



Independent Expert Scientific Committee  
on Coal Seam Gas and Large Coal Mining Development

## Research Summary



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For information about this report or about the work of the IESC, please contact:

IESC Secretariat  
Department of the Environment and Energy  
GPO Box 787  
CANBERRA ACT 2601

Cover image: *Reflections on the lake at the Hunter Wetlands Centre (Shortlands Wetland)*

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Page 22: Green and Golden Bell Frog (*Litoria aurea*). Image by Frank Lemckert (SFNSW)

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*Billabong on the Condamine River*

# Foreword

## From the IESC Chair

We advise the Australian Government and state regulators on the potential impacts on water resources from proposed coal seam gas and coal mining developments.

Applying the latest science to our advice is a major priority. For this reason, we also advise the Australian Government on priorities for research on the impacts of coal resource developments. Between 2013 and 2017, the Australian Government invested \$19 million in a research program which was guided by our research priorities. This research has advanced scientific understanding of impacts of coal seam gas extraction and large coal mining developments on water flow, surface and groundwater connectivity, as well as water quality changes, ecosystem impacts and cumulative impacts. The research has improved understanding in key areas and strengthened the science to support regulatory decision making. This research has also informed our advice to regulators.

This Summary highlights the advances in knowledge made since 2013.

We recently reviewed the research priorities to identify any emerging knowledge gaps in our understanding given the Committee's experience in providing advice on the potential water-related impacts of over 100 coal mines and coal seam gas extraction projects. We identified knowledge needed to improve the scientific understanding across three priority areas – hydrology, chemicals and ecology. Public consultation on the proposed revised research priorities was undertaken.

The full list of revised research priorities, which were released in 2017, can be accessed on the IESC website: [www.iesc.environment.gov.au](http://www.iesc.environment.gov.au)



**Dr Chris Pigram PhD, FTSE, GAICD**  
IESC Chair

June 2018





*Ibis colony in the paperbark forest at the  
Hunter Wetlands Centre (Shortlands Wetland)*

## About the Committee

*The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the Committee) was established to build community confidence in regulatory decision making.*

*Our advice is independent, scientific in nature, transparent and available on our website.*

## How was the Committee formed?

The Committee was established in November 2012 by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). The Committee has eight members, who are appointed on a part time basis by the Minister with responsibility for the Environment.

## What we do

We give independent scientific advice to the Australian and state government environment ministers. Our advice enables environmental regulators to base their decisions about coal seam gas and large coal mining development proposals on the best available science. We are not responsible for making decisions about whether or not to approve coal seam gas or large coal mining development proposals. This is the role of the relevant state and/or Australian Government environmental regulator.

Since 2012 when our Committee began, we have advised on over 100 development proposals. We have also endorsed the methodology for bioregional assessments and a number of research publications, and published fact sheets on key scientific issues associated with the water-related impacts of coal seam gas and large coal mining development.

## Our expertise

Our Members are leading scientists in fields that include hydrogeology, hydrology, ecology, geology, and ecotoxicology.

## More information

Further information about the Committee, its activities, including advice on development proposals, visit our website: [www.iesc.environment.gov.au](http://www.iesc.environment.gov.au)





*View of the Hunter River  
downstream from Keys Bridge*



# Introduction

*Research is strengthening our understanding of the water-related impacts of coal seam gas and large coal mining development.*

This is an overview of research projects commissioned by the Department of the Environment and Energy between 2013 and 2017. The aim of the research program was to fill identified knowledge gaps and improve the scientific understanding of the potential impacts of coal seam gas and large coal mining developments on Australia's water resources.

In 2013, the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the Committee), in consultation with key stakeholders, identified four broad priority areas for research:

*Hydrology* – address gaps in knowledge on regional hydrology, hydrological connectivity across aquitards and faults and through bores, and modelling of these in assessment of developments.

*Chemicals* – improve understanding of the potential risks of chemicals used in coal seam gas extraction in surface and groundwater systems. Naturally occurring (geogenic) chemicals were also characterised.

*Ecology* – improve ecological conceptual modelling and explore better ways to monitor and reduce the effects of coal seam gas and coal mining on aquatic ecosystems, key species and ecological communities, especially in swamps and intermittent streams.

*Cumulative impacts* – address gaps in knowledge on approaches to evaluating the cumulative effects of coal seam gas and coal resource developments, and the uncertainty of model predictions.

The investment of \$19 million from 2013-2017 resulted in significant advances in the scientific information available to inform the Committee's decisions about coal seam gas extraction and coal mining proposals. This summary highlights the findings from several important reports in each theme. The full list of commissioned research is available at the end of the section on each theme.

**For more information and to download any of the technical reports:**

<http://www.environment.gov.au/water/coal-and-coal-seam-gas/science-research>



*Aerial view of the freshwater lakes of Moreton Island  
(part of the Moreton Bay Ramsar wetland area)*

# Hydrology research

## Why it matters

Extraction of water for coal seam gas will reduce groundwater pressure, which may affect the quantity and quality of water in connected freshwater aquifers and base flow to connected streams.

