

**Senate Standing Committee on Environment and Communications  
Legislation Committee**

Answers to questions on notice

**Sustainability, Environment, Water, Population and Communities portfolio**

Supplementary Budget Estimates, October 2010

**Program: Division or Agency:** 4: NWC **Question No:** 59

**Broad Topic:** Kimberley groundwater projects

**Proof Hansard Page and Date** 41 (19/10/10)  
**or Written Question:**

**Senator Siewert asked:**

Senator SIEWERT—I have got questions that you may need to take on notice. One question that I specifically want to start with is this. It is in terms of the work you are doing on groundwater and the projects that you are doing. Are there any being done in the Kimberley, particularly the West Kimberley?

Mr Cameron—I would have to take that question on notice. We are doing a number of projects that have national relevance. For example, we have a project underway looking at the cumulative impacts of mining on groundwater, which obviously has relevance in areas with significant mining activities, so that would have some implications for the East Kimberley. I cannot answer as to whether we have specific projects that are focused on that region alone.

Senator SIEWERT—Could you take on notice the question about the West Kimberley. With regard to the projects on the impacts of mining, you mentioned East Kimberley but are they looking at the West Kimberley as well?

Mr Cameron—That is a project which is looking at better ways for water planners to manage and model the potential impacts of multiple mines in one area. In that sense it is a project with national application. We are undertaking some trials of the models which are developed in particular regions of the country, including one in Western Australia, but the project is intended to provide messages and information that will be useful for the country as a whole.

Senator SIEWERT—So it would not be providing recommendations about specific areas?

Mr Cameron—No.

Senator SIEWERT—When is that one due to be completed?

Mr Cameron—That project is expected to be completed early next year.

Senator SIEWERT—Just so I understand: there is no further work being done in the Kimberley, or do you have to take it on notice to check?

Mr Cameron—I will have to take that on notice to check.

**Answer:**

To date the Commission has funded the following projects in the western Kimberly region of Western Australia:

The *Fitzroy River Integrated Ground and Surface Water Hydrology Assessment* project, managed by the WA Department of Water (Attachment A)

Current hydrological and hydrogeological knowledge for the Fitzroy River is limited and this project will improve the knowledge of groundwater and surface water related to the Fitzroy River to support water management and planning. The project is expected to assist in developing

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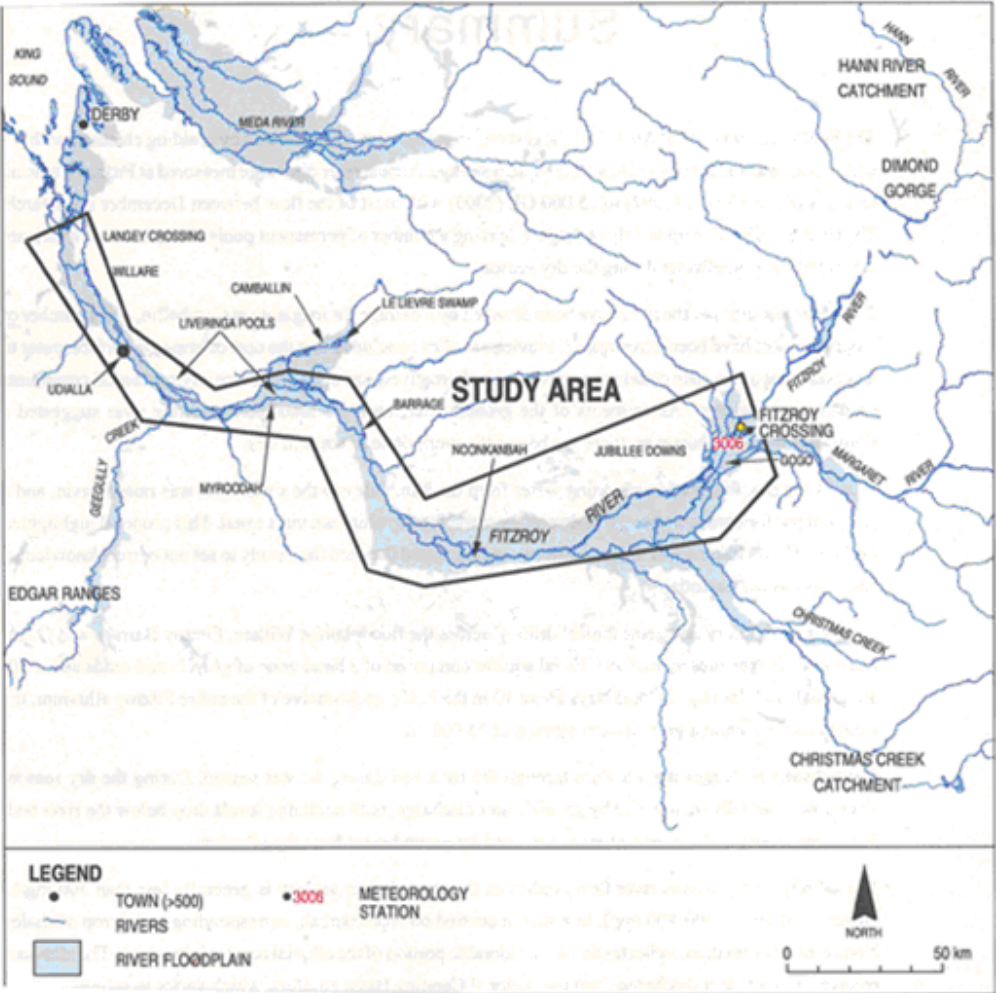
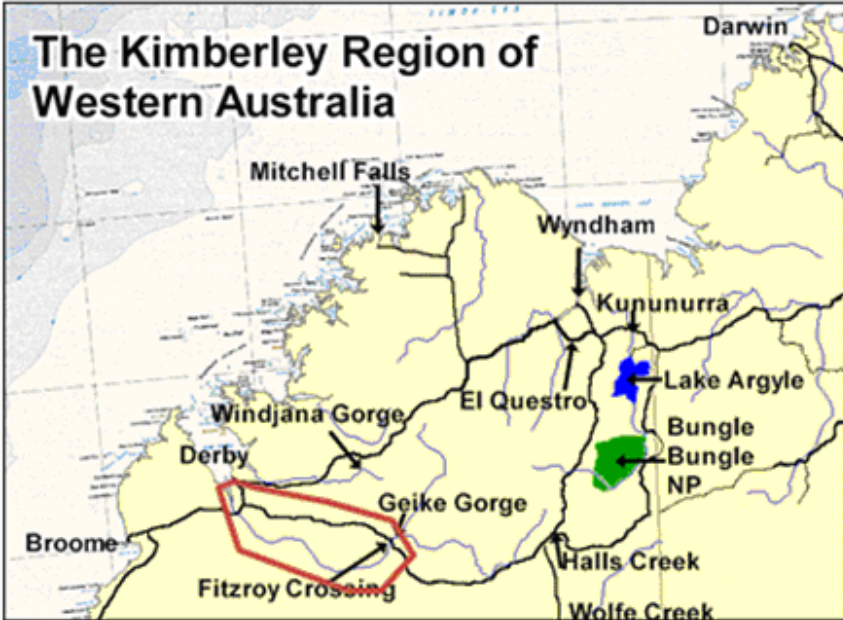
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partnerships and complement alliances already developed under the Tropical Rivers and Coastal Knowledge (TRACK). The results of this project will be released late 2011.

