limited range of animals, a situation that may improve when the effects of the series of floods have ameliorated.

Table 33: Values of indicators sampled on Site 601 on the Molonglo River at Dairy Flat Bridge

Indicator	Units	Regulation limits	Long term average	Average 2010–11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.58	6.99	6.8	7.3	6.9	7.0	6.9
Chlorophyll 'a'	ug/L	10	14.97	15.00	7.2	14	20	26	7
Conductivity	uS/cm	N/A	247.50	214.71	93	180	200	240	310
Dissolved Oxygen	mg/L	>4	7.66	8.47	8.2	9	9.4	10.1	9.8
Faecal Coliforms – confirmed	cfu/100mL	200	102.98	405.29	2500	200	60	15	12
Suspended Solids	mg/L	25	11.98	29.14	130	21	10	12	9
Total Nitrogen	mg/L N	N/A	1.47	2.00	1.9	1.2	1.6	1.9	3.3
Total Phosphorus	mg/L P	0.1	0.10	0.08	0.15	0.071	0.077	0.068	0.057
Turbidity	NTU	30	12.21	24.76	110	14	11	9	9.3

Table 34: Values of indicators sampled on Site 608 (AUSRIVAS 242) on the Molonglo River at Yass Road

Indicator	Units	Regulation limits	Long term average	Average 2010-2011	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.31	7.09	6.7	7.3	7.1	7.1	7.1
Chlorophyll ‘a’	ug/L	10	4.42	4.70	6.4	6.5	6.0	3.3	4.2
Conductivity	uS/cm	N/A	348.33	213.43	150	24	230	250	330
Dissolved Oxygen	mg/L	>4	6.80	9.31	7.6	7.5	8.8	10.6	9.6
Faecal Coliforms – confirmed	cfu/100mL	200	365.48	252.14	1500	73	36	26	62
Suspended Solids	mg/L	25	12.20	13.29	27	22	12	9	6
Total Nitrogen	mg/L N	N/A	0.47	0.59	1.8	0.73	0.43	0.29	0.26
Total Phosphorus	mg/L P	0.1	0.04	0.04	0.089	0.052	0.031	0.021	0.014
Turbidity	NTU	30	18.94	12.91	27	19	12	7.8	7.2
		2009–10				Oct 2010			Mar 2011
AUSRIVAS score	A,B,C,D	C;B				C			C

Queanbeyan River (Site 769)

The Queanbeyan River is sampled at the ACT border, after the water has come through the weir and the long established urban area of Queanbeyan. The post-flood turbidity and suspended solids is clear in the September data, while the aged infrastructure of Queanbeyan’s urban and industrial areas may have helped keep the faecal coliform count elevated across spring and summer. The AUSRIVAS score for March of B, with a drop in numbers of worms and non-biting midges and more caddis fly larvae, indicated the effect of the floods in improving site condition.

Table 35: Values of indicators sampled on Site 769 on the Queanbeyan River at the ACT border

Indicator	Units	Regulation limits	Long term average	Average 2010–11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.37	6.90	6.7	7.1	6.9	6.9	7.1
Chlorophyll ‘a’	ug/L	10	6.55	2.97	4.9	5.3	2.0	1.5	1.6
Conductivity	uS/cm	N/A	216.21	136.71	87	140	140	130	150
Dissolved Oxygen	mg/L	>4	7.53	9.03	7.9	7.7	8.4	9.7	9.9
Faecal Coliforms – confirmed	cfu/100mL	200	665.74	325	1100	480	85	180	140
Suspended Solids	mg/L	25	8.19	16.14	51	11	11	8	12
Total Nitrogen	mg/L N	N/A	0.53	1.37	1.5	1.4	1.5	1	1.3
Total Phosphorus	mg/L P	0.1	0.04	0.06	0.1	0.056	0.05	0.049	0.05
Turbidity	NTU	30	7.27	22.14	71	16	15	12	17
		2009–10				Oct 2010			Mar 2011
AUSRIVAS score	A, B, C D	B;C				C			B


Paddys River at Murrays Corner, spring 2011

Paddys River (Sites 842 and 10)

Paddys River catchment has a combination of rural, forestry and conservation land uses. It was affected directly by the January 2003 bushfires but was even more affected by the long drought.

