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Submission One

to

Senate Environment, Communications, Information Technology and the Arts Committee

Inquiry into Australia's national parks, conservation reserves and marine protected areas

Submission One addresses terms of reference (a) (d) and (e), and focusses on FRESHWATER PROTECTED AREAS ('other conservation reserves' in the ToR).

Urgent need for a systematic expansion of freshwater protected areas in Australia

A scientists' consensus statement

Revised: 1 January 2006

This statement has been prepared by an informal working group of Australian scientists, and is supported by additional scientists from academia and private industry, with over 50 total signatories. The spokesman for the group is Professor Richard Kingsford from the University of New South Wales. The corresponding author is Jon Nevill from OnlyOnePlanet Consulting, Hampton Melbourne. More details may be found below under 'authorship'.
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Abstract
Freshwater ecosystems (including inland saline wetlands and mound springs) are among the more imperilled ecosystems in the world. Australia is no exception, but their protection has lagged behind programs of terrestrial protection. Freshwater protected areas are an essential component of biodiversity conservation programs, but a systematic approach to their development in Australia has been slow, and hindered by incomplete ecosystem inventories at State and national levels. We examine this problem and suggest avenues for action. Further, while there is no shortage of relevant legislation and policy for protecting freshwater aquatic ecosystems in Australia, some protective mechanisms have not yet been used, many years after their development. In some places 'protection' has been only partially applied without regard to important issues of hydrologic connectivity – with species extinction as a direct consequence. The most urgent priority is to identify those aquatic ecosystems most at risk. A comprehensive national assessment of the conservation status of freshwater ecosystems should be undertaken immediately. Such an assessment would provide both a platform and an impetus for the systematic expansion of the nation's freshwater protected areas. Political will is then essential for effective conservation, utilising the plethora of conservation and management tools available.

Keywords:
Inland aquatic, freshwater, protected areas, biodiversity, reserves, biodiversity conservation, governance, representative, ecosystems.

Introduction
Most Australians are familiar with the protection provided by national parks in terrestrial environments, and marine reserves in our oceans. However the concept of protected rivers is seldom discussed – or the more general concept of freshwater protected areas (here 'freshwater' means 'inland aquatic', including saline wetlands and mound springs[1]). This is despite evidence that freshwater biota are particularly imperilled both globally and in Australia[2] (Boulton and Brock 1999, Revenga and Kura 2003).

The world's biodiversity is in serious decline[3]. According to the international *Convention on Biological Diversity 1992* (CBD, www.biodiv.org) the conservation of biodiversity, including aquatic biodiversity, requires the protection of representative examples of all major ecosystem types, coupled with the sympathetic management of ecosystems outside those protected areas. These twin concepts[4] underpin, in theory at least, all Australian biodiversity protection programs (Commonwealth of Australia 1996:Principle 8). They are fundamental to the development of a coherent and effective framework for the protection and management of high conservation value aquatic ecosystems (Kingsford *et al.* 2005).

The importance of protected areas
Protected areas are the single most important tool used in biodiversity conservation programs throughout the world (ESA 2003). They also support ecosystem functions beyond their boundaries, and have other economic and cultural benefits (Nevill and Phillips 2004:s4.3). Systematic conservation planning approaches are now accepted as essential tools in protected area identification and selection (Margules and Pressey 2000) and have been used in Australia for 30 years and 15 years in terrestrial and marine environments respectively. Such approaches are essentially aimed at getting the best value (in terms of biodiversity conservation) from a reserve system which comprises a relatively small part of the total landscape. At this stage they have *not* been applied to the establishment of freshwater protected areas in a cohesive and focused way by Australian State agencies (Nevill and Phillips 2004).

Protected areas, as defined by the World Conservation Union (IUCN 1994) are areas of land or water 'especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means'. The logic underlying the IUCN definition has three key elements. The area should be under defined management (i.e., with an agreed management plan). Secondly, actual management arrangements should effectively reduce at least one major threat to the area's values (i.e., value and condition should be monitored and reported over time). Thirdly, the area should have secure tenure (preferably through statute). The IUCN lists 6 categories of protected area, from full protection through to multiple use.

The long-term benefits of creating freshwater protected areas[5], if properly managed, are likely to far outweigh short term costs[6] (Balmford *et al.* 2002, MEA 2005:39). Many marine protected areas enhance fisheries outside the protected zone (Gell and Roberts 2003, Ward and Hegerl 2004), and some freshwater protected areas will have similar effects, with consequent benefits for recreational fishers. Australian hunters' organisations have helped fund the purchase of freshwater areas to provide breeding grounds for ducks and other waterbirds. Tourism in Canada has benefited from the Canadian Heritage Rivers System, and is now one of the key drivers of system expansion. Australian tourist operators will benefit from healthy and impressive rivers and wetlands. Fledgling tourism operations in places like the Macquarie Marshes struggle because of river degradation. Farmers will benefit from the protection of aquifer recharge areas. Indigenous groups supported the formation of the first listed Ramsar site in the world: Coburg Peninsula in the Northern Territory. All Australians will benefit from the protection of our living freshwater environments – which have huge economic, cultural, recreational, educational, spiritual and scenic values.