Similar impacts apply to large coal mines, which may also disrupt surface flow through river diversions and flood protection works, and with longwall mines, through the effects of subsidence.

## Achievements

The following research projects improve scientific understanding and modelling of changes to groundwater and surface water characteristics and processes.

Results of the research provide regulators and the industry with some practical approaches to dealing with a number of challenges in developing groundwater flow models at differing scales.

A full list of commissioned research under the Hydrology theme is listed at the end of the section.

## Research to better include faults and aquitards in Australian regional groundwater models<sup>1</sup>

This suite of reports presents work flows, techniques and worked examples to improve the treatment of faults and aquitards in Australian regional groundwater models, particularly those used to assess the potential impacts of coal mines and coal seam gas extraction projects.

Faults and aquitards can modify the impact of groundwater extraction on nearby groundwater users, streams and groundwater-dependent ecosystems, yet can be difficult to incorporate meaningfully into groundwater models. There is a need to improve on methods for characterising and representing faults and aquitards in groundwater models. This project uses data and models from the Narrabri and Gloucester regions in NSW to test and illustrate methods. In particular, the project mostly focusses on data already available to industry.

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<sup>1</sup> Craig Simmons, Jim Underschultz, Joan Esterle, Julian Strand, Susan Hayes, Chris Turnadge, Dirk Mallants, Luk Peeters, James McCallum, Okke Batelaan, Stanley D Smith, Emeline Mathouchanh, Lionel Esteban, Irina Emelyanova, David Nguyen, Marina Pervukhina, Tongcheng Han, 2018



These methods include:

- Low-cost ways to generate high-resolution hydraulic conductivity data across an aquitard and upscale them for use in a regional groundwater model.
- A new method for measuring formation-scale hydraulic conductivity of aquitards.
- Rigorous methods for representing aquitard heterogeneity in groundwater flow models.
- A practical workflow for using multiple methods to characterise faults in conceptual models of geology.
- A method for incorporating fault properties into regional groundwater flow models using a common modelling package.

## Bore and well induced inter-aquifer groundwater connectivity: consequence modelling and experimental design<sup>2</sup>

Coal seam gas development has meant the drilling of a large network of production bores over a relatively short period of time. Any integrity problems in these and pre-existing bores can represent a risk both locally and regionally to groundwater pressures and quality. This has led to community concerns. This research project investigated how modelling techniques can help to improve our understanding of the potential impacts of leaky and open wells on aquifers.

The project consisted of:

- A literature review based on international studies including water bores, conventional gas bores and coal seam gas bores.
- Analytical and numerical models for assessing local pressure and quality impacts and testbed for regional modelling,
- Application of numerical regional groundwater flow model and a solute transport model to Narrabri region in order to assess regional pressure and quality impacts, and
- An analysis of this approach.

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<sup>2</sup> Rebecca Doble, Jim McCallum, Chris Turnadge, Luk Peeters, Bailin Wu, Dirk Mallants, Saskia Noorduijn, 2018

The modelling showed that for the Narrabri region:

- inter-aquifer connectivity would not be materially enhanced by the presence of leaky coal seam gas wells in a coal seam gas well field.
- the greatest impact occurs with open wells (degraded water bores and exploration wells) and becomes noticeable at 5% failure rate or greater.
- the effect of leaky wells on groundwater quality was limited to within 100's of metres of the well.

This research improves our understanding of potential hydrogeological responses to changes in groundwater pressure and quality caused by aspects of coal seam gas extraction and coal mining. It provides a sounder perspective on which to manage well integrity issues, including good bore design, selection of appropriate construction materials to withstand pressures and deterioration processes and good cementing.

## Other hydrology research projects

The Department also commissioned:

- Subsidence from coal seam gas extraction in Australia
- Subsidence from coal mining activities
- Monitoring and management of subsidence induced by coal seam gas extraction
- Monitoring and management of subsidence induced by longwall coal mining activity
- Groundwater hydrogeochemical characterisation of the Surat region and Laura Basin Queensland.
- Regional hydrogeological characterisation studies in four coal basins in Queensland, South Australia and Victoria
- Aquifer connectivity within the Great Artesian Basin, and the Surat, Bowen and Galilee Basins.

**For more information and to download any of the technical reports:**

<http://www.environment.gov.au/water/coal-and-coal-seam-gas/science-research/hydrology>



*View of Lee's Reserve on the McIntyre River near Goondiwindi  
in the Border Rivers Condamine Catchment area*



# Chemicals research

## Why it matters

It is important to understand what coal seam gas extraction means for human health and the environment.

Coal seam gas extraction is closely regulated by the Australian, state and territory governments, which legally require protective measures to safeguard human health and the environment. These regulatory frameworks apply to all aspects of the industry, including the handling and use of chemicals throughout the extraction process.

