

# NSW Groundwater Strategy - Stakeholder survey

Thank you for taking the time to provide your feedback on the draft NSW Groundwater Strategy.

Groundwater is water found underground in rock formations called aquifers and is an important resource for NSW. For more information about groundwater, [visit the department's website](#).

The draft strategy sets a long-term vision and direction for groundwater management in NSW.

This survey aims to gather your opinion about the draft strategy. Your comments will help us identify community views and key areas of interest and help us to develop the final strategy.

This survey will close on **Sunday 14 August 2022 at 11.59pm (AEST)**.

The survey is structured according to the draft strategy's main chapters:

- Introduction and general overview of groundwater resources and management in NSW.
- Strategic Priority 1 – Protect groundwater resources and the ecosystems that depend on them in the strategy.
- Strategic Priority 2 – Build community and industry resilience through sustainable groundwater use (this part of the survey also includes an opportunity for Aboriginal people to provide cultural-specific feedback).
- Strategic Priority 3 – Improve groundwater management decisions with better information.

## Confidentiality preferences - Publishing your submission

Please indicate if you give permission for your submission to be published on the department's website, and whether you give permission to be identified as the author of the submission or wish to remain anonymous.

I give permission for the department to publish my name with my submission on the department's website.

I do not give permission for the department to publish my name with my submission on the department's website. In selecting this option, I understand that my submission will be published anonymously.

I do not give permission to publish my submission at all.

## Sharing your submission within the department

Please indicate if you give permission for your name and email to be included when sharing survey response data internally within the department.

- I give permission for my name and email to be shared within the department.
- I do not give permission for my name and email to be shared within the department. In selecting this option, I understand that my submission will be shared anonymously.

## Your submission

If you would like to provide additional feedback in an attached document, please add it to this submission when you return the survey.

Please note, if you wish to remain anonymous, please do not include personal information in your attachment.

If you would prefer to email your feedback or if you have any enquiries, please email the department at [nsw.groundwaterstrategy@dpie.nsw.gov.au](mailto:nsw.groundwaterstrategy@dpie.nsw.gov.au).

## Data privacy

The Department of Planning and Environment is subject to the *Privacy and Personal Information Protection Act 1998* in managing your personal information. In the interests of transparency, the department's website intends to publish all feedback received on its website. You can choose to have your feedback published anonymously or not published at all. Please review our [privacy statement](#) for further information.

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## Introduction and overview of groundwater resources and management in NSW

Groundwater is water found below the ground in rock formations called aquifers. Groundwater is also used for a multitude of purposes in NSW such as agriculture, town water supply, and also to sustain important ecosystems.

**Thinking about your relationship to groundwater, which of the following user groups or parts of the community best describes you? (please select only one)**

- General public
- Local Council / Local water utility
- NSW Government department
- Australian Government department
- Domestic and stock
- Agriculture
- Industry
- Manufacturing
- Research / academia
- Environmental group
- Other (please specify) ARC Industrial Transformation and Training Centre

*In NSW, there are almost 80 groundwater sources west of the Great Dividing Range and over 450 sources on the coast.*

**Based on the 13 NSW regions outlined in the map below, in which region are you located?**



Choose your region

- Border Rivers
- Far North Coast
- Greater Hunter
- Greater Sydney
- Gwydir
- Lachlan
- Macquarie-Castlereagh
- Murray
- Murrumbidgee
- Namoi
- North Coast
- South Coast
- Western

*Groundwater is an important resource for NSW. It is used for town water supply, agriculture in the Namoi for example, or industry in the Hunter Valley.*

**How important is it for you to access groundwater as a resource?**

- Not at all important
- Of minor importance
- Neutral
- Important
- Very important

**To what extent do you agree with the following statements? (please select one response per row)**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Groundwater is important for basic human needs (drinking, cooking)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Groundwater is important for stock watering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Groundwater is important for Aboriginal communities and Country	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Groundwater is important for agriculture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Groundwater is important for the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Groundwater is important for industrial businesses (including mining)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Groundwater is important for manufacturing (water bottling, food processing and others)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Groundwater in NSW currently provides close to 10% of water used for town supply, and over 70% for agriculture, as well as supporting a range of ecosystems. In the context of a growing population and climate change, please answer the following questions.*

**Please indicate what you think NSW's groundwater needs will look like over the next 20-40 years.**

- The same
- Less than current needs
- More than current needs
- Not sure

**Which part/s of the community do you think will have the greatest change in their groundwater needs in the future?**

**Select all that apply.**

- Households
- Agriculture
- Industry
- Manufacturing
- Towns and cities
- Aboriginal communities and Country
- Ecosystems dependent on groundwater
- Not sure
- I don't believe there will be any change