Freshwater ecosystems supply major (often unprotected) ecosystem services such as water supply, flood mitigation and groundwater regulation[7]. Fully protected ecosystems provide essential environmental benchmarks by which the management of utilised ecosystems may be measured and refined. The cost of rehabilitating such areas after degradation far exceeds

the cost of protecting these services (according to Bernhardt *et al.* 2005, over US$14 billion has been spent rehabilitating degraded streams in the USA since 1990).

International initiatives

The Ramsar *Convention on Wetlands 1971* created the world's largest and most widely applied protected area system for freshwater habitats, with 145 of the world's 192 nations participating[8]. In its decisions and guidance, to which the Australian Government is party, the Ramsar Convention has committed to (among other things) a *Strategic Framework for the Ramsar List* based on criteria that include 'representative wetland types'[9](www.ramsar.org). The potential for the Ramsar framework to provide protection to all types of aquatic ecosystem has not been fully developed in Australia (see below).

The Conference of Parties to the CBD, meeting in February 2004, developed a revised program of work on inland waters. The adopted measures include Goal 1.2: 'to establish and maintain comprehensive, adequate and representative (CAR) systems of protected inland water ecosystems within the framework of integrated catchment/watershed/river-basin management' (Conference of the Parties 2004). This measure was adopted in part to meet the 2002 World Summit on Sustainable Development's implementation target of 'a significant reduction in the rate of loss of biodiversity' by 2010.

This emphasis on freshwater ecosystems was reinforced by the World Conservation Congress, meeting in November 2004, which recommended that all nation-states 'establish protected areas representative of all freshwater ecosystems, including but not limited to riverine, lacustrine, wetland, estuarine and groundwater-dependent ecosystems, in cooperation with local communities and resource users, so as to safeguard the biodiversity of each of their freshwater ecosystems…' (www.iucn.org).

Some countries have made significant advances in protecting freshwater ecosystems, with a few notable developments relating to rivers. The United States passed their *Wild and Scenic Rivers Act* in 1968 after a vigorous public campaign to stop the damming of several major rivers (172 rivers or river reaches are now listed). In Canada, the *Canadian Heritage Rivers System* (1984) is now so popular that nominations for further protected rivers come entirely from community pressure (40 rivers or river reaches are listed) (www.chrs.ca).

The 1968 USA legislation helped support a 'wild and scenic rivers' campaign starting in New Zealand (NZ) in 1976, which resulted in *Water Conservation Order* (WCO) legislation being passed in 1981. With minor amendments, National WCOs have been investigated and gazetted as 'protected waters' since then. To date 13 river catchments and 2 stand-alone coastal lakes are largely protected. Ramsar candidate sites (i.e., meeting Ramsar criteria) in NZ total 103 at this stage and include many rivers, some of which are already protected through WCOs and/or terrestrial reserves and other protected areas. New Zealand embarked on a *Waters of National Importance* project in 2003, with a stated objective to protect: 'water bodies with nationally significant natural, social and cultural heritage values'. A major study (Chadderton *et al*. 2004) has identified nationally significant rivers for biodiversity protection. This study has, as yet, no Australian equivalent.

The European Union has recently promoted freshwater ecosystem protection as a component of its wide-ranging 'water framework directive' and 'water initiative'[10] programs, which complement the earlier *Conservation of Natural Habitats and Wild Fauna and Flora Directive* 1992[11]. It is too early to judge the success of these endeavours (which rely heavily on river basin management for improved water quality) but they seem likely to re-enforce commitments within the *Convention on Biological Diversity 1992* towards the protection of 'comprehensive, adequate and representative' aquatic ecosystems (Conference of the Parties 2004).

Australian freshwater ecosystems

Australia is the driest inhabited continent, and southern river systems have been extensively degraded by water extraction and regulation, and by other forms of habitat destruction (Arthington and Pusey 2003; Kingsford 2000; Kingsford and Thomas 2004). The National Audit reports 2001 show extensive and continuing degradation of Australia's rivers and

estuaries. Many major river systems are in a state of ecological crisis, and their inhabitants – like the iconic Murray Cod[12], colonial waterbirds, floodplain eucalypts, and Tasmania's Giant Freshwater Crayfish[13] – are in decline. Increased protection for the ecosystems of Australia's rivers – and lakes, wetlands, springs, subterranean ecosystems and estuaries – is long overdue[14].

Climate change is also an issue which needs consideration during the process of protected area network development. Apart from temperatures, rainfall patterns are also changing (Pittock 2003). In the southwest of Western Australia, rainfall over the last three decades has been around 15% lower than historic long-term trends[15], and in some catchments this has translated into a 20-30% decline in surface runoff. Further declines are predicted – according to Berti *et al*. (2004): "… an 11% reduction in annual rainfall by the middle of this century could likely result in a 31% reduction in annual water yield." Where surface waters have already been over-committed to extractive use (through binding water licence entitlements) river ecosystems are placed under extreme pressure. Massive damage to freshwater ecosystems in areas of declining rainfall and high existing extractions, such as the Murray-Darling River, is almost inevitable[16], unless governments undertake licence buy-back to supply adequate environmental flows.