Paddys River has been flowing again since early 2010, and flooded like the other rivers in the region. The AUSRIVAS counts have returned to reference values, which not only reflects the much improved condition of the waterway, but helps the comparison with other sites. The elevated Dissolved Oxygen readings in May and June 2011 are indicative of very favourable conditions for macroinvertebrate and fish life.

Table 36: Values of indicators sampled on sites 842 and 10 along Paddys River

Indicator	Units	Regulation limits	Long term average	Average 2010–11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.62	6.97	6.5	6.9	6.8	6.9	7.0
Chlorophyll ‘a’	ug/L	10	2.15	1.43	3.3	1.5	0.65	0.58	1.1
Conductivity	uS/cm	N/A	87.95	63.86	54	65	68	65	66
Dissolved Oxygen	mg/L	>4	10.54	10.33	9.7	8.4	11.2	12.8	12.5
Faecal Coliforms – confirmed	cfu/100mL	200	637.98	343.14	320	1400	180	92	130
Suspended Solids	mg/L	25	11.91	12.57	40	28	5	3	4
Total Nitrogen	mg/L N	N/A	0.45	0.36	1.1	0.55	0.2	0.18	0.17
Total Phosphorus	mg/L P	0.1	0.05	0.03	0.071	0.059	0.023	0.015	0.014
Turbidity	NTU	30	14.79	11.86	35	25	6.2	4	1.5
		2009–10				Oct 2010			Mar 2011
AUSRIVAS band (10)	A,B,C,D	C;A				A			A

Gudgenby River (Sites 901 and 20)

The Gudgenby River drains a rural catchment dominated by native forest that opens out into pastoral leases. Water quality at the Smiths Road site was close to standard condition. The biological condition of site 20 at Sunshine Road (Angle Crossing Road) causeway was at reference standard in spring 2010 and showed as B, significantly impaired, in autumn 2011. While the range of macroinvertebrates was high on both occasions, the proportions of more tolerant species rose in the autumn with the warm weather and lowering flows. Grazing disturbance may be the cause of notable faecal coliform counts, but the mildly elevated turbidity and suspended solids readings in September are rain related.

Table 37: Values of indicators sampled on sites 901 and 20 along the Gudgenby River

Indicator	Units	Regulation limits	Long term average	Average 2010–11	Sep 2010	Feb 2011	Apr 2011	May 2011	Jun 2011
Acidity	pH	6-9	7.71	6.99	6.4	7.0	7.3	7.0	6.9
Chlorophyll ‘a’	ug/L	10	1.89	1.11	2.5	1.2	0.4	0.72	1
Conductivity	uS/cm	N/A	99.84	70.14	50	77	76	75	71
Dissolved Oxygen	mg/L	>4	9.93	10.20	8.6	9.0	9.3	11.0	11.8
Faecal Coliforms –confirmed	cfu/100mL	200	333.78	193.14	200	520	42	110	30
Suspended Solids	mg/L	25	9.51	11.00	29	28	4	4	5
Total Nitrogen	mg/L N	N/A	0.44	0.40	1.00	0.73	0.28	0.20	0.21
Total Phosphorus	mg/L P	0.1	0.05	0.05	0.11	0.08	0.037	0.028	0.025
Turbidity	NTU	30	10.86	10.96	36	21	3.8	4	4
		2009–-10				Oct 2010			Mar 2011
AUSRIVAS score (20)	A, B, C, D	B;B				A			B

Minor waterways

These four waterways are monitored for AUSRIVAS bioassessment only. There is insufficient data about any of the parameters to draw any conclusions about trends about water quality. All four sites are among those monitored by Waterwatch volunteers. Further information about their water quality may be obtained from ACT Waterwatch at act.waterwatch.org.au/

Tidbinbilla River (Site 15)

Site 15 (Figure 7) on the Tidbinbilla River is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. It is one of the three reference sites. In both spring and autumn this site was highlighted for its healthy populations of pollution sensitive mayflies. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. Indications are that the waterway is in excellent condition although with a slightly elevated turbidity from heavy spring rain.