Despite these protections being in place, we need to understand the risks of any potential scenarios where workers, the public or the environment may come into contact with chemicals used in drilling and hydraulic fracturing for coal seam gas.

## Achievements

Much of the research in this priority area, including the projects highlighted in this section, was part of the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia.

The Australian Government commissioned this complex project in 2012, recognising the extent of scientific and community interest in the risks of chemical use in the industry and the need to improve the knowledge of the water-related risks to the environment and human health from chemicals used in coal seam gas extraction. The research involved three partner agencies<sup>3</sup>.

Information from the Assessment will enable regulators and operators to implement more targeted risk management actions and practices for safely managing chemicals in the coal seam gas industry.

This project produced 14 technical reports and reviews, including the three outlined below.

A full list of commissioned research under the Chemicals Theme is available at the end of the section.

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<sup>3</sup> The Department of the Environment and Energy, the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) and CSIRO.

## Human health risks associated with surface handling of coal seam gas chemicals<sup>4</sup>

This research project assessed the occupational and public health risks of 113 chemicals used for drilling and/or hydraulic fracturing at coal seam gas extraction sites in Australia between 2010 and 2012.

It developed scenarios describing how coal seam gas workers or the public might come into contact with these chemicals.

For workers, these scenarios involved skin contact, breathing dust or chemical vapours, or contact with spills during the transport, storage and handling of chemicals.

These scenarios did not take into account standard safety and handling precautions. In practice, measures to protect coal seam gas workers, such as workplace design, safe work practices, chemical labelling and personal protective equipment, are required by law or industry standards.

In these scenarios, the majority of chemicals (65 of the 113 tested) were found to be unlikely to cause harm to workers' health during coal seam gas extraction, even without the standard protections.

Some chemicals were found to be potentially harmful to workers through one-off contact in an industrial accident, or if repeated contact occurs during long-term mixing and blending or cleaning and maintenance.

The general public are very unlikely to come into direct contact with chemicals used in coal seam gas operations. Scenarios for public health therefore focused on large-scale accidental spills or leaks that may not be detected or managed.

The scenarios did not take into account all standard precautionary measures. In reality, Australia has a strict regulatory regime for coal seam gas operations that requires safety and handling precautions to prevent spills and to promptly control, report and remediate them if they occur.

In these pre-mitigation scenarios, the majority of chemicals (73 of the 113 tested) were found to be unlikely to cause harm to public health when used in coal seam gas extraction, even if they were to spill or leak in large volumes undetected.

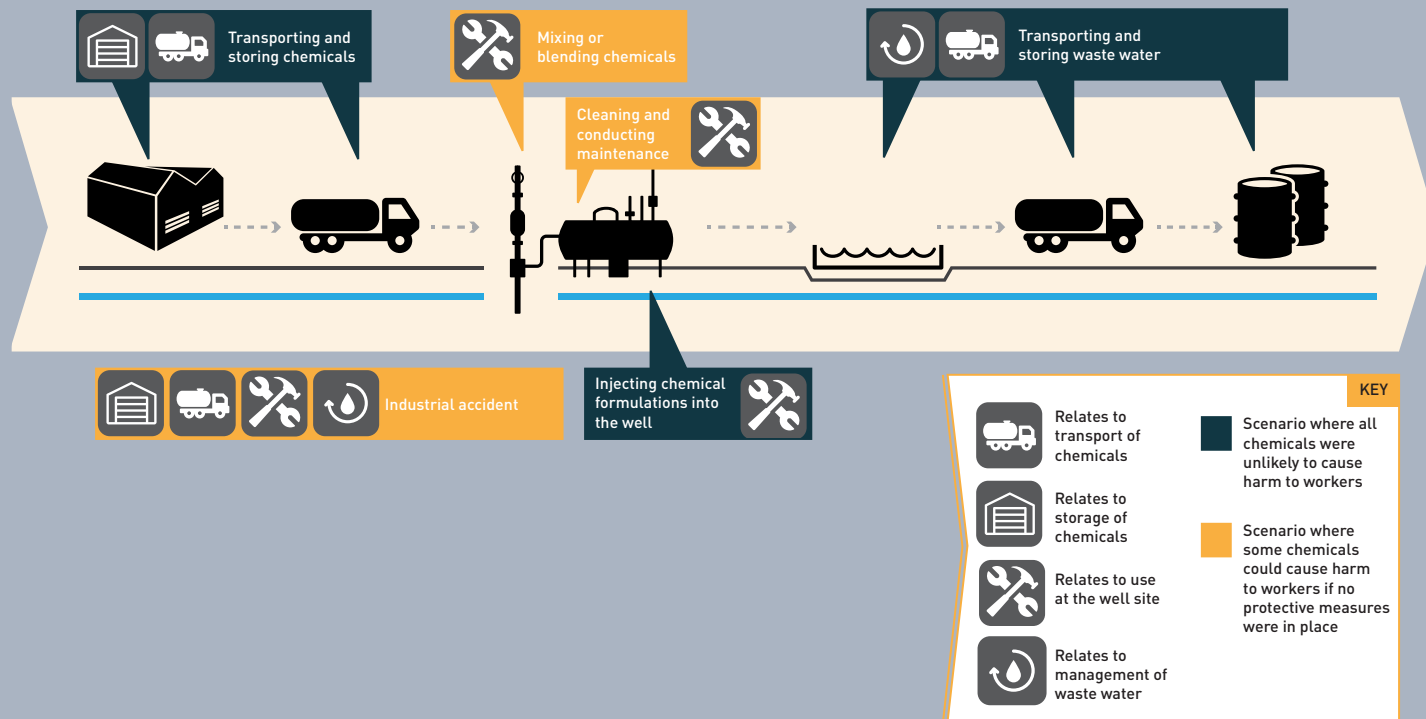
There are two scenarios where some chemicals could be a risk to the health of a member of the public in the absence of standard risk management measures: a large transport spill and a long-term below-ground leak from a storage pond. Both scenarios require the person to drink, wash with or swim in water containing the chemical on a regular basis over an extended period for harm to occur.