An increase in the severity and frequency of extreme events, floods and especially droughts, is also predicted (Pittock 2003) – an increase that will severely strain current water management and biota conservation practices. Overall, the distribution of species is likely to change, and where species movements are constrained, extinction is a possibility. This may be an issue of considerable concern for small localised endemic populations (freshwater molluscs, for example). Precautionary redundancy in reserve design is likewise an important and related issue.

Of special concern are those ecosystems typically supporting short-range endemic taxa (e.g., groundwater systems and mound springs). Australian subterranean aquatic ecosystems and other groundwater-dependent ecosystems (GDEs) have been largely neglected by scientists and by planning frameworks. Biodiversity in some Western Australian aquifers is high by world standards (Humphreys and Harvey 2001). The stygofauna of the limestone and calcrete 'underground wetlands' of the western half of Australia are little known outside the specialist scientific group who study them, despite their fascinating links to our long geological history as both evolutionary and distributional relicts. Many species are confined to a single cave system or karst area (Eberhard and Humphreys, 2003).

Existing water planning, land use planning, and development assessment frameworks are not providing adequate protection for Australia's freshwater ecosystems (Morton *et al.* 2002, Nevill 2001, Wentworth Group 2002, 2003).

There is still much scope for improving water resource management at the State level (Kingsford *et al.* 2005). Apart from the issues of over-allocation[17] of water to extractive use, protected areas, and alien species, the most serious concern is a failure (principally on the part of State governments) to effectively control the cumulative effects of incremental water infrastructure development - particularly farm dams, levee banks, agricultural drainage[18], extraction of groundwater and surface water, and GDE matrix removal[19] (Nevill 2003, see also 'comprehensive water accounts' in Wentworth Group 2003). Nevill proposed five key management principles which, while often accepted, are seldom applied in practice. Even for new developments, there is little evidence of the application of the precautionary principle, although all governments are committed to it on paper (Coffey 2001; Stein 1999).

Australian flood-plain graziers, fishers, hunters, indigenous groups and conservationists generally support river and wetland protection. However they are often suspicious of each other's motives, with the result that (to date) there has been no united voice for protection which can be clearly heard at the level of national politics. Threats are compounded in Australia by the relative scarcity of freshwaters and the low commercial value placed on their biota in comparison with other continents – making the development of a strong 'river protection' constituency more difficult than in other countries such as New Zealand or Canada.

Overview of aquatic protected areas in Australia

The history of freshwater protected areas in Australia is, in large part, a story of good intentions not carried through. There is a plethora of different conservation tools that can be used – but have largely remained under-utilised (Kingsford *et al.* 2005, Nevill and Phillips 2004:ss.1.5 & 7).

Australia's three-tiered government system places most resource management responsibilities in the hands of the eight States and Territories (hereafter referred to as 'States'). The Australian (Commonwealth) Government is responsible for international treaty obligations, and consequently seeks the cooperation of the States as well as local government (where most land use planning responsibilities lie) – and, where they exist, regional resource management planning bodies[20]. The Australian government can establish protected areas on Commonwealth land, and can encourage or require limited protective action from the States where values of national importance are threatened (Nevill and Phillips 2004:s.6.1).

Australia signed the international Ramsar Convention on Wetlands in 1971, which requires the conservation and 'wise use' of all wetland types – which, under the Ramsar definition of 'wetlands', includes rivers and groundwater ecosystems. After 34 years, few Australian rivers[21] have been directly protected under Ramsar provisions, although some have been listed in the *Directory of Important Wetlands in Australia* (DIWA) (DEH 2001). The DIWA contains State-by-State lists of nationally (and internationally) important wetlands, including Australia's 64 Ramsar-listed wetlands[22].

Australia's obligations under the Ramsar convention include the preparation of ecosystem inventories. Although none of the State-wide inventories are comprehensive in the sense of containing up-to-date information on value and condition, work is progressing slowly. New South Wales has digital coverage of all wetlands (including floodplains) and their protective status (Kingsford *et al.* 2004). Victoria, Tasmania and the Australian Capital Territory also have reasonably good State-wide inventories of wetlands, with floodplains variously mapped. Other jurisdictions are preparing State inventories, apart from Western Australia and the Northern Territory where the focus is on regional inventories (Nevill and Phillips 2004). Queensland has embarked on the most comprehensive inventory yet attempted in Australia.

State governments have listed[23] some wetlands as Ramsar sites or (more often) included them within the DIWA. Ramsar sites receive limited protection under the Commonwealth's *Environment and Biodiversity Protection Act 1999,* as well as some State legislation such as Victoria's *State Environment Protection Policy (Waters of Victoria) 2003.* DIWA listing constitutes a referral trigger in Queensland's *Integrated Planning Act 1997*[24]*.* While the DIWA itself is not formally linked to any Commonwealth or State protection policies other than in Queensland, it is taken into account by many local government and regional resource planning bodies in making land use planning decisions. However, it does not yet include rivers or underground ecosystems in a comprehensive way, despite the Ramsar Secretariat's broad 'wetland' definition.