The Northern Australia Water Futures Assessment project *Water-related Socio-Cultural Values, Beliefs and Practices in Northern Australia*

One of the case studies for this project will focus on the groundwater systems of the Dampier Peninsula. It will provide social, cultural and economic analysis to support the assessment of competing values and uses for land and water use planning, catchment level water planning and local decision making. The mound springs on the Dampier Peninsula are places where the groundwater breaks the surface and are important cultural and ecological sites. The impact on the mound springs of development in the region, particularly in the communities of Beagle Bay and Ardyaloon, will be assessed.

Further details for each of these projects are available on the Commission's website:  
[www.nwc.gov.au](http://www.nwc.gov.au).



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**Sustainability, Environment, Water, Population and Communities portfolio**

Supplementary Budget Estimates, October 2010

**Program: Division or Agency:** 4: NWC **Question No:** 60

**Broad Topic:** Groundwater and surfacewater

**Proof Hansard Page and Date** Written Question  
**or Written Question:**

**Senator Joyce asked:**

1. Does the NWC's work on groundwater involve assessing the connectivity between groundwater and surfacewater? If so, what does your work show? What does your work show with particular reference to the Murray-Darling Basin?
2. What is the level of consistency in groundwater standards and groundwater regulations between the States?
3. Do any inconsistencies pose difficulties for the national management of groundwater resources?
4. Are the MDBA estimates in the Guide to the Basin Plan consistent with the findings in the NWC's "Surface and/or groundwater interception activities: initial estimates report"? Does the MDBA rely on sources that you do not or that are more up to date than yours?
5. The NWC's report is titled "initial estimates" how much more work do we need to do to come up with final estimates?

**Answer:**

1. The National Water Initiative (NWI) aims to ensure the economic and environmental sustainability of groundwater and surface water. To achieve this, the connectivity between surface water and groundwater must be taken into account.

The Commission assessed the progress being made in integrated management of connected groundwater and surface water by the NWI Parties, in its most recent Biennial Assessment, Australian Water Reform 2009. The relevant chapter (Chapter 2) details progress in each state and territory and is included at Attachment A.

In addition, the Commission is funding several projects involving the assessment of the connectivity between groundwater and surface water. All projects outlined below, except the Fitzroy River project, are relevant to the Murray-Darling Basin:

Mapping Potential Surface Water/Groundwater Connectivity across Australia (Expected completion – late 2011)

Interconnection of Surface and Groundwater Systems in New South Wales– River Losses from Losing/Disconnected Streams (Expected completion – first half 2011)

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Fitzroy River Integrated Ground and Surface Water Hydrology Assessment (Expected completion – late 2011)

A New Approach to Accounting for Groundwater Dependent Ecosystems (GDEs) and Surface Water Systems when Building Management Plans in Victoria (Expected completion – first half 2012)

Quantifying Surface Water / Groundwater Exchange using thermal and chemical measurements (Expected completion – late 2011)

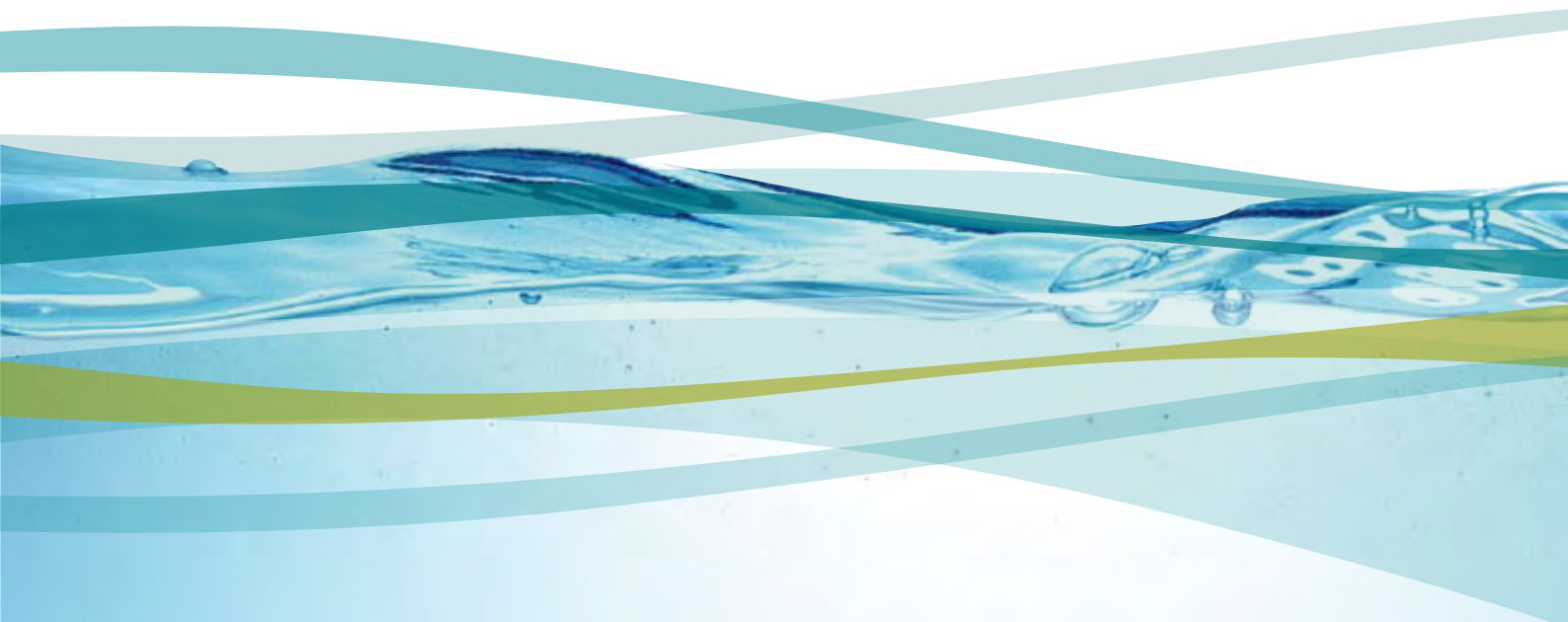
Groundwater/Surface Water Connectivity Guidelines (Completion – mid 2011)