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<sup>4</sup> NICNAS 2017



## Scenarios where workers could come into contact with coal seam gas chemicals





## Environmental risks associated with surface handling of chemicals used in coal seam gas extraction<sup>5</sup>

This project assessed the potential risks to the surface and near-surface water environments of 113 drilling and hydraulic fracturing chemicals. Of these, about half were assessed using a range of quantitative approaches.

Where only basic information was available, it compiled evidence from the international scientific literature to support and expert judgement on the chemical's potential to harm the environment. It considered how chemicals were used in coal seam gas extraction, how they behaved in the environment and what harm they could cause to aquatic and terrestrial biota. It factored in the most likely ways for chemicals to be released during the extraction process, and protective measures to prevent and limit spills and leaks.

Where quantitative assessments were possible, scenarios were developed to show how chemicals might enter a water body such as a river, pond or lake. The Assessment looked at what could happen if a chemical entered the environment through accidental spills and leaks, or intentional reuse of untreated coal seam gas waste water for other purposes.

Potential harm to the environment was assessed by determining what effect the chemicals could have on aquatic organisms, including algae, invertebrates and fish.

The majority of chemicals (61 of the 113 chemicals tested) were found to be unlikely to cause harm to the environment when used in coal seam gas extraction, even if they were to spill or leak in high volumes. If no protective measures were in place, some of the chemicals were of potential concern if released accidentally through surface spills or transport accidents. These included salts, mineral acids, oxidisers and synthetic organic chemicals such as polymers and biocides. Three boron compounds were a potential risk to plants if they accumulate in soils following use of untreated waste water for irrigation or dust suppression.

## Deeper groundwater screening research<sup>6</sup>

This research investigated how chemicals used in coal seam gas extraction may move from deeper groundwater to other parts of the environment, how long this might take, and what the concentrations might be at receiving environments such as water bores and streams. It also considered the potential movement of chemicals in the coal seam that might be mobilised by hydraulic fracturing.

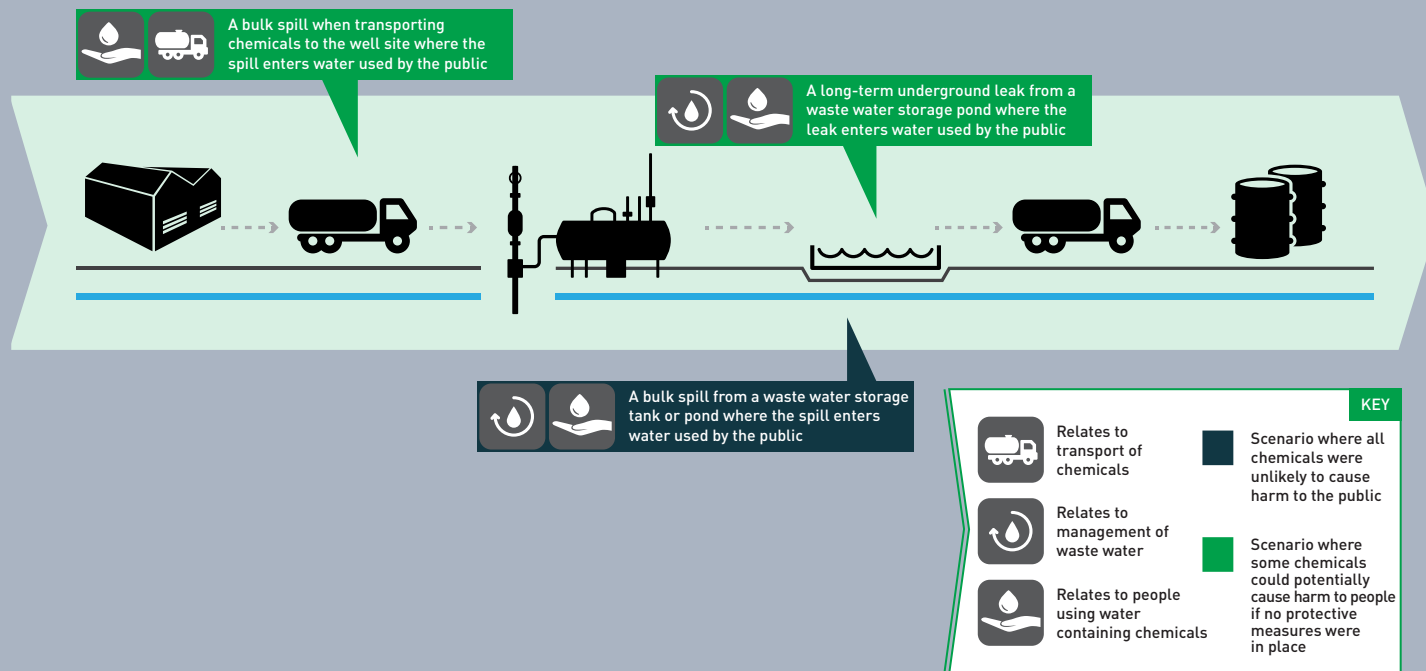
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<sup>5</sup> The Department of the Environment and Energy