**Do you think you should change the way you will use groundwater in the future?**

- Yes, I've already begun to change my groundwater usage habits
- Yes, I've started doing research and am in the process of making changes
- I've thought about it, but have done nothing more
- No, it hasn't even crossed my mind
- I don't use groundwater

**How well do you know the NSW groundwater management framework, rules and legislation?**

- Not at all
- Not well at all
- Unsure
- Well
- Very well

*The Draft NSW Groundwater Strategy identifies 4 key issues affecting change in groundwater management in NSW.*

**Please rank these issues from most important to least important, where 1 = Most important and 4 = Least important.**

- 1\_\_\_\_\_ Our climate is changing, and groundwater recharge and demands will be affected by this
- 4\_\_\_\_\_ The risks to groundwater from development and land use change are increasing
- 3\_\_\_\_\_ Community notions of sustainability and fair access to groundwater have evolved over time
- 2\_\_\_\_\_ Our understanding of groundwater, its behaviour and use is improving

Please see our extended submission added to this form. We propose developing increased capacity to make more informed groundwater decisions based on quantified uncertainties.

**Please tell us of any other challenges that are affecting groundwater management in NSW.**

In the following sections of this survey, you will be asked questions based on each of the draft NSW Groundwater Strategy priorities. [You can read the draft strategy on our website.](#)

## Strategic Priority 1 – Protect groundwater resources and the ecosystems that depend on them

Strategic Priority 1 aims to sustain our groundwater resources for current and future uses and protect our important ecosystems that depend on groundwater.

In priority 1 of the draft strategy, 4 key challenges affecting groundwater resources and the ecosystems that depend on them are identified.

**Please rank these challenges in order of importance, where 1 = Most important and 4 = Least important.**

- 1 \_\_\_\_\_ Our policy framework for sustainable groundwater management needs to be updated to be more responsive to emerging challenges such as climate change
- 3 \_\_\_\_\_ Ecosystems that depend on groundwater face increased threats such as intensive groundwater extraction and pollution
- 2 \_\_\_\_\_ There is a lack of integration between groundwater, surface water and land management
- 4 \_\_\_\_\_ Threats to groundwater quality are growing and need to be addressed

**Please tell us any other challenges you think will affect the protection of groundwater resources and the ecosystems that depend on them.**

There is still a lack of understanding of the actual thresholds and resilience of groundwater dependent ecosystems, including the uncertainty in these estimates. In particular, there is significant work on individual systems, but limited understanding how this translates to large scales, such as whole catchments and the whole basin. More work is needed to extend the local knowledge to large scales including quantified uncertainties. Please see our attached extended response.

**How important for you is the protection of groundwater resources and the ecosystems that depend on them?**

- Not at all important
- Of minor importance
- Neutral
- Important
- Very important

The department has put forward a range of draft actions to increase the protection of groundwater resources and the ecosystems that depend on them. The following questions will review each of the draft actions and their sub-actions.

### **Action 1.1 - Refresh and expand our approach to sustainable groundwater management by reviewing and updating our groundwater policy and planning framework.**

**To what extent do you agree with this draft action?**

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

### **Action 1.2 - Better integrate groundwater management with other land and water management processes.**

**To what extent do you agree with this draft action?**

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 1.2?

	Not at all important	Of minor importance	Neutral	Important	Very important
Refresh and expand our approach to sustainable groundwater management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Manage groundwater and surface water together	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Integrate groundwater considerations into land use planning decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Improve management of large developments impacting groundwater	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Strengthen cross-border groundwater management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

**Action 1.3 - Improve management and protection of groundwater dependent ecosystems and baseflows to streams.**

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 1.3?

	Not at all important	Of minor importance	Neutral	Important	Very important
Review and update our approach to protecting groundwater dependent ecosystems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Deliver a program to improve our understanding of groundwater dependent ecosystems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

**Action 1.4 - Review and update approaches to sustainable groundwater extraction.**

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 1.4?

	Not at all important	Of minor importance	Neutral	Important	Very important
Review groundwater source extraction limits using new knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Better manage impacts of extraction at a local level	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Improve clarity around management of groundwater sources with a low long-term entitlement share value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

**Action 1.5 - Protect groundwater quality within natural limits.**

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 1.5?

	Not at all important	Of minor importance	Neutral	Important	Very important
Review and update our approach to managing groundwater quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Deliver a program to better understand groundwater quality and risks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Please tell us any other suggested actions you think we should consider in Strategic Priority 1.

Please see our attached extended response in relation to quantifying uncertainties to assist with decision making and management.  
 The key issue with the draft strategy is that "review and update" is rather vague without clearly indicating first what is actually not working in the management and how this might be improved. Is it a lack of knowledge? Cumbersome bureaucracy?