- 2-3. Under the NWI, state and territory governments have committed to achieving a nationally compatible system of water resource management. The planning, management and accounting provisions of the NWI apply equally to groundwater and surface water resources. The detailed implementation of NWI commitments are a matter for state and territory governments, however, and will vary across jurisdictions.

The Commission has sought to facilitate improved compatibility in groundwater management across jurisdictions through a number of its Raising National Water Standards projects, including by supporting the development of nationally consistent standards on mapping, definitions and assessment.

4. The Commission does not have information regarding how the Murray Darling Basin Authority took account of this report in its work.
5. The report provides the first ever nation-wide baseline assessment of total unaccounted water use as a result of interception activities that have a significant effect on water resources: forestry plantations, stock and domestic activities, overland flows (floodplain harvesting) and farm dams.

Under the NWI, all Australian governments acknowledged that interception activities present a risk to the security of water access entitlements and the achievement of environmental water objectives. Governments committed to apply appropriate planning, management and regulatory measures to account for interception water use by 2011.



# 2

## Understanding surface and groundwater connectivity

## 2.1 Overview

The NWI aims to ensure the economic and environmental sustainability of groundwater and surface water. To achieve this, the connectivity between surface water and groundwater must be taken into account.

To date, the connections between surface water and groundwater have not always been recognised in water planning, management and use. Failure to manage connected surface and groundwater resources jointly has meant that water allocation decisions on one resource have affected the security of the connected resource.

Under the NWI, parties have agreed to recognise the connectivity between surface and groundwater resources and to manage connected systems as a single resource (NWI clause 23(x)).

**To mitigate the risks to the water resource, the Commission considers that unless and until it can be demonstrated otherwise, surface water and groundwater resources should be assumed to be connected, and water planning and management of the resources should be conjunctive. This is the reverse of the current situation.**

Such integrated water management should also include compatible charging regimes for groundwater and surface water, to prevent market distortions and inequities among water users.

It is anticipated that when NWI clause 23(x) has been achieved:

1. There will be a clear, evidence-based understanding of the **extent and significance of the connectivity** between surface water and groundwater resources.
2. Risks to connected resources will be **identified and managed** to mitigate the identified risk.
3. **Effective integrated planning, management and licensing arrangements** will be in place, in proportion to the degree of connectivity.
4. Integrated **monitoring, accounting, compliance and enforcement** arrangements will have been rolled out.
5. **Strong technical capacity will have been developed** to support integrated surface water – groundwater management.

The Commission considers that good progress is being made in each of the areas outlined above, but that there remains much to do to complete the identification and integrated management of connected surface water and groundwater resources across Australia.

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### Finding 2.1

The Commission finds that all jurisdictions have commenced assessments of connectivity, as required under the NWI. The Commission appreciates that each jurisdiction takes a different approach to assessment and management of its water resources, in line with its assessment of management needs. However, applying different thresholds of significance, and hence differing thresholds that trigger integrated management, risks undermining confidence in water planning and entitlements, particularly in areas where entitlements can be traded across borders.

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### Finding 2.2

All jurisdictions have now passed legislation, or in the case of Western Australia implemented planning processes, that recognise the potential connectivity of surface and groundwater resources and provide for their conjunctive planning and management.

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### Finding 2.3

Where plans have been developed, Queensland, New South Wales, South Australia, the Australian Capital Territory and the Northern Territory account for the potential connectivity of surface water and groundwater resources in the determination of the sustainable extraction limits. Other jurisdictions have commenced the development of plans that will set out integrated management arrangements.

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### Finding 2.4

All jurisdictions have made some progress in developing integrated management arrangements for some connected systems. However, the continuing slow progress in rolling out the enabling water plans, and failure to adequately address overallocation in some systems, are inhibiting widespread adoption of integrated surface water and groundwater management.

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### Recommendation 2.1

The Commission recommends that unless otherwise established, it should be assumed that all surface and groundwater systems are connected and that the eventual impact of groundwater pumping on surface water flow may be as high as 100%. This is the reverse of current practice.