<sup>6</sup> Dirk Mallants, Simon Apte, James Kear, Chris Turnadge, Sreekanth Janardhanan, Dennis Gonzalez, Mike Williams, Zuorong Chen, Rai Kookana, Andrew Taylor, Matthias Raiber, Merrin Adams, Jody Bruce, Henning Prommer, 2017



## Scenarios where the public could come into contact with coal seam gas chemicals



It found that chemicals remaining underground after hydraulic fracturing are unlikely to reach people or ecosystems in concentrations that would cause concern. This is because natural dilution and degradation that reduce concentrations to negligible levels. Risks are therefore likely to be very low.

The research developed methods that can be used on a project-by-project basis to assess risks to human health and the environment from chemicals remaining deep underground as a result of hydraulic fracturing in coal seam gas operations.

## Release of geogenic contaminants from Australian coal seams: experimental studies<sup>7</sup>

Geogenic chemicals, which are part of the natural geology of coal seams, have the potential to be mobilised by hydraulic fracturing activities. The concentrations of these geogenic contaminants depend on a number of factors including the groundwater composition and the nature of the coal seam undergoing extraction.

This report describes a laboratory-based study that investigated the potential for release of geogenic contaminants from coal samples taken from eight locations across Eastern Australia. This involved the development and application of leach tests which were designed to assess the release of geogenic substances and to provide some information on the physicochemical factors affecting contaminant release. The tests were designed to provide upper bound estimates of contaminant release.

Detectable concentrations of over 60 trace elements were observed in the laboratory-based tests. Large variability was observed in the measured trace element and organics concentrations in the different coal types and their leachates. This emphasises the benefits of site-specific investigations to ascertain the risk posed by geogenic contaminants at a given coal seam gas operation.

Understanding the transformation and fate of geogenics under different conditions, and the formation of new chemicals and their risks, have been identified as key future IESC research priorities.