The most comprehensive data analyses in New South Wales (NSW) show that about 0.8% of wetland area is listed under Ramsar[25], 3% lies within terrestrial protected areas, and 20.7% is listed in the DIWA (Kingsford *et al.* 2004). A similar situation may be expected in other States. By far the bulk of wetlands lie outside formal protective frameworks, thus relying on State government provisions for 'sympathetic' management – largely within land and water planning mechanisms. Here serious problems in the delivery of environmental flows need to be addressed[26] (Ladson and Finlayson 2004).

Several discharge springs from the Great Artesian Basin (GAB) as well as four other aquatic ecosystems[27] are listed as 'threatened ecological communities' under the EPBC Act – another protective mechanism albeit not very effective at present. While in theory the EPBC Act can protect against major new developments that may constitute a threat to an area's values, it cannot force proactive biodiversity management, nor can it control a multitude of small widespread activities draining water flows from a site. Many GAB springs, known to

include endemics (Ponder 2004) are already extinct as a result of drawdown resulting from over-use of artesian water[28]. Failure to effectively control the cumulative effects of incremental water development is causing major problems for biological reserves worldwide (Pringle 2001).

Australia's existing reserve system has some profound achievements (particularly with respect to the protection of terrestrial biodiversity) but inherent limitations now demand new approaches to ensure adequate representation of freshwater ecosystems. While some reserves in Australia were created to protect lakes and wetlands and also a few rivers (e.g., Shannon River National Park, and Prince Regent River Nature Reserve in WA), these areas constitute only a small proportion of the total protected area estate. An additional limitation is that many terrestrial protected areas provide little protection to enclosed freshwater ecosystems – for example from hydroelectric regulation, beyond-boundary water diversion, or recreational fishing (including the introduction of alien fish such as trout). These are all issues identified more than 20 years ago (Lake 1978). For example in Kosciusko National Park, rivers or creeks are not protected, with the result that the Snowy Mountains Hydroelectric Scheme damaged seven major rivers and left only two medium-sized rivers unregulated[29]. The Menindee Lakes within Kinchega National Park are similarly not protected, except when they have no water in them. Another similar situation applies to Tasmania's Southwest World Heritage Area.

We are not protecting all of our most important aquatic ecosystems. Certainly the existing reserve system includes some important freshwater areas (e.g., Ramsar sites) and other freshwater ecosystems are contained within large terrestrial reserves (Nevill 2005a). However the reserve system has not been created with the benefit of a systematic analysis of wetland types, and *little published information is available on the extent to which representative freshwater ecosystems are protected within existing reserves***.** Here it is worth noting the exception of studies such as those in the Wimmera[30] and northern Victoria (Fitzsimons and Robertson 2003, Robertson and Fitzsimons in press) and in NSW where there is an analysis of the conservation status for broad wetland types (Kingsford *et al.* 2004). A comprehensive assessment would identify the original[31] extent of different ecosystem types at a finer level, their current extent, and the degree to which they are now protected (Fitzsimons and Robertson 2005). The methodology for such studies is well established as similar investigations were undertaken for forest ecosystems some years ago, as part of the Regional Forests Agreement (RFA) process[32].

Bioregions: issues of representation

Australia's existing terrestrial bioregionalisation does not provide a detailed guide for freshwater ecosystem protection. Wells and Newall (1997) found that the terrestrial *Interim Bioregionalisation of Australia* (IBRA) was 'not effective in representing aquatic ecosystem patterns across Victoria', and suggested an approach to delineating aquatic bioregions based partly on physical and biological data, and partly on expert opinion. It is possible to develop aquatic bioregions – for example, aquatic ecoregions exist for North America (Abell *et al.* 2000, 2002).

The biodiversity elements that would underpin a freshwater bioregionalisation would be different from, and would not necessarily have the same boundaries as those used in the existing terrestrial bioregionalisation. In addition, freshwater systems are by their nature more connected than terrestrial systems. The connections are largely linear and directional, whereas terrestrial connections tend to be non-linear and weakly directional. Selecting priority sites for freshwater protected areas needs to accommodate these, and other, unique aspects of freshwater biodiversity, ecology, and system function. The need to develop agreed surrogates[33] and units to map and measure freshwater biodiversity is an important related issue (Robertson and Fitzsimons 2004). Issues of ecosystem process and scale need to be taken into account, particularly when selecting taxa[34] as biodiversity surrogates.

Development of an 'interim freshwater bioregionalisation of Australia' is an important step in the processes of objective conservation assessment (Kingsford *et al.* 2005; Tait *et al.* 2002; Tait 2004;). Such a regionalisation would provide a platform for a national conservation status assessment of freshwater ecosystem types (Kingsford *et al.* 2005). Systematic

conservation planning approaches will need to be modified to take account of the connected nature of rivers[35] in particular. The identification of Australian freshwater biodiversity hotspots is also important, and is now proceeding.

State programs

All States are, in theory at least, committed to the establishment of systems of protected areas which contain representative examples of *all* major ecosystem types, including aquatic ecosystems. Victoria[36] holds the earliest of these commitments (1987) and South Australia the most recent (2003) (Nevill and Phillips 2004). Such programs are in line with Australia's obligations under the *World Charter for Nature 1982* (a resolution of the United Nations General Assembly) and the *Convention on Biological Diversity 1992*. However, it is the *timing* which is at issue – there have been extended delays in implementing policy. With respect to freshwater protected areas, these obligations have not yet been carried through in a systematic way in any Australian jurisdiction other than the Australian Capital Territory[37].