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<b>Finding 2.5</b>	The quality of data on Australia's groundwater resources is particularly poor, and more resources need to be devoted to improving it. The quality of metering and monitoring of groundwater extractions is variable. The National Groundwater Action Plan is helping to improve the quality of data on groundwater resources.
<b>Recommendation 2.2</b>	<p>The Commission considers that ultimately all surface and groundwater extractions, including for stock and domestic purposes, should be licensed and metered or otherwise measured. However, the Commission also recognises the practical constraints to universal metering of groundwater extractions. The Commission therefore proposes that a risk-based approach be adopted, in which the following three criteria are given particular weight in determining metering priorities among different water systems as universal metering is rolled out:</p> <ol style="list-style-type: none"> <li>1) the level of water use in the system, with priority for systems at or approaching full allocation</li> <li>2) in the case of systems which are not at or approaching full allocation, the cost-effectiveness of metering investments (including benefits implicit in the acquisition of better water use data)</li> <li>3) the potential contribution of further metering to public confidence about compliance and the general quality of management of the given water system.</li> </ol> <p>Refer also to the Commission's Recommendation 3.5.</p>
<b>Recommendation 2.3</b>	The Commission recommends that, in helping redress the lack and quality of groundwater data available to support integrated management, it is important that the Bureau of Meteorology's emerging national water data and accounting systems treat surface water and groundwater data in an integrated fashion. The National Water Accounting Standards currently under development (Chapter 3) need to incorporate accounting for connected surface and groundwater systems from the outset.
<b>Finding 2.6</b>	There is currently a critical need for increased national expertise in groundwater assessment and management, and especially skills in assessment and management of connected systems. Progress is being made in this area through initiatives such as the National Centre for Groundwater Research and Training and the National Groundwater Action Plan.

## 2.2 Context for this assessment

Surface water resources have received more attention than groundwater resources in the development of water management arrangements, largely due to the higher levels of development of surface water resources. The lack of recognition of connectivity between surface water and groundwater resources is now a significant factor undermining confidence in the security of water access entitlements and water provided for the environment. An area of particular concern is the Murray–Darling Basin, where groundwater extractions have increased dramatically following the 1995 cap on surface water diversions. The Murray–Darling Basin Plan to be developed under the *Water Act 2007* will set a new sustainable diversion limit on the quantities of surface water and groundwater that may be taken from basin water resources.

The planning, management and accounting provisions of the NWI apply equally to groundwater and surface water resources. For example:

- + Addressing the overallocation and overuse of water resources, including groundwater, is the highest order priority, and is the crucial first step before effective water planning can be put in place.
- + The identification and assessment of the water needs of groundwater-dependent ecosystems need to be brought into the planning and allocation process, just as for surface water-dependent ecosystems.
- + Standardised rigorous water accounting applies no less to groundwater than to surface water.
- + Water management authorities should recover the cost of groundwater planning and management, just as they should for surface water resources.

Each of these matters is addressed substantively in other chapters of this assessment. This chapter focuses specifically on progress in identifying and integrating the management of connected surface water and groundwater resources.



The *Australian water resources 2005* report (NWC 2007a) found that 61 surface water management units and 121 groundwater management units had a draft or final management plan in place. Of these, 22% of the surface water plans gave some consideration to groundwater, while of the groundwater management plans, 65% referred to local surface water resources.

The 2007 Biennial Assessment (NWC 2007b) and 2008 Update (NWC 2008) found that there had been limited recognition in water plans of the connectivity between surface water and groundwater resources. Although jurisdictions usually had arrangements in place to manage groundwater, those arrangements did not amount to sophisticated, integrated management. The Commission concluded that significantly more effort was needed to build knowledge of groundwater resources and the capacity to manage them.

The National Water Commission's \$82 million National Groundwater Action Plan, which commenced in January 2008, is designed to address the serious knowledge and resource impediments that are hindering better management of Australia's groundwater resources, and to accelerate the implementation of the National Water Initiative. Better knowledge of groundwater – surface water connectivity is one of the thematic investment areas under the plan, and studies have now commenced across all jurisdictions.

At its March 2008 meeting, COAG commissioned the development of a comprehensive new water reform work program to address overallocation and improve environmental outcomes. This work program is seeking to, among other things, prioritise implementation of NWI commitments in relation to groundwater planning and management (WGCCW 2008).

In November 2008, Senator the Hon. Penny Wong, Minister for Climate Change and Water, released the report from the Murray–Darling Basin Sustainable Yields study (CSIRO 2008). The study concluded that, at current rates of development, by 2030 one-quarter of current groundwater use will be sourced directly from streamflow, equivalent to about 4% of current surface water diversions in the basin. The impact of connectivity, combined with declining water availability due to climate change, will significantly affect the security of water resources for consumptive and non-consumptive uses.

Based on this and other evidence, the Commission continues to see better joint management of connected surface and groundwater resources as an urgent reform priority.

## 2.3 The Commission's assessment and findings

### 2.3.1 Identifying the extent and significance of connectivity

#### **Background: Terminology and relevant National Water Initiative clauses**

Under the NWI, jurisdictions have accepted that 'there are significant knowledge and capacity building needs for [the Agreement's] ongoing implementation, including ... interaction between surface and groundwater components of the water cycle' (NWI clause 98).

A major impediment to the integrated management of surface water and groundwater at present is the relatively limited understanding of physical and temporal characteristics of specific groundwater resources and their connections to surface water.

Recognition and understanding of the nature of connectivity between surface water and groundwater resources is the crucial first step in preventing overuse and/or overallocation of the shared resource. Adopting appropriate management arrangements is dependent on sound appreciation of the location of the shared resource, the time over which impacts of connectivity occur, and the degree and significance of the connectivity.

Different approaches to assessing connectivity have been employed across Australia.

New South Wales, Queensland and South Australia have undertaken assessments of surface and groundwater connectivity.

Victoria, Western Australia and Tasmania have assessment processes in train. The Australian Capital Territory considers its surface water and groundwater systems to be fully connected. The Northern Territory recognises and is accounting for connectivity in its water allocation planning processes.

Queensland takes a risk management approach, using an assessment of the impacts of groundwater extraction on surface water flows.

In New South Wales, the physical extent of connectivity has been assessed in all groundwater plan areas (the Great Artesian Basin is the only plan area in which New South Wales considers there to be no connectivity).