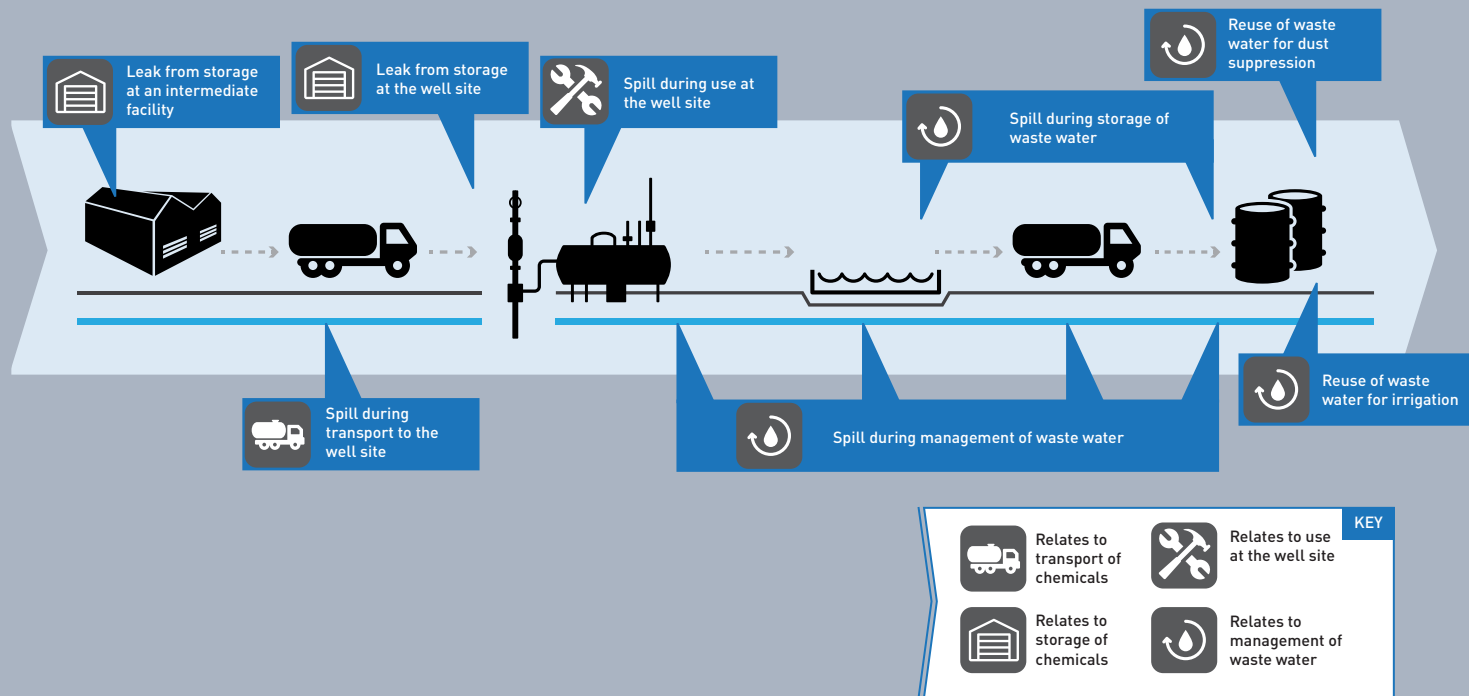
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<sup>7</sup> Dr Simon Apte, Dr Mike Williams, Dr Rai Kookana, Dr Graeme Batley, Mr Josh King, Mr Chad Jarolimek and Mr Rob Jung of the Land & Water, Commonwealth Scientific and Industrial Research Organisation (CSIRO).





## Scenarios where coal seam gas chemicals could enter the environment



## Other chemicals research

The other reviews and reports of the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia are:

- Literature review: Summary report
- Literature review: Human health implications
- Literature Review: Environmental risks posed by chemicals used in coal seam gas operations
- Literature review: Hydraulic fracture growth and well integrity
- Literature review: Geogenic contaminants associated with coal seam operations
- Literature review: Identification of potential pathways to shallow groundwater of fluids associated with hydraulic fracturing
- Identification of chemicals associated with coal seam gas extraction in Australia
- Human and environmental exposure conceptualisation: Soil to shallow groundwater pathways
- Environmental exposure conceptualisation: Surface to surface water pathways
- Human and environmental exposure assessment: Soil to shallow groundwater pathways – A study of predicted environmental concentrations
- Chemicals of low concern for human health based on an initial assessment of hazards
- Human health hazards of chemicals associated with coal seam gas extraction in Australia
- Human health risks associated with surface handling of chemicals used in coal seam gas extraction
- Environmental risks associated with surface handling of chemicals used in coal seam gas extraction

The Department also commissioned:

- Background review: Hydraulic fracturing techniques
- Developing models to better predict fracture growth in Australian Coal Seams
- Developing simulators and scenarios to better understand the potential for fracturing fluids to move into aquifers
- Risk assessment guidance manual: For chemicals associated with coal seam gas extraction – Exposure draft

**For more information and to download any of the technical reports:**

[www.environment.gov.au/water/coal-and-coal-seam-gas/national-assessment-chemicals](http://www.environment.gov.au/water/coal-and-coal-seam-gas/national-assessment-chemicals)

[www.environment.gov.au/water/coal-and-coal-seam-gas/science-research/chemicals](http://www.environment.gov.au/water/coal-and-coal-seam-gas/science-research/chemicals)

<https://www.csiro.au/en/Research/Major-initiatives/Unconventional-gas/CSG-chemicals>





*Aerial view of the Guydir Wetland System*

# Ecology research

## Why it matters

Many aquatic ecosystems and water-dependent terrestrial systems (such as floodplain vegetation) are highly dependent on the timing, quantity and quality of water in streams, rivers and groundwater.

Changes in water flows can affect water temperature, salinity and the connectivity of stream habitats in ways that can seriously damage ecosystems. To avoid this, we need to better understand the relationships between water flow, water quality and the health of ecosystems. This is especially true for intermittent streams because their ecology is poorly known but they are common in areas where coal mining or coal seam gas extraction occurs

As well as studies of the impacts of changes in water flows, we need research on the risks involved with storing and disposing of saline groundwater, which can be brought to the surface as co-produced water.

## Achievements

The following research projects improve our understanding of the potential impacts to water-dependent ecosystems from coal resource developments.