Table 38: Values indicators sampled on Site 15 on the Tidbinbilla River

Indicator	Units	Regulation limits	October 10	March 11
Conductivity	µS/cm	N/A	59.8	53.2
Acidity	pH	6.5-9	7.7	7.81
Alkalinity	mg/L CaCO3	N/A	30	30
Dissolved Oxygen	mg/L	>4	9.41	10.82
Turbidity	NTU	<10	48	11.8
		2009–10		
AUSRIVAS score	A, B, C, D	A;A	A	A

Jerrabomberra Creek (Site 246)

Site 246 (Figure 7) on Jerrabomberra Creek is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling.

Jerrabomberra Creek drains through industrial, rural and urban settings, and receives water from Woden Creek and its tributaries. Water quality was poor while new bridgework on Lanyon Drive was being completed. Biological condition dropped to 'extremely impaired' in the spring as the creek bed had filled with sediment and the water was anaerobic. The floods in December and February cleared the channel. The worms and blood worms were replaced with caddis larvae and more sensitive fly larvae.

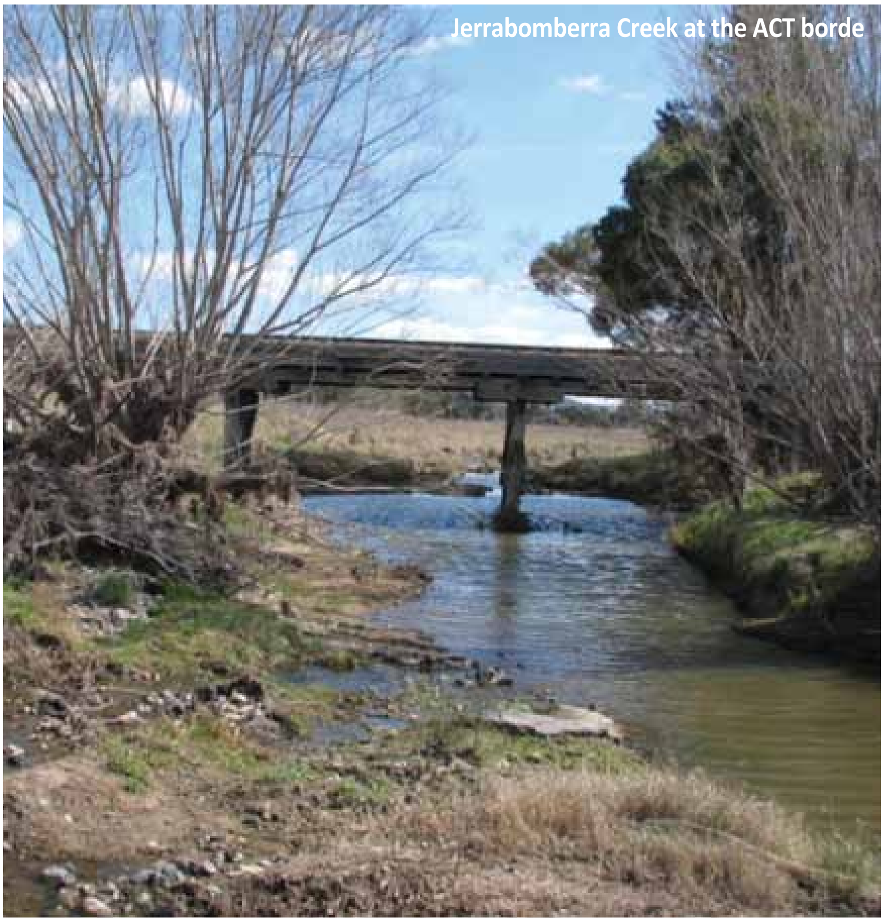

Jerrabomberra Creek at the ACT borde

Table 39: Values of indicators sampled on Site 246 on Jerrabomberra Creek near Hindmarsh Drive