All prescribed water resources in South Australia have been assessed for connectivity. For the majority of these resources, extraction has been assessed to be from confined aquifers, with little or no connectivity to surface water resources.

It is clear that jurisdictions each take different approaches to attributing the significance of connectivity. For example, significant connectivity is reported in the south-east of South Australia, while directly across the border in Victoria, moderate connectivity is found (NWC 2007a). New South Wales has found connectivity worthy of some form of management for all its groundwater resources (except the Great Artesian Basin), while Victoria reports that six water management areas have already been assessed as having low connectivity, and expects to find only two or three areas of significant connectivity.

The nature of connectivity can be complex. Although such geological complexity is by no means limited to Western Australia, Western Australia has initiated a review of the definition of 'interconnectivity', to take into account that aquifers can be layered over each other. The different separating layers range in permeability and therefore connectedness, and each individual layer changes over a geographical area to be more or less permeable in different locations. Western Australia has developed a number of large groundwater models, and some of its research in this area is world-leading. The significant expense of investigating and developing complex numerical modelling of deep and multilayered groundwater systems is being recognised through a review of potential cost-recovery methodologies.

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### ■ Finding 2.1

The Commission finds that all jurisdictions have at least commenced assessments of connectivity, as required under the NWI. The Commission appreciates that each jurisdiction takes a different approach to assessment and management of its water resources, in line with its assessment of management needs. However, applying different thresholds of significance, and hence differing thresholds that trigger integrated management, risks undermining confidence in water planning and entitlements, particularly in areas where entitlements can be traded across borders.

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Further details of the status of assessment of connectivity in each jurisdiction are provided in Section 2.3.2 and Table 6.

## 2.3.2 Integrated planning and management arrangements

### Background: Terminology and relevant National Water Initiative clauses

Under the NWI, jurisdictions have committed to 'establish effective and efficient management and institutional arrangements to ensure the achievement of the environmental and other public benefit outcomes, including: ... common arrangements in the case of significantly inter-connected groundwater and surface water systems' (NWI clause 79(i)(c)); and to 'identify by end 2005 situations where close interaction between groundwater aquifers and streamflow exist and implement by 2008 systems to integrate the accounting of groundwater and surface water use' (NWI clause 83).

Groundwater and surface water planning underpinned by the best available science should seek to recognise connectivity, and the subsequent management actions should be designed to optimise productive, environmental and public benefit outcomes for the shared resource. To protect the integrity of integrated plans into the future, the accounting of groundwater and surface water use should also be integrated.

The integration of surface and groundwater management is evolving, particularly in areas where groundwater extraction has already manifested itself as a major risk to the shared resource. Since the 2007 Biennial Assessment, some jurisdictions have developed water management plans—the primary mechanism for setting out integrated management arrangements—that provide for the management of surface and groundwater as a single resource.

The majority of jurisdictions recognise in their legislation or water management planning policy the potential for connectivity between surface and groundwater systems. However, the issue is frequently complicated by the fact that boundaries of water plans and groundwater management units are not congruent.

In its review of water-related legislation, the Commission found that the potential for connectivity between surface and groundwater resources is explicitly recognised in statute in Queensland, South Australia, Tasmania and Victoria. Water management plans that recognise the potential for connectivity have been developed in the Australian Capital Territory, New South Wales and the Northern Territory.

However, with the exception of the Commonwealth, no jurisdictions have an enforceable, explicit legislative requirement for the integrated management of connected systems.

**Table 6: Legislative provisions for the recognition and integrated management of surface water — groundwater connectivity**

Jurisdiction	Recognition of connectivity between surface water and groundwater	Integrated management mechanisms for surface water and groundwater
<b>ACT</b>	Surface and groundwater are defined in the <i>Water Resources Act 2007</i> but their connectivity is not explicitly recognised.	The <i>Water Resources Act 2007</i> allows for integrated management of groundwater and surface water. The ACT reports that all surface and groundwater resources are considered to be a single resource and are managed accordingly.
<b>NSW</b>	Surface and groundwater are defined in the <i>Water Management Act 2000</i> but their connectivity is not explicitly recognised.	The <i>Water Management Act 2000</i> provides for integrated management of surface and groundwater but does not require it. Its provisions on water planning and implementation apply to both surface and groundwater, and allow for plans to be developed incorporating both.
<b>NT</b>	Surface and groundwater are defined in the <i>Water Act</i> but their connectivity is not explicitly recognised	The <i>Water Act</i> provides for integrated management of surface and groundwater, but does not require it.
<b>Qld</b>	Surface and groundwater are defined in the <i>Water Act 2000</i> and their connectivity is explicitly recognised. A water resource plan for any area must regulate subartesian water if there is a risk that taking, or interfering with, subartesian water in the area may significantly impact on the plan's outcomes.	The <i>Water Act 2000</i> provides for the integrated management of surface and groundwater but does not require it. The Act allows for two plans to be in place for an area where one plan relates to artesian water. In drafting a plan relating to surface water, consideration must be given to the potential effects of the plan on water 'not covered by the plan', which could include subartesian and/or artesian water.
<b>SA</b>	Surface and groundwater are defined in the <i>Natural Resources Management Act 2004</i> and their connectivity is explicitly recognised.	The <i>Natural Resources Management Act 2004</i> provides for integrated management of surface and groundwater but does not require it.
<b>Tas.</b>	Surface and groundwater are defined in the <i>Water Management Act 1999</i> and their connectivity is explicitly recognised.	The <i>Water Management Act 1999</i> provides for water plans to cover a watercourse or watercourses, a lake, one or more groundwater resources or any combination of these, whether the water resources are joined naturally or artificially.
<b>Vic.</b>	Surface and groundwater are defined in the <i>Water Act 1999</i> and their connectivity is explicitly recognised.	The <i>Water Act 1999</i> provides for an integrated approach to management of surface and groundwater. Under the Act, a management plan may relate to groundwater resources, surface water resources or both, in the relevant water supply protection area.
<b>WA<sup>9</sup></b>	Surface and groundwater are defined in the <i>Rights in Water and Irrigation Act 1914</i> but their connectivity is not explicitly recognised.	Integrated management of surface and groundwater is not considered in the <i>Rights in Water and Irrigation Act 1914</i> . However, planning processes do take into account connectivity, and provide for integrated management.
<b>Commonwealth</b>	Surface and groundwater connectivity is explicitly recognised in the <i>Water Act 2007</i> .	Integrated management of entitlements must occur in connected systems.