They provide regulators and the industry with new approaches to integrating models to identify impacts on ecosystems, including groundwater-dependent vegetation and animals. This will enable coal seam gas and coal mining operators to implement more targeted risk management actions and practices.

A full list of commissioned research under the Ecology theme is listed at the end of this section.

## Modelling water-related ecological responses to coal seam gas extraction and coal mining<sup>8</sup>

This research investigated the benefits of integrating current hydrological and hydrogeological conceptual models with ecological ones to provide a more complete picture of the likely water-related ecological impacts of coal seam gas extraction and coal mining.

The report describes a series of consecutive steps and illustrated worked examples aimed at helping with the preparation and review of environmental impact statements (EISs).

Ecological conceptual models are matched with narrative tables that specify hypothesised responses and relevant supporting evidence. These make the assumptions about ecological impacts in EISs explicit and identify response pathways and potential cumulative effects. The outcome is a transparent and consistent framework for the design of monitoring programmes to test hypotheses proposed from the conceptual models.

The project highlights the need to incorporate ecological components in the modelling and conceptualisation of hydrology and hydrogeology in EISs. This will enable the production of ecohydrological models that can illustrate likely water-related ecological responses to coal seam gas extraction and coal mining.

The proposed approach is expected to:

- help the resources industry identify and predict the water-related impacts of coal seam gas extraction and coal mining
- help the Committee evaluate EIS documentation for coal seam gas and coal mining proposals and provide advice to regulators that identifies and explains the potential water-related ecological responses
- provide a framework for ecological conceptual modelling that can be used in the bioregional assessments.

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<sup>8</sup> Auricht Projects and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for the Department of the Environment, Commonwealth of Australia.



## Research to inform the assessment of eco-hydrological responses to coal seam gas extraction and coal mining<sup>9</sup>

This research investigated the role of groundwater in supporting vegetation, intermittent stream ecosystems, and Great Artesian Basin spring wetlands, focusing on potential ecological impacts of groundwater drawdown associated with coal mining or coal seam gas extraction. Each of the case studies illustrates the approaches, methods and data needed to build ecohydrological conceptual models.

One component of the study found that when plants can reach groundwater with their roots, they are likely to use groundwater, especially during dry periods. Dependence on groundwater varies between different vegetation and situations. To help identify groundwater-dependent vegetation, the researchers developed:

- an easy-to-use categorisation tool for identifying the proportion of plants in a vegetation community that may depend on groundwater.
- a low-cost remote sensing tool using satellite imagery for identifying groundwater-dependent vegetation at a landscape scale.

Another component of the study explored how groundwater supports intermittent streams. Upwelling groundwater can reduce the duration of non-flowing periods, preserve pools of water at the surface and maintain carbon and nutrient recycling in the sediments of the streambed.

It also showed that groundwater supports biodiversity and ecological processes under the streambed. Wet streambed sediments can contain diverse aquatic invertebrates, such as crustaceans and insects, which need a supply of oxygenated water to survive. Insights from the study can help identify when streambed sediments are likely to harbour invertebrates and maintain important ecological processes.

Overall, groundwater discharge to surface aquatic environments often plays a critical role in sustaining important ecological processes and local and regional biodiversity. This means that long periods of reduced flow caused by groundwater extraction may reduce the overall productivity of groundwater-influenced intermittent streams.

This research improves our understanding of potential ecological responses to changes in groundwater-surface water dynamics caused by human activities such as coal seam gas extraction and coal mining. It also gives regulators and industry a better understanding of the ecological importance of groundwater-surface water connectivity in intermittent streams

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<sup>9</sup> Anderson M, Barron O, Bond N, Burrows R, Eberhard S, Emelyanova I, Fensham R, Froend R, Kennard M, Marsh N, Pettit N, Rossini R, Rutledge R, Valdez D & Ward D, (2016)



## Other ecology research

The Department also commissioned:

- Co-produced water – risks to aquatic ecosystems
- Ecological and hydrogeological survey of the Great Artesian Basin springs – Volume 1: History, ecology and hydrogeology
- Ecological and hydrogeological survey of the Great Artesian Basin springs – Volume 2: Hydrogeological profiles
- Temperate Highland Peat Swamps on Sandstone: Ecological characteristics, sensitivities to change, and monitoring and reporting techniques
- Temperate Highland Peat Swamps on Sandstone: Longwall mining engineering design – subsidence prediction, buffer distances and mine design options
- Temperate Highland Peat Swamps on Sandstone: Evaluation of mitigation and remediation techniques.

**For more information and to download any of the technical reports:**

<http://www.environment.gov.au/water/coal-and-coal-seam-gas/science-research/ecosystems>



*Green and Golden Bell Frog* (*Litoria aurea*)



*Glossy ibis* (*Plegadis falcinellus*)





*Minor flooding occurring in a creek flowing through the  
Brigalow Nature Reserve in Goondiwindi*

# Cumulative impacts

## Why it matters

The assessment of cumulative environmental impacts is increasingly an area of focus for the community, industry and government.