Indicator	Units	Regulation limits	October 10	March 11
Conductivity	µS/cm	N/A	455.5	407.7
Acidity	pH	6.5-9	7.74	8.06
Alkalinity	mg/L CaCO3	N/A	190	170
Dissolved Oxygen	mg/L	>4	7.83	8.79
Turbidity	NTU	<10	20	20
		2009–10		
AUSRIVAS band	A, B, C D	C, C	D	B

Yarralumla Creek (Site 189)

Site 189 (Figure 7) on Yarralumla Creek is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. This creek is mostly a concrete-lined drain meandering through the urban areas of Phillip and Woden, but becomes more creek-like as it crosses the horse paddocks before joining the Molonglo River below Scrivener Dam. Conductivity is usually high in this waterway but the turbidity is usually well less than 10 NTU. Although the waterway is still 'severely impaired', the fauna has diversified from very pollution tolerant worms and water snails to include blood worms and water boatmen.

Yarralumla Creek, upstream of Cotter Road bridge, with playing fields and Curtin in the distance

Table 40: Values of indicators sampled on Site 189 on Yarralumla Creek downstream of the suburb of Curtin

Indicator	Units	Regulation limits	October 10	March 11
Conductivity	µS/cm	N/A	374.3	860.5
Acidity	pH	6.5-9	8.24	7.15
Alkalinity	mg/L CaCO3	N/A	88	220
Dissolved Oxygen	mg/L	>4	9.16	7.15
Turbidity	NTU	<10	191	2.2
		2009–10		
AUSRIVAS	A, B, C, D	B;C	C	C

Tuggeranong Creek (Site 58)

Site 58 (Figure 7) on Tuggeranong Creek is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. This site is in the creek downstream of Lake Tuggeranong. Although Lake Tuggeranong helps prevent sediments and pollutants from reaching this section of the creek habitat, the surrounding land use of grazing and the bushfire disturbance means this site is susceptible to degradation. Water quality at sampling times this year was good, except for the alkaline pH.

The AUSRIVAS rating for this small waterway is quite variable. The creek vegetation has recovered from the 2003 bushfire, but the flow regime through Lake Tuggeranong is partly dependent on storms, and the test site may become a pool for significant periods. While the rating in spring 2010 was at severely impaired, it had risen to significantly impaired in autumn 2011, a pattern this waterway has shown for some years now. The flushing in December and February has again improved habitat conditions for the fauna.

Table 42: Values of indicators sampled on Site 58 on Tuggeranong Creek downstream of Lake Tuggeranong

Indicator	Units	Regulation limits	October 10	March 11
Conductivity	(µS/cm)	N/A	151.8	143.2
Acidity	pH	6.5-9	7.55	7.64
Alkalinity	(mg/L CaCO3)	N/A	38	200
Dissolved Oxygen	(mg/L)	>4	9.07	5.28
Turbidity	(NTU)	<10	22	11.7
		2009–10		
AUSRIVAS score	A, B, C D	C;B	C	B

Macquarie perch survey

Section 3: Research activities

Groundwater resources in the ACT

Groundwater in the ACT is a rather small resource compared to surface water because geologically the ACT sits on low yield fractured rock aquifers. However, in localised situations there will be opportunities to efficiently use an aquifer to help offset demand on water supply dams.

Since 2002 the ACT Government has been rolling out more accurate groundwater assessments and broadening the extent of monitoring as a response to a very substantial increase in demand and use of groundwater. A risk based approach to groundwater monitoring has been developed where the amount of monitoring in an area is proportional to the risk posed to the groundwater through abstraction, contamination or landuse change. A very wet winter and summer made attempts to construct monitoring bores difficult, with drill rigs becoming stuck in unstable ground. As a result only one extra monitoring bore was commissioned, in Weston.