9 Western Australia is currently drafting new water management legislation.

## ■ Finding 2.2

All jurisdictions have now passed legislation, or in the case of Western Australia implemented planning processes, that recognise the potential connectivity of surface and groundwater resources and provide for their conjunctive planning and management.

Jurisdictions' progress in identifying and managing connected surface water and groundwater resources is subject to assessment under NRMCC performance indicator 10.1 (see Box 6). The indicator is designed to reveal actions taken by the jurisdictions to identify areas of connectivity between surface and groundwater resources and whether water plans have subsequently been developed providing for integrated management of the connected systems. Jurisdictions' responses to this indicator are summarised in Table 7.

### **Box 6: NRMCC Indicator 10.1—Performance indicator for assessment and integrated management of connected surface and groundwater**

Proportion and spatial area within water plans:

- a) with no assessment of connectivity between surface and groundwater systems;
- b) that are assessed and have no connectivity between surface and groundwater systems;
- c) that identify interconnected surface and groundwater systems but do not have integrated management; or
- d) have integrated management for interconnected surface and groundwater systems.



Windmill pumping groundwater for stock in Australia

**Table 7: Reporting on Natural Resource Management Ministerial Council performance indicator for connectivity**

Jurisdiction	Indicator	Response
<b>ACT</b>	a) No assessment	All resources assessed
	b) Assessment, no connectivity	NA
	c) Connectivity, no integrated management	NA
	d) Connectivity, integrated management	Integrated management for all resources
<b>NSW</b>	a) No assessment	Connectivity assessed in all groundwater plan areas
	b) Assessment, no connectivity	Great Artesian Basin
	c) Connectivity, no integrated management	None—where connectivity assessed as high, integrated management is in place
	d) Connectivity, integrated management	Where connectivity is high, integrated plans will be developed. Where lower connectivity is assessed, separate surface water and groundwater plans are put in place, but provision is made in each plan to address connectivity
<b>NT</b>	a) No assessment	The completed plans in the territory have been fully assessed for connectivity. All current plans being developed include an assessment of connectivity.
	b) Assessment, no connectivity	
	c) Connectivity, no integrated management	
	d) Connectivity, integrated management	
<b>Qld</b>	a) No assessment	Statewide assessment of impacts of groundwater extraction on surface water flows completed
	b) Assessment, no connectivity	No advice
	c) Connectivity, no integrated management	Identified high-risk systems are dealt with through explicit integrated management. For other systems, integrated management is implicit, as modelling and assessments undertaken to develop plans account for connectivity.
	d) Connectivity, integrated management	
<b>SA</b>	a) No assessment	All 20 prescribed areas assessed
	b) Assessment, no connectivity	No connectivity in 11 prescribed areas
	c) Connectivity, no integrated management	Surface and groundwater have low levels of connectivity in five prescribed areas, and are managed separately
	d) Connectivity, integrated management	Four prescribed areas are subject to integrated management—base flow estimates for catchments considered when determining groundwater sustainable yield.

Jurisdiction	Indicator	Response
<b>Tas.</b>	a) No assessment	No assessments—investigations of connectivity at key sites within the state; development of a policy framework for integrated management of surface water and groundwater has recently commenced
	b) Assessment, no connectivity	
	c) Connectivity, no integrated management	
	d) Connectivity, integrated management	
<b>Vic.</b>	a) No assessment	Statewide assessment of connectivity underway. Expect two or three systems with a high degree of connectivity
	b) Assessment, no connectivity	
	c) Connectivity, no integrated management	Six management plans in place with assessment of low connectivity
	d) Connectivity, integrated management	One draft integrated management plan being developed (Upper Ovens)
<b>WA</b>	a) No assessment	No assessment data available. Planning for surface and groundwater systems is undertaken separately. However, planning processes do take into account connectivity between surface water and groundwater. Where planning for surface water and groundwater in an area is concurrent, then connectivity is considered and provisions will be put in place recognising that the system is connected.
	b) Assessment, no connectivity	
	c) Connectivity, no integrated management	
	d) Connectivity, integrated management	

The Commission considers that, by concentrating on the areas within water plans, the NRMCC indicators may not identify areas outside water plans with significant connectivity, or the actual implementation of integrated management arrangements. There may be significant local impacts on water users and the environment due to extraction in connected systems, which are not accounted for if the region does not have an active management plan. The usefulness of the indicator will increase as plans are implemented.

In jurisdictions where substantive integrated management has been occurring, it is common to find a management response hierarchy that sets out a systematic risk-based approach to dealing with different degrees of connectivity and different levels of resource development.

Queensland and New South Wales provide examples where integrated surface and groundwater plans are being developed.

In New South Wales, there are currently 45 water sharing plans gazetted or under development, and an intention to develop a further eight water sharing plans where surface and groundwater management will be combined. In the areas to be covered by macro water sharing plans, specific rules will be developed to deal with connectivity, such as those for the Hunter unregulated rivers and alluvials systems (Box 7). As integrated management in New South Wales is implemented through the water sharing plans, the Commission considers it urgent that current plans be reviewed and new plans be commenced and completed as a matter of priority, particularly in areas where connectivity is posing a high level of risk to the resource. New South Wales has indicated to the Commission that it considers the level of connectivity between rivers and the deep aquifers of major inland groundwater alluvial systems in New South Wales to be relatively limited.

### **Box 7: Integrated surface water – groundwater management—New South Wales Draft Hunter Unregulated Rivers and Alluvial Water Sharing Plan**

#### **Connectivity between groundwater and surface water has been established**

Based on an assessment of aquifer types and their connectivity, the decision was made to include the up-river alluvial aquifers with the Hunter Valley unregulated rivers in a single water sharing plan. The boundary between upstream and coastal alluvial aquifers has been pragmatically defined as the tidal limit.