Protection measures for entire rivers can be devised, but are poorly implemented in Australia. The Victorian government identified 15 'representative rivers' for protection in 1992; 13 years later, four of these rivers remain without management plans (Nevill and Phillips 2004). Victoria passed a *Heritage Rivers Act* in 1992, nominating 18 rivers and 25 'natural catchments'[38] to be protected[39]. The Act established a management sequence: (a) preparation of draft management plans, (b) public comment and review, (c) ministerial endorsement of the plans, and (d) implementation. Draft management plans for these 18 rivers were published for stakeholder comment in 1997. However, after 8 years, all river management plans remain as drafts without the required ministerial endorsement (Nevill and Phillips 2004) in spite of a government commitment to have them complete by 1998[40].

Several States have legislation in place aimed specifically at the protection of threatened species and ecological communities; however the area-protection provisions of these statutes have rarely been used to protect freshwater environments[41]. The 'critical habitat' provisions of Victoria's *Flora and Fauna Guarantee Act 1988*, for example, have not yet been used to protect freshwater habitats (Nevill and Phillips 2004). It is however worth noting that Victoria is the only State so far to extend the concept of 'no net loss' to 'net gain' in relation to developments impacting on important areas of native vegetation – including wetland vegetation (Nevill and Phillips 2004:A3.15).

In line with the international *Code of Conduct for Responsible Fisheries* (FAO 1995:6.8) Queensland, New South Wales, Victoria, South Australia and Tasmania all have fisheries legislation providing for the establishment of aquatic protected areas. However (in spite of progress in the marine environment) none of these provisions have been used to protect freshwaters (Nevill and Phillips 2004).

Both Western Australia and New South Wales considered legislation similar to Victoria's *Heritage Rivers Act 1992*, but there was inadequate parliamentary support in the face of opposition by farmer and fisher groups. Western Australia developed a *Wetlands Conservation Policy* in 1997 which covered rivers using the Ramsar definition; however, seven years later, the protective provisions foreshadowed in this policy have not yet been put in place in a comprehensive way (Nevill and Phillips 2004). In the mid-1990s New South Wales amended the *National Parks and Wildlife Act 1974* to provide for the declaration of 'wild rivers'. A discussion paper was prepared by the NSW National Parks and Wildlife Service in 2004 on the Act's wild river provisions (Kingsford *et al.* 2005) and in December 2005 the NSW Government announced the listing of five rivers within existing terrestrial protected areas (Nevill 2005a).

The Queensland Government started work on a rivers policy in 2000, which developed into a commitment to provide legislative protection for wild rivers. Nineteen rivers were proposed for consideration in 2004, and a policy implementation paper was provided to stakeholders. The *Wild Rivers Act 2005* came into effect on 14 October 2005; it is to be hoped that wild river declarations under this statute will be fully implemented and effective. The recent history of native vegetation protection legislation in several States[42], as well as Victoria's

Heritage Rivers Act, has indicated that effective implementation can be a major stumbling-block.

South Australia and the Northern Territory (NT) both have government policy statements committing to the protection of representative examples of all major freshwater ecosystems, however at this stage neither jurisdiction has funded a program to carry these commitments through in a systematic way (Nevill and Phillips 2004). The NT's draft *Parks and Conservation Masterplan* 2005 reinforces earlier commitments.

In the NT, as in northern Queensland and Western Australia, significant areas of land (around 50% in the case of the NT) are under the custodianship of Indigenous groups. The Commonwealth's long-standing Indigenous Protected Area (IPA) program has achieved successes, and could be extended to assist Indigenous groups protect freshwater ecosystems. The recent Tropical Rivers Program (a Commonwealth initiative under Land and Water Australia) is providing increased knowledge of tropical freshwater ecosystems and measures needed to protect them .

Tasmania's *Nature Conservation Strategy 2000* and the subsequent *State Water Development Plan* established a commitment to develop comprehensive protection for all freshwater ecosystem values, and so far the program is moving in a systematic way. The Conservation of Freshwater Ecosystem Values (CFEV) Project has undertaken the design phase of this work, which, when completed, will establish the scientific basis for the identification and selection of freshwater protected areas across the State, as well as providing information for regional natural resource planning initiatives. The CFEV project is expected to produce its final report in late 2005. No specific funds were allocated for project implementation in the 2005/6 State budget, in spite of the fact that the project is expected to identify priority sites for protection. The above discussion indicates that excellent scientific preparation and good policy development do not guarantee effective implementation.