ESDD, through the Environment Protection and Water Regulation Branch, currently maintains fifteen dedicated monitoring bores, with information from another six sites coming from interested groundwater abstractors. These monitoring bores provide information about the transmissivity (capacity for water to move through the aquifer), hydraulic conductivity, storage capacity potential and recharge rates of the various aquifer types within water management areas. Monitoring of the aquifer recharge response to rainfall is a critical activity that may enable us to quantify potential effects of changed rainfall patterns expected from climate change.


Monitoring bores

Canberra Integrated Urban Waterways Project

ESDD is continuing to implement the Canberra Integrated Urban Waterways program. This program focuses on integrating urban water management by reducing potable water use through investment in water pollution control ponds and stormwater harvesting reticulation infrastructure, and demonstrating aquifer storage and recovery.

The year has seen continued planting at the Banksia St, O'Connor wetland, commencement of construction of the Dickson and Lyneham wetlands and the implementation of a community engagement program for The Valley Ponds, Gungahlin. Construction of The Valley Ponds will start in late 2011. There has been a high level of community interest, input and engagement in the wetlands' development.

A successful community planting day was held at the Dickson wetland on 4 June 2011. Over 200 people planted native grasses, reeds and trees and more than 100 became members of the Dickson Wetland Carer group.

Community planting day at Dickson Wetland, 2011

The Urban Waterways team participated in: the Festival of the Forests, Arboretum March 2011; the Living Green Festival, University of Canberra, March 2011; and World Environment Day, Garema Place, June 2011. In recognition of its work with the community, the directorate won a Keep Australia Beautiful Award in 2010 for its partnership with the Banksia St Wetland Carers in creating the Banksia St, O'Connor wetland. The Urban Waterways team, along with the Molonglo Catchment Group, has engaged with local schools and community groups like Girl Guides in field trips and activities at the wetlands.

Three pilot stormwater harvesting projects have been progressed, with the design of the reticulation infrastructure in the inner north of Canberra, Tuggeranong and Weston Creek close to completion. Funding was obtained to construct the Inner North Reticulation Scheme. Once built, the reticulation network will supply harvested stormwater from the ponds adjacent to Flemington Road, Mitchell to irrigated assets such as sportsgrounds in the inner north. Construction of the network will commence in 2011–12.

In collaboration with the Department of Education and Training and the Australian Sustainable Schools Initiative, the directorate produced the wetlands education curriculum *Understanding Canberra's wetlands: a school curriculum program for the study of constructed wetlands.*

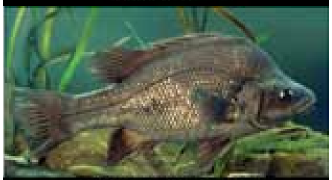
Field investigations into the extent and capacity of the Flemington aquifer, Mitchell commenced in the year. Results indicated that the aquifer has a large storage capacity and the presence of high yielding bores. A trial will be undertaken in 2011–12.

Threatened fish in the ACT

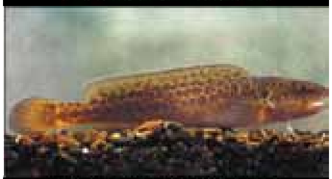
Monitoring of threatened fish species is conducted by ESDD's Conservation, Planning and Research Unit. 2010–11 was the 'on-year' for the biennial Murrumbidgee Fish Survey. Currently, joint research projects involving ACTEW, the University of Canberra (UC), the Australian National University (ANU) and ACT Government have been established to gain knowledge on Macquarie perch and other threatened species populations in the Cotter Reservoir and River.

MURRAY COD

TROUT COD



MACQUARIE PERCH



TWO-SPINED BLACKFISH

Murrumbidgee River surveys.

Murray cod (*Macquaria peelii peelii*) were detected upstream of Gigerline Gorge for the first time. The Murray cod caught were potentially dispersal from a private dam during the high flows.

Trout cod (*Maccullochella macquariensis*) have been stocked in the ACT for the local conservation of the species since the 1980s. The first indication of natural breeding in trout cod in the Murrumbidgee River above Burrinjuck was found in the 2010–11 survey. A single juvenile trout cod was recorded at Angle Crossing. The individual, an estimated two years old, was too young to have come from the conservation stockings in the Upper Murrumbidgee Catchment undertaken over the past 15 years.