The plan notes that all alluvial aquifers upstream of the tidal limit are significantly connected, while some subcatchments are highly connected with substantial alluvial aquifers, and others are less connected.

#### **Joint management of connected water sources is required**

- + Boundaries for application of river water rules to aquifer extraction are determined on a pragmatic basis rather than through detailed physical surveys and assessments.
- + All river and alluvial aquifer extraction is to be managed to a single long-term extraction limit.
- + The taking of water from alluvial aquifers that adjoin unregulated rivers will be governed by daily river flows.
- + Seasonal allocations of water from alluvial aquifers that adjoin regulated rivers will be linked to seasonal extraction allocations from the rivers.
- + Opportunity for conversion of licences between surface and groundwater is provided.
- + Opportunity for trade of groundwater licences subject to the same constraints as surface water licences in the same subcatchment is provided.

Queensland legislation provides for immediate intervention (such as a moratorium) where the impact of connectivity is seriously impacting on the resource. More commonly, connectivity is managed through the water planning process.

In developing water resource plans in Queensland, the impact of existing groundwater development is incorporated into the hydrological model for the water system as a whole. As the level of existing resource development is 'in-built' in the plan, it follows that regulating the further development of groundwater resources acts as a de facto means of managing the connected resource. However, such an approach is only appropriate for reasonably stable systems, where seasonal variations in groundwater extraction do not impact on streamflow. There remain a number of areas in Queensland with significant groundwater extractions, including the Condamine alluvium and Lockyer Valley, where the development of integrated water resource plans is only now commencing. Connectivity is less significant in the Condamine alluvium, where the prime issue is overallocation of the groundwater resource. Connectivity is a significant concern in the Lockyer Valley. Furthermore, the complex issue of potential conjunctive use of recycled water in the Lockyer Valley is yet to be settled.

South Australia has developed sound management principles for integrated management (Box 8). However, water allocation planning in South Australia needs to be completed before integrated management of connected resources can be put fully into operation.

### **Box 8: Integrated surface water – groundwater management—Management principles for connected systems, South Australia**

South Australia has in place principles for management of connected surface and groundwater systems.

- + Groundwater and surface water plans in physically and/or economically connected systems can be dealt with either through individual plans managed in an integrated way or through developing one integrated plan.
- + Planning, management and reporting boundaries are to be based on those for the dominant resource.
- + In high-risk areas, and until better processes become available, the relationship between groundwater extraction and surface water flow should be estimated by a panel of experts using best available information.
- + Where entitlements are to be issued or traded in a connected system, their impact on both elements of the resource must be taken into account on the basis of the determined relationship.
- + The work of [a nominated] expert group is to be supported by developing and utilising appropriate catchment models.
- + The relationship between groundwater extraction and surface water flow is to be refined at plan review, taking into account any new information or assessment techniques.

In Western Australia, as described earlier in this chapter, the nature of connectivity is complex. Single plans can apply to multiple layers of aquifer systems, to several kilometres in depth. Water plans need to address the connectivity between aquifer systems and through this manage the impact on surface expressions of groundwater, including wetlands and lakes as well as river systems. The plans need to manage the water users of the different aquifer layers and their potential impact on each other, and the cumulative effect of abstraction from all aquifers in an area on the water-dependent values at the surface.

Victoria and Tasmania are still in the process of identifying connectivity. An integrated plan for the Upper Ovens system is currently under development in Victoria. Tasmania has commenced development of the Wesley Vale Water Management Plan, which relates to a key groundwater usage area and will consider both surface and groundwater resources. The Northern Territory reports that it recognises and is accounting for connectivity in all water allocation planning processes.

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### ■ Finding 2.3

Where plans have been developed, Queensland, New South Wales, South Australia, the Australian Capital Territory and the Northern Territory account for the potential connectivity of surface water and groundwater resources in the determination of the sustainable extraction limits. Other jurisdictions have commenced the development of plans that will set out integrated management arrangements.

In line with the Commonwealth *Water Act 2007*, the Murray–Darling Basin Authority is currently preparing a basin-wide plan for the Murray–Darling Basin. It is intended that the Basin Plan, due to commence in 2011, will set out environmentally sustainable limits on the quantities of surface water and groundwater that may be taken from basin water resources (excluding the Great Artesian Basin, which is not defined as part of Basin water resources under the *Water Act*, and is managed through a separate process). While the provisions of the *Water Act 2007* are consistent with the NWI Agreement, it is too soon to assess the extent to which the Basin Plan meets this requirement. However, the Commission is encouraged that the Basin Plan offers a historic opportunity to require basin jurisdictions to accelerate and harmonise their treatment of groundwater and surface water connectivity in individual basin water plans.

Until then, while progress is being made in integrating the management of connected water resources, the continuing slow progress in developing water plans generally (Chapter 1), and addressing overallocation (Chapter 5), are inhibiting the broad application of integrated management.

The Commission considers that all jurisdictions need to immediately return overallocated and/or overused groundwater systems to sustainable levels of extraction as the essential precursor to effective integrated management of connected resources. Priority should also be given to completing water plans in areas that have a high level of connectivity to ensure that the impacts of extraction on other water users and the environment are effectively managed.

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### ■ Finding 2.4

All jurisdictions have made some progress in developing integrated management arrangements for some connected systems. However, the continuing slow progress in rolling out the enabling water plans, and failure to adequately address overallocation in some systems, are inhibiting widespread adoption of integrated surface water and groundwater management.

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### ■ Recommendation 2.1

The Commission recommends that unless otherwise established, it should be assumed that all surface and groundwater systems are connected and that the eventual impact of groundwater pumping on surface water flow may be as high as 100%. This is the reverse of current practice.

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## 2.3.3 Capacity and resources to identify and manage connected resources

### Background: Terminology and relevant National Water Initiative clauses

Under the NWI, jurisdictions have accepted that 'there are significant knowledge and capacity building needs for [the Agreement's] ongoing implementation, including ... interaction between surface and groundwater components of the water cycle' (NWI clause 98).