Conclusion

There are solutions. Techniques are available for managing highly connected linear reserves (Saunders *et al.* 2002). There are a variety of under-utilised 'conservation tools' for protecting and managing Australia's aquatic ecosystems, including environmental flows, protected areas, natural resource management plans and landholder incentives (Kingsford *et al.* 2005, Whitten *et al.* 2002). Australia should implement existing State policies to establish systems of representative protected areas for freshwater ecosystems, in line with our international commitments under the *Convention on Biological Diversity 1992* (Dunn 2000; Georges and Cottingham 2001; Nevill 2001). Furthermore:

a) Major rivers where ecosystems remain substantially intact should be protected (Morton *et al.* 2002; Wentworth Group 2002, 2003). Models of protection have been proposed. These include the establishment of a four-tiered river classification, including 'heritage rivers' and 'conservation rivers' which would both receive special protection (Cullen 2002; Wentworth Group 2003). There is potential for introducing an Australian Heritage River system loosely based on the *Canadian Heritage River System* (Kingsford *et al.* 2005). Already some whole catchments receive protection from specific agreements (e.g., Lake Eyre Basin Agreement; Paroo River Agreement). The inclusion of rivers within the Ramsar framework could also be promoted (Nevill and Phillips 2004).
b) The 2004 Sydney *Conference on Freshwater Protected Areas* (WWF Australia and the Inland Rivers Network) recommended that all Australian jurisdictions accelerate the development of freshwater protected areas.
c) Ecosystem inventories also need accelerated development, partly to underpin protected area identification and selection, and partly to support 'sympathetic' management of biodiversity values within regional resource planning frameworks. Classification and mapping techniques must be used thoughtfully in reserve design and selection (Fitzsimons and Robertson 2005) to ensure an adequate CAR protected area system. Inventories should be constructed to support a variety of classification methods (Blackman *et al.* 1992; Finlayson *et al.* 2002; Ramsar Secretariat 2002[43]).

d) The control of cumulative effects, particularly within catchment-scale management, needs much greater attention (Collares-Pereira and Cowx 2004; Nevill 2003; Pringle 2001). The precautionary approach, generally accepted but not applied, needs strong support especially where high conservation values remain intact.
e) The rehabilitation[44] of significant aquatic sites should remain a priority (Koehn and Brierley 2000, Rutherfurd *et al.* 2000).
f) Stakeholders with common interests need to start building consensus and raising awareness. Adequate stakeholder consultation in the selection of protected areas is essential to allow for the inclusion of local and regional values, and to build community support for protected area programs and the wider sympathetic management of utilized ecosystems (Kingsford *et al.* 2005).

The National Reserve System (NRS) *Directions Statement* (NRMMC 2005) signalled a new emphasis on freshwater ecosystems (Direction 7): *'Review the current understanding of freshwater biodiversity in relation to the NRS CAR [comprehensive, adequate and representative] reserve system, and finalise an agreed approach, which may include future amendments of the NRS Guidelines, to ensure freshwater ecosystems are appropriately incorporated within the NRS.'* This initiative needs strong support, as does the Murray Darling Basin Commission native fish strategy (MDBMC 2003).

The need to establish comprehensive and representative freshwater protected areas is urgent, given increasing concerns about limited water availability for Australia's cities, industries and agriculture - and the ongoing degradation of aquatic ecosystems. This should be accompanied by effective land and water management that pays more than lip service to the environmental requirements of aquatic ecosystems. State governments should act with the support and collaboration of the Commonwealth.

The most urgent initiative appears to be a national reserve system 'gap analysis' which would identify those ecosystems most at risk. A comprehensive national assessment of the conservation status of freshwater ecosystems should be undertaken immediately[45]. Such a study would provide a platform for the systematic expansion of the nation's freshwater protected areas, as well as a catalyst for innovative 'bottom-up' conservation approaches driven by local stakeholders. This could include establishment of an Australian Heritage River system, coordinated by governments, and supported by regional communities.

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Endnotes:

[1] . 'Freshwater' is a commonly used keyword for current literature dealing with inland aquatic ecosystem management.
[2] see also: Master et al. 1998, Harrison & Stiassny 1999, Ricciardi & Rasmussen 1999, Myers & Knoll 2001[2], Cowx 2002, Barmuta 2003, MEA 2005.
[3] The critical nature of the biodiversity crisis facing the planet was acknowledged when representatives of 190 countries at the 2002 Johannesburg World Summit on Sustainable Development committed themselves to "…achieving by 2010 a significant reduction of the current rate of biodiversity loss at global, regional and national levels…" UN (2002) Key outcomes from the Summit, UN, New York. See also UNEP, "Report on the Sixth Meeting of the Conference of the Parties to the Convention on Biological Diversity (UNEP/CBD/COP/6/20/Part 2) Strategic Plan Decision VI/26" (CBD 2002); overview available at http://www.biodiv.org/2010-target/default.asp (accessed 20/8/2005).
[4] These two core concepts of biodiversity conservation have been enunciated in several major international statements apart from the CBD, including the Stockholm Declaration 1972, the World Charter for Nature 1982, the Rio Declaration 1992 and the Johannesburg Declaration 2002. Further detail may be found in Declaration implementation statements. In the Australian context they are contained in Principle 8 of Commonwealth of Australia 1996.
[5] The literature assessing the effects of freshwater protected areas suggests that the size of the protected area, and the management of the surrounding catchment are critical factors in the success of such areas in protecting biodiversity. Judging by the scant available literature, some groups of biota, such as fishes, in general do not appear to have derived significant benefit from existing protected areas (Nevill 2005b). Less mobile biota are likely to have faired better, however.
[6] The ubiquitous use of 12-month accounting cycles (based on readily measurable financial attributes and current interest/discount rates) under-values the importance of ecosystem services, which in many cases are difficult to calculate, and depend on ecosystem processes operating on time-scales of decades or centuries. Where they are calculated, long term ecosystem service benefits are systematically undervalued by the use of standard discount-rate accounting procedures (Goulder & Stavins 2002). Attempts to measure the value of long-term ecosystem services accurately often show that the conservation of natural ecosystems yields higher overall benefits than their destruction for short term gains (see the examples discussed in MEA 2005 p.39, and Balmford et al. 2002). An overview of recent literature on the effects of freshwater protected areas (Nevill 2005b) suggests that benefits depend substantially on both reserve size and complementary management of the surrounding catchment beyond the reserve boundaries, as well as the size and mobility of conserved target species. Small reserves in poorly managed catchments are likely to be of limited value.
[7] Including major salinity mitigation functions.
[8] Refer: http://www.ramsar.org/key_guide_list_e.htm, accessed 20/4/05.
[9] Refer: http://www.ramsar.org/key_criteria.htm, accessed 20/4/05.
[10] See http://europa.eu.int/comm/research/water-initiative/index_en.html, accessed 30/4/05.
[11] See http://europa.eu.int/comm/environment/water/water-framework/index_en.html, accessed 30/4/05. Note however that the European Council Directive 92/43/EEC (21.5.92) *Conservation of Natural Habitats and Wild Fauna and Flora* does *not* require the *comprehensive* protection of *representative* ecosystems. This Directive precedes national commitments to the Convention on Biological Diversity 1992, which would thus appear to require a expansion of the scope of the Natura 2000 programs currently funded under the older EC Directives. Cowx & Collares-Periera recommend an extension of the Natura 2000 programs (2002:448).
[12] *Maccullochella peeli.*
[13] *Astacopsis gouldi.*

[14] [14] Calls such as those by Pollard & Scott (1966) and Lake (1978) for the protection of Australia's freshwater ecosystems continue to be ignored. Lake wrote in 1978: "…the conservation of rivers in Australia needs urgent and effective treatment".
[15] Indian Ocean Climate Initiative: http://www.ioci.org.au/what/index.html.
[16] Changes brought about by agricultural or rural-residential landuse can create dramatic change to catchment hydrology – with the ability to magnify reductions in streamflow caused by climate change. The growth of farm dams, groundwater bores, land-levelling, or significant planting of fast-growing deep-rooted vegetation within a catchment (for example) can hugely reduce runoff to streams – the water is simply diverted (and ultimately transpired) before it can appear as streamflow (see pp. 305-317 of David Ingle Smith (1998) "Water in Australia" Oxford University Press, Oxford, for a discussion of these effects). Landuse can have other important effects – soil porosity in an undisturbed native forest can be much higher than that of adjacent land which has been ploughed, planted and cropped – thus encouraging surface groundwater uptake. Across southern Australia, rivers feed from surface groundwater most of the time. Extensive forest can alter meteorological surface roughness, creating direct impacts on local climate (Pitman et al. 2004).
[17] "Over-allocation" refers to the over-allocation of available water supplies by State water management agencies (see Nevill & Phillips 2004 section 4.2.1). Both surface waters and groundwaters have often been over-allocated and used with excessive waste, a legacy which remains a major ongoing problem over much of Australia.
[18] Agricultural drainage includes drainage of wetlands and their surrounds, as well as land levelling and reshaping.
[19] Groundwater dependent ecosystem (GDE) matrix removal includes, for example, the extraction of river gravels and groundwater calcretes.
[20] Including, in some jurisdictions, formal or informal integrated catchment planning groups (Maher, Nevill & Nichols 2002).
[21] Australia has hundreds of rivers, but only a handful are well protected (Nevill 2005a). The largest Ramsar-listed river is the South Alligator River in the Northern Territory, where 91% of the river catchment lies within the Kakadu National Park and associated Ramsar site. Within the Murray-Darling Basin, the Ramsar sites on rivers such as the Paroo and the Murray provide a measure of legal protection against new deleterious developments, and form five of the six 'significant ecological assets' that underpin the Murray Darling Basin Commission's *Living Murray Initiative* action program to restore some measure of environmental health to the Murray River system.
[22] Australia's 64 Ramsar sites (2004) are viewed as 'internationally significant' and cover a total of approximately 7.3 million hectares. More info: http://www.deh.gov.au.
[23] Strictly speaking, State governments do not 'list' Ramsar sites. While in practice State governments recommend areas to the Commonwealth Government, who then recommends listing to the Ramsar Secretariat, this is the result of the Commonwealth's policy of bilateral cooperation. Legally the only role of State governments (under the EPBC Act) is to be consulted by the Australian Government on proposed listings. Only the Australian Government can 'declare' Ramsar sites which the Ramsar Secretariat then lists.
[24] See Schedule 8 of the *Integrated Planning Regulations 1998.*
[25] Most of the Ramsar areas are within State terrestrial protected areas. Note however that Ramsar wetland listing does not constitute 'protected area' status in its own right, other than through the provisions of the EPBC Act. A small number of Ramsar sites are declared over constructed wetlands not managed primarily for biodiversity conservation (e.g. the Western Sewage Treatment Plant at Werribee, Victoria).
[26] In some cases, agreed environmental flows have not been delivered as a direct result of poor management arrangements and inadequate State funding.
[27] The five listed freshwater *threatened ecological communities* (at the close of 2005) can be found at http://www.deh.gov.au/cgi-bin/sprat/public/publiclistchanges.pl. Apart from the GAB springs, the remaining four communities are lentic wetlands.
[28] Many GAB stock bores have a wastage rate of 90% or more (see http://www.gabcc.org.au/tools/getFile.aspx?tblContentItem&id=50, accessed 18/9/05).
[29] An additional complication is created by secrecy surrounding key management information. According to A/Prof Brian Finlayson (pers. comm. 13/5/05): "All the river gauging in the Kosciusko National Park is now done by the newly 'corporatised' Snowy Hydro and all