Macquarie perch (*Macquaria australasica*) were recorded for the second consecutive year at Angle Crossing. Surveys in the Cotter River continue.

Two spined blackfish (*Gadopsis bispinosus*): The populations downstream of major impoundments on the Cotter River recruited well in 2011 despite high flows sufficient to cause significant bed movement around the breeding season. Previous surveys have shown that the environmental flows provided from the impoundments have maintained the blackfish populations at reasonable levels through the recent drought. The high flows of 2010–11 are likely to have caused bed movement during the breeding season, which is of concern as blackfish breed in the spaces under cobbles. Unfortunately the population in the unregulated areas of the Upper Cotter, which were found to have declined in 2010, have continued to decline. These populations were likely to have been affected by the drought in 2010 and it is also possible that the high flows in 2010–11 occurred during a critical stage in the breeding season, causing further impact on recruitment. Blackfish in the regulated reaches further downstream breed earlier due to warmer water temperatures and are not as likely to have been affected by the flooding.

Urban Lakes Recreational Fishery Survey 2010–11

European carp (*Cyprinus carpio*) were recorded for the first time in Yerrabi Pond since its construction in the 1990s. It appears carp have invaded the pond from the recently created ponds upstream in the Harrison subdivision. Unfortunately, there are no current practical control options once carp are established in the pond and upstream.

In 2010–11 the ACT Government stocked **Murray cod** into Lake Tuggeranong (13,000), and Yerrabi Pond (8,000). Half the cod stocked into Yerrabi Pond were marked with fluorescent dye to facilitate detection of survival levels.

Gungahlin Pond was stocked with 7,500 **golden perch** (*Macquaria ambigua ambigua*. The National Capital Authority stocked 100,000 golden perch into Lake Burley Griffin. The Canberra Anglers Club stocked 2,500 golden perch into West Belconnen Pond and Point Hut Pond as part of a five year trial to assess yearly stocking in small ponds.

Upper Murrumbidgee River Demonstration Reach

The Upper Murrumbidgee River Demonstration Reach (UMDR) is about 70 km long, from the Scottsdale area in south-eastern NSW downstream to Kambah Pool in the ACT. It includes the popular Pine Island, Tharwa Bridge and Tharwa village recreation areas, and the prominent river crossings at Angle Crossing and Point Hut Crossing. Demonstration reaches, which usually have an emphasis on native fish and fish habitat, are part of the Commonwealth Government's *Caring for Our Country* initiatives.

The UMDR is releasing an implementation plan providing background for the reach, the major ecological assets within it, threats posed to them and measures for long term reduction of those threats. Those major ecological assets include: the native fish populations, notably those of several species nationally and regionally listed as under threat; riparian floodplain vegetation communities; threatened and migratory animals; aboriginal cultural heritage assets; and social, community and historic assets.

The primary threats include unsuitable environmental flow allocations, future diversions of water to support Canberra's growing population, reduced water yields in an arid landscape becoming more like rangeland with climate change, pollution and unsustainable use of surface and ground water.

Companion plans will include: a communications, education, participation and awareness plan; a monitoring and evaluation plan; and a carp reduction plan. A river based schools' education package, Sustaining River Life, is ready for release

PCL staff backpack electro-fishing on the Cotter River in 2009

Section 4: Community Engagement


UMCCC forum field day, Tharwa

Upper Murrumbidgee Catchment Coordinating Committee

The Upper Murrumbidgee Catchment Coordinating Committee (UMCCC) is a community based organisation made up of agencies and groups that are responsible for, or contribute to, natural resource management in the upper Murrumbidgee catchment. UMCCC operates as a regional cross border network to promote communication, build awareness and disseminate knowledge between its members. These include agencies and groups in NSW and the Australian Capital Territory. UMCCC actively participates in community forums and has received presentations and made submissions on numerous natural resource management policy initiatives. The organisation is assisted by funding and in-kind support from the Australian and ACT Governments.