A major impediment to the integrated management of surface water and groundwater at present is the relatively limited understanding of physical and temporal characteristics of specific groundwater resources and their connections to surface water.

#### 2.3.3.1 Quality of data

It has been acknowledged that the quality of data on Australia's groundwater resources is poor in relation to data on surface water (which itself needs improvement), and action to improve this knowledge needs to be given priority and adequately resourced (National Groundwater Committee 2004, NWC 2006). This is a key first step to the development of genuinely effective integrated management.

The Commission is concerned that the data deficiency problem arises in part because of variable levels of licensing, metering and monitoring of groundwater extractions, compared to surface water extractions. While the Commission acknowledges the extensive metering of groundwater use and the substantial network of observation and monitoring wells in South Australia, and efforts by Western Australia to manage groundwater resources, further overall progress still needs to be made. In highly connected systems, deficiencies in licensing and metering are of particular concern, as unregulated and unmonitored groundwater extractions are essentially extracting surface water, with no accounting for connectivity.

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#### ■ Finding 2.5

The quality of data on Australia's groundwater resources is particularly poor, and more resources need to be devoted to improving it. The quality of metering and monitoring of groundwater extractions is variable. The National Groundwater Action Plan is helping to improve the quality of data on groundwater resources.

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#### ■ Recommendation 2.2

The Commission considers that ultimately all surface and groundwater extractions, including for stock and domestic purposes, should be licensed and metered or otherwise measured. However, the Commission also recognises the practical constraints to universal metering of groundwater extractions. The Commission therefore proposes that a risk-based approach be adopted, in which the following three criteria are given particular weight in determining metering priorities among different water systems as universal metering is rolled out:

- 1) the level of water use in the system with priority for systems at or approaching full allocation
- 2) in the case of systems which are not at or approaching full allocation, the cost-effectiveness of metering investments (including benefits implicit in the acquisition of better water use data)
- 3) the potential contribution of further metering to public confidence about compliance and the general quality of management of the given water system.

Refer also to the Commission's Recommendation 3.5.

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#### ■ Recommendation 2.3

The Commission recommends that, in helping redress the lack and quality of groundwater data available to support integrated management, it is important that the Bureau of Meteorology's emerging national water data and accounting systems treat surface water and groundwater data in an integrated fashion. The National Water Accounting Standards currently under development (Chapter 3) need to incorporate accounting for connected surface and groundwater systems from the outset.

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### 2.3.3.2 Technical capacity

A lack of technical capacity and dedicated resourcing continues to delay progress towards integrated management of connected water resources. There is currently a critical need for increased national expertise in groundwater assessment and management, and especially skills in assessment and management of connected systems (Evans et al 2006, NRMSC 2002, Cullen 2006).

This need is currently being addressed, to some extent, through the establishment of the new National Centre for Groundwater Research and Training (funded jointly by the Commission and the Australian Research Council) aimed at increasing and appropriately skilling groundwater scientists and managers. This initiative will help build the national skill base over the medium term.

Other programs are also helping to enhance technical capacity for groundwater management. For example, Queensland has been funded by the Bureau of Meteorology under the Modernisation and Extension of Hydrologic Monitoring Systems Program to develop modern and standard procedures for technical staff in groundwater assessment. These and other programs will continue to support further integrated management of connected surface and groundwater resources.

The National Groundwater Action Plan (see Box 9) includes the National Groundwater Assessment Initiative, components of which are helping to improve understanding and management of groundwater resources.

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#### ■ Finding 2.6

There is currently a critical need for increased national expertise in groundwater assessment and management, and especially skills in assessment and management of connected systems. Progress is being made in this area through initiatives such as the National Centre for Groundwater Research and Training and the National Groundwater Action Plan.

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#### Box 9: National Groundwater Action Plan

The comprehensive \$82 million *National Groundwater Action Plan* was initiated by the National Water Commission in 2007. The plan aims to improve knowledge and understanding of groundwater. It includes the following components:

- i) The National Groundwater Assessment Initiative. This \$50 million initiative is the centrepiece of the action plan. It funds hydrogeological investigations to help overcome critical groundwater knowledge gaps.
- ii) National Centre for Groundwater Research and Training. This \$30 million joint venture between the National Water Commission and the Australian Research Council will build capacity in groundwater knowledge and tackle the shortage of skilled groundwater scientists and managers in Australia. The centre will train postgraduate and postdoctoral scientists in advanced hydrogeological and related technologies.
- iii) Knowledge and Capacity Building. This \$2 million component is delivering principles, guidelines and good practice examples that can be used by groundwater managers, users and water planners to improve understanding and sustainable management of groundwater resources.

To support the plan, the National Water Commission has established the Groundwater Technical Advisory Committee to advise on groundwater direction setting and investment strategies. The panel is predominantly skills-based and includes high-level Australian groundwater experts, representation from groundwater managers, the Chair of the National Groundwater Working Group and the Chair of Australian Chapter of the International Association of Hydrogeologists.

**Senate Standing Committee on Environment and Communications  
Legislation Committee**

Answers to questions on notice

**Sustainability, Environment, Water, Population and Communities portfolio**

Supplementary Budget Estimates, October 2010

**Program: Division or Agency:** 4: NWC **Question No:** 61

**Broad Topic:** Mining and water issues

**Proof Hansard Page and Date** Written Question  
**or Written Question:**

**Senator Joyce asked:**

How have governments responded to your report “Water issues in jurisdictional planning for mining”? What specific actions are they taking? Is the NWC doing anymore work in this area?

**Answer:**

The Commission is not aware of any specific responses by governments to this report.

The next phase of this project is the development of a national framework of standardised tools and methodologies to assist the mining sector and regulators to better understand and manage the local and cumulative effects of multiple mining activities on groundwater resources.

The Commission is also undertaking a project *Integrating the Mining Sector into Water Planning and Entitlements Regimes* that will commence early 2011.