the data they collect are 'Commercial in Confidence' and they will not release it to anyone. So we have the situation where all the flow data for rivers in one of our major national parks (a 'protected area') is kept secret."

[30] The Wimmera lies in western Victoria.

[31] "Original" in this context means pre-European (prior to 1750).

[32] According to Pressey et al. (2004): "Recent Australian guidelines for expanding forest reserves [Commonwealth of Australia 1995; Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS) 1997] stipulated a baseline conservation target of 15% of the pre-European extent of each forest type. The guidelines also recognized that larger targets would be necessary for rare and/or threatened types and that reductions below the 15% baseline might be appropriate for extensive, secure types."

[33] Robertson and Fitzsimons (2004) found that different surrogates for the same ecosystem can produce very different results for measuring and mapping representation.

[34] O'Meally & Colgan (2005): "… single taxa are not usually good surrogates for the prediction of genetic value in other groups".

[35] Here "river" is defined as including headwater streams. The minor spring-fed tributaries of many coastal rivers contain significant invertebrate endemism – quite different and often arguably more significant than the rivers themselves (W. Ponder, pers. comm. 19/4/05, Meyer et al. 2003).

[36] Victoria was an early leader in respect to representative terrestrial ecosystem reservation, with its *Reference Areas Act 1978* and the program of systematic reservation commenced under the Land Conservation Council. Victoria's *State Conservation Strategy 1987* and its biodiversity strategy 1997 both contain commitments to the development of a fully representative reserve system. Although implementation problems have dogged freshwater protection under these policies, the commitments themselves were repeated again in the *Healthy Rivers Strategy 2003* (Nevill & Phillips 2004). There is a clear gap between rhetoric and reality in relation to freshwater ecosystem protection; nevertheless many significant wetland additions to Victoria's Nature Conservation Reserves have occurred through land purchases over the last decade (Fitzsimons et al. 2004).

[37] Conservation in the ACT has some unusual aspects, including the large proportion (~52%) of the total land area under some form of protected area management (Nevill & Phillips 2004, CAPAD 2000 database at www.deh.gov.au.)

[38] Largely headwater catchments already protected by large national parks or reservations within utilised forests.

[39] According to A/Prof Brian Finlayson (pers. comm. 13/5/05): "The Thomson River is a Heritage River yet the Victorian government apparently had no qualms about reducing the scientifically determined environmental flow allocation. The Thomson Expert Panel process recommended an environmental flow regime of 47 GL annually. The Task Force (made up of water managers and water users) eventually agreed to an environmental flow of 12 GL/yr initially rising to 25 GL/yr in 5-6 years. The fact that it was a Heritage River appeared to carry no weight in this decision and was not mentioned in the Task Force report." According to Jon Nevill: "The Thomson River feeds one of Melbourne's major water supply dams. Given that the Victorian Government has never reported on the management of Victoria's Heritage Rivers, there appears the possibility that the 13-year delay in implementing protective management is not an administrative oversight".

[40] Commonwealth of Australia (1999) National report of Australia for the seventh Ramsar Convention on Wetlands Conference of Parties CoP7; Department of Environment and Heritage; Canberra. http://www.ramsar.org/cop7/sop7_nr_australia.htm, accessed 20/11/05.

[41] It is worth noting that that Fisheries NSW has supported the declaration (as threatened) by the NSW Government of some species and aquatic communities in the Murray-Darling and Lochlin Rivers. Recovery plans will (hopefully) be developed and fully implemented in the near future.

[42] The substantial failure of the NSW government to enforce its native vegetation protection legislation was documented on the Australian Broadcasting Commission Radio National *Background Briefing* of 14/9/2003.

[43] See clause 37.

[44] River restoration must be planned and conducted within a catchment context (Lake 2005) and should be undertaken within a framework of adaptive management over a timeframe commensurate with the catchment's ecological processes (Palmer et al. 2005).
[45] Australia is not alone: such investigations are needed in other nations, and ideally should be carried out in such a way that data can be assimilated globally (Brooks et al. 2004:1090).