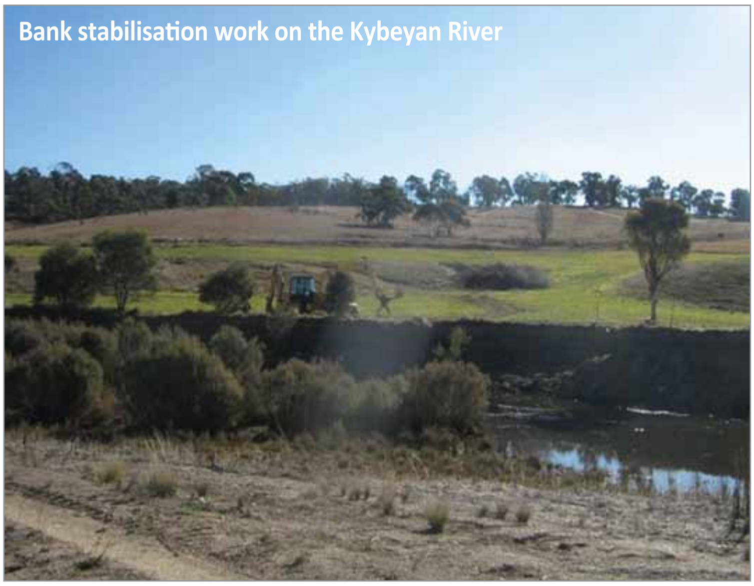
In 2010–11 the UMCCC held its biennial forum on the topic *The Upper Murrumbidgee – helping it work*. A field trip prior to the forum, on the banks on the Murrumbidgee River at Tharwa, was very informative for the 50 participants, with discussion topics including indigenous land management, water quality monitoring and fish rehabilitation. The forum hosted speakers from a wide range of interest areas across the catchment who discussed questions put to them about catchment health and values. The 80 participants later had an opportunity to put forward their views on the same questions. The UMCCC continues to enjoy strong support from community and Landcare groups, and ACT and NSW government agencies as it provides an effective cross border network.

Waterwatch

Waterwatch is a nation-wide water quality monitoring program where the sampling and testing is done by community volunteers. It is a 'monitoring to action' program that aims to equip local communities with the skills and knowledge to become actively involved in the protection and management of their local waterways and catchments. The ACT program is funded by both the Commonwealth and Territory governments, with four part-time coordinators attached to the Ginninderra, Molonglo and Southern ACT Catchment groups and Cooma Landcare, and supported by the Upper Murrumbidgee Waterwatch Facilitator in ESDD.

Waterwatch groups have initiated many positive, community-based conservation activities such as creek restoration, willow removal, litter removal from waterways, weed eradication, drain stencilling, habitat development, reduction in the use of pesticides, fertilizers and other pollutants – and more.


Workshop at forum, in progress



Bank stabilisation work on the Kybeyan River

The three catchment groups with Waterwatch sites within the ACT now have so many reliable volunteers regularly sampling creeks, ponds and the upper reaches of rivers that they are producing Catchment Health indicator Reports. These reports are based on a simple rating system where volunteers' water quality data are collected and modes (or medians) calculated across both the whole data set and the six months of the reporting period. Values are assigned to the modes by comparison with their variance from regulation values for the six parameters tested (pH, electrical conductivity, turbidity, % saturation of dissolved oxygen, orthophosphates and nitrates). A sub-catchment rating is calculated from the mean of the values for the sites in that sub-catchment. This indicator can be compared to the long term indicator for that sub-catchment. When each indicator is given a colour, a 'traffic light' map may be generated and indicate sub-catchment condition from excellent (blue) to degraded (red). Thus the indicators help to point out sub-catchments where water quality deserves further examination. The Catchment Health indicators program (CHiP) also provides input on riparian condition at sites, macroinvertebrate surveying in autumn and spring, Frogwatch data and a locally devised conspicuous algal rating sent in from sites throughout the region. While limited by the basic equipment supplied to volunteers and volunteers' time constraints, these CHiP reports provide a valuable background to the annual ACT Water Report.