The Committee's advice on a proposed development usually covers the cumulative water-related impacts of the proposal in the context of past, present and/or reasonably foreseeable actions.

Cumulative impact assessment needs to be appropriately scaled and designed to address the relevant levels of risk from combined activities.

## Achievements

The cumulative management framework of the Australian Government's Bioregional Assessment Program provides crucial information on regional-scale cumulative impacts on water resources.

## Bioregional assessments

Bioregional assessments use science to analyse the cumulative impacts of proposed coal mines and coal seam gas projects on regional water resources and water-dependent assets such as wetlands and groundwater bores.

There are 13 assessments of different bioregions. Figure 1 shows these regions.

Bioregional assessments identify where impacts of past, current and proposed coal mines and coal seam gas projects are unlikely and where possible cumulative impacts on water resources and water-dependent assets may need more investigation.

Each assessment displays information about how groundwater levels and surface water flows might change (out to 2102) as a result of coal seam gas and coal mining development. Results are reported as probabilities.

The bioregional assessment for the Maranoa-Balonne-Condamine region used the groundwater model from the Queensland Government's Office of Groundwater Impact Assessment to generate hydrogeological results to understand potential cumulative impacts to water dependent assets identified by the community.



The Bioregional Assessment Information Platform makes this information more transparent and accessible by providing open access to the science, methods, data, models, reports, provenance information and maps used in the assessments.

The platform includes BA Explorer, a mapping tool that displays results of the bioregional assessment.

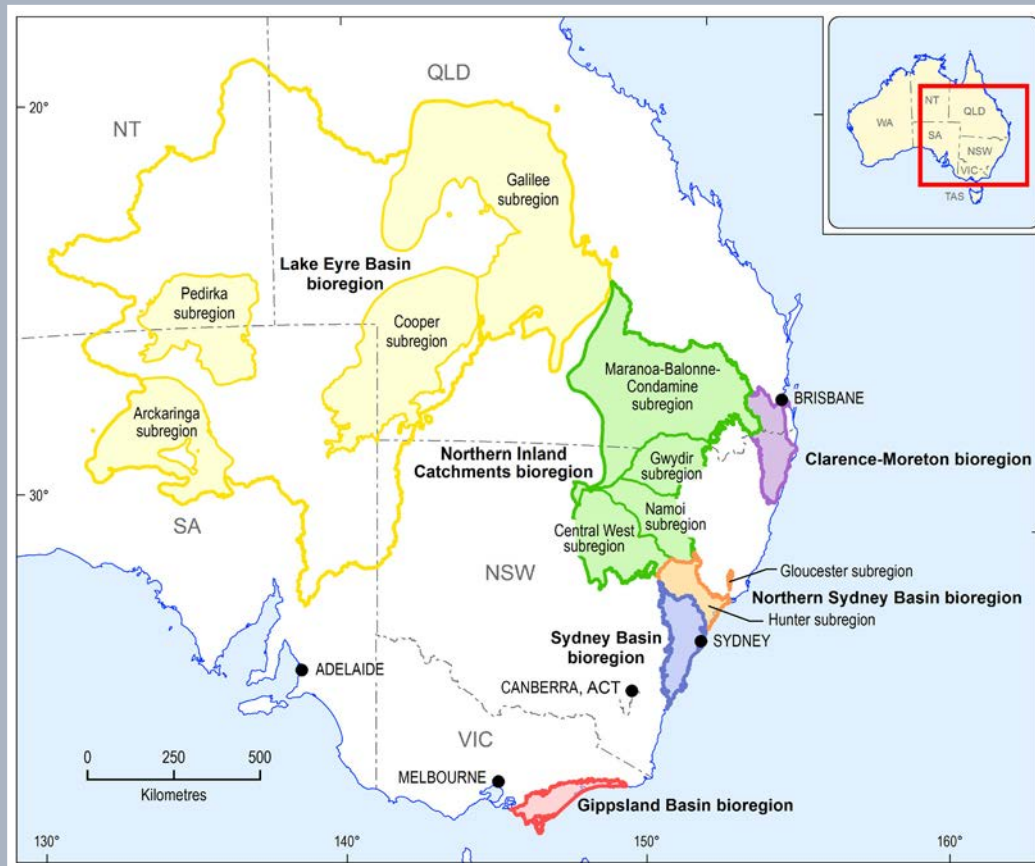
Regulators can use this information when deciding whether to allow projects to proceed and under what conditions.

Bioregional assessment findings help inform the advice that the Committee gives to Australian and state environment ministers about proposed projects.

**For more information and to download any of the technical reports:**

<http://www.bioregionalassessments.gov.au/>

Figure 1: Map of 13 bioregions under the Bioregional Assessment Program





**Australian Government**

This initiative is funded by the Australian Government

**[www.iesc.environment.gov.au](http://www.iesc.environment.gov.au)**