Regional partnerships

2010–11 saw the large scale expansion of Upper Murrumbidgee Waterwatch (UMWW) into the greater region. UMWW spearheaded the development of the Actions for Clean Water Project, which brought together ACTEW, ActewAGL, the ACT Natural Resource Management Council and Murrumbidgee Catchment Management Authority to develop a prioritised and strategic plan of attack for the management of turbidity in the Monaro region. Through this project, nearly one million dollars have flowed into the upper catchment for planning, erosion control, in-stream structures and riparian plant.

Further, UMWW is increasing its engagement with Yass Council by providing testing equipment and training, and assisting the Palerang Shire Council in mapping its sub-catchment health. The year old Cooma region Waterwatch Program continues to consolidate, with nearly 50 monitoring sites and a fast growing volunteer base.

Volunteers at a quality control and assessment training day

Data collection and quality

UMWW currently has over 160 sites being regularly monitored for water quality by highly trained volunteers. Volunteers are accredited, and their data valued by the Territory Government and ACTEW/Bulk Water Alliance.

SACTCG Waterwatch coordinator Martin Lind netting

New projects

In partnership with ESDD's Conservation Planning and Research Unit, UMWW launched a community-based plague minnow (*Gambusia holbrookii*) control project in 2010–11. This ground-breaking effort will tap community knowledge to control feral Gambusia populations in the Capital Region.

Education

The public education program also expanded in 2010–11. Partnerships with the scouting movement, National Museum of Australia and Australian National Botanic Gardens have engaged many young people. The on-going schools and education program now offers a choice of 24 lessons that Waterwatch can bring to the class-room. There are teachers' resources, storybooks to engage children's interest in water life, and information to support community on-ground programs.

Dr Chris Bourke MLA and MCG Waterwatch Coordinator at the launch of the Glove box guide

Publications

As always, UMWW undertakes the publication of educational materials for both schools and the broader community. UMWW was pleased support the publication of *The Glovebox Guide to Waterplants of the ACT Region and The Patience of the Water Scorpion*, both by Molonglo Waterwatch Coordinator, Stephen Skinner.

Getting involved in Waterwatch

If you are interested in improving the health of your local waterway and meeting or forming a group of likeminded individuals, please contact the Waterwatch facilitator on 6207 2246.

Online information about Waterwatch is available at www.waterwatch.act.org.au and features Waterwatch resources, contact details and a library of relevant publications and fact sheets.

Platypus and water rat Monitoring

Platypus Count, a joint venture of Waterwatch and the Australian Platypus Conservancy, has been going for three years in the region. Monitoring in the Capital Region has provided the first evidence anywhere that platypus populations can cope with high water events, such as those seen during the December 2010 floods in Queanbeyan. Further, these monitoring programs are assisting UMWW in engaging with young families and community members who do not traditionally see themselves as advocates of river health or water quality.

Frogwatch

Frogwatch is a community frog monitoring program that aims to involve large numbers of volunteers of all ages to undertake frog monitoring and protect frog habitats. In National Water Week in October 2009, well over 200 Frogwatch participants monitored frog populations at 361 sites, 291 within the ACT and 70 in the region. Eight different frogs were detected in the region, with numbers and distribution up on October 2009. This year the spotted grass frog (*Limnodynastes tasmaniensis*) was the most commonly heard with the common eastern froglet (Crinia signifera) also widespread and common.

Frogwatch participants attend a training seminar about frogs, how to monitor them and ways to help protect them and their habitats. The Frogwatch census is an assessment of the types and abundance of frogs living in our environment. Frog species are widely recognised as indicators of environmental health and their presence can indicate the long term health of a catchment. Results of the Community Frogwatch Census are available on the Ginninderra Catchment Group website at: www.ginninderralandcare.org.au/ .

Schools in the ACT region, with the support of Frogwatch ACT are participating in a program to breed tadpoles and provide new frogs for release in the area.