## Strategic Priority 2 – Build community and industry resilience through sustainable groundwater use

Strategic Priority 2 aims to improve water security through the sustainable use of groundwater by urban populations, water dependent cultural, spiritual and economic aspirations of Aboriginal people, and support opportunities for other groundwater dependent development.

The strategy identifies 3 key challenges affecting the resilience of communities and industries using groundwater.

**Please rank these challenges in order of importance, where 1 = Most important and 3 = Least important.**

- 3 \_\_\_\_\_ Increasing demand for groundwater undermines town water supply
- 2 \_\_\_\_\_ New and expanding industries need to consider groundwater opportunities and constraints
- 1 \_\_\_\_\_ Aboriginal rights to and uses of groundwater are not adequately recognised

**Please tell us any other challenge you think will affect community and industry resilience in using groundwater.**

The current legislation and management that does not explicitly link groundwater and surface water as one domain creates barriers for innovative solutions in the groundwater management. An example of this are the barriers to the implementation of MAR for groundwater management. Industry and town water supply should also focus more on recycling water rather than pumping groundwater.

**How important is it for you that communities and industries using groundwater resources have a reliable and secure supply?**

- Not at all important
- Of minor importance
- Neutral
- Important
- Very important

The department has put forward a range of draft actions to increase the resilience of communities and industries using groundwater. The following questions will review each of the draft actions and their sub-actions.

## Action 2.1 - Support towns and cities using groundwater to improve their urban planning.

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

## Action 2.2 - Support economic growth using groundwater.

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 2.2?

	Not at all important	Of minor importance	Neutral	Important	Very important
Provide better information on groundwater opportunities and constraints to communities and industries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Enable the increase of sustainable groundwater use in targeted areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Foster innovative groundwater solutions, including Managed Aquifer Recharge (also called 'water banking', to support communities and industries)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

**Action 2.3 - Support Aboriginal rights, values and uses of groundwater.**

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 2.3?

	Not at all important	Of minor importance	Neutral	Important	Very important
Increase access to groundwater for Aboriginal people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Protect groundwater-dependent places of significance to Aboriginal communities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Better integrate Aboriginal knowledge into groundwater management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

The following questions focus on groundwater challenges and opportunities for Aboriginal people in NSW.

Please only answer questions 43 to 51 if you identify as Aboriginal or Torres Strait Islander. If you do not identify as Aboriginal or Torres Strait Islander, please go to question 52.

A key objective of the NSW Government is to improve groundwater management outcomes for Aboriginal people across the state. We want to ensure that Aboriginal people and their wisdom and knowledge have a greater influence in groundwater planning and management.

You have indicated that you are of Aboriginal or Torres Strait Islander descent. To help us to better plan for and manage groundwater to support Aboriginal rights, interests and access, please answer these additional questions.

**Do you identify as Aboriginal and/or Torres Strait Islander?**

- Aboriginal
- Torres Strait Islander
- Both Aboriginal and Torres Strait Islander
- Neither
- Prefer not to say

**Please tell us what groundwater health and secure groundwater supply means for you, your family, your clan, your Nation.**

**Please tell us about the changes you have seen in groundwater management in your cultural landscape.**

**Please indicate which of these cultural opportunities you have seen in action in the way groundwater is managed in NSW.**

Select all that apply.

- Cultural wellbeing and healing
- Cultural significance of higher flows to waterways
- Protection and restoration of cultural sites of significance
- Restoring healthy Country
- Cultural ecotourism
- Other (please specify) \_\_\_\_\_

**Please provide any other comments about cultural opportunities or challenges in groundwater management in NSW.**

The strategy strives to provide more cultural and economic opportunities for Aboriginal people in relation to groundwater.

**What are the most important opportunities for you?**

Select all that apply.

- Fairer access to traditional land and resources
- Better contemporary economic opportunities in culture and recreation
- Increased access to employment and commercial opportunities on projects
- Improving awareness of Aboriginal people’s knowledge and contribution to how groundwater is managed in NSW in the next 20-40 years
- Other (please specify) \_\_\_\_\_

**Please provide any other comments about benefits of cultural and economic opportunities and how we realise those benefits in groundwater management and planning in NSW.**

This concludes the questions specific to your cultural heritage. If you would like to provide additional material to support your position, please email them along with this document.

**Please tell us any other suggested actions you think we should consider in Strategic Priority 2.**

**Strategic Priority 3 – Improve groundwater management decisions with better information**

Strategic Priority 3 aims to support better groundwater management and investment decisions with improved innovation and knowledge.

The strategy identifies 3 key challenges affecting the use of information to manage groundwater resources sustainably.

**Please rank these challenges in order of importance, where 1 = Most important and 3 = Least important.**

- 3\_\_\_\_\_ Being underground and difficult to investigate, information about groundwater is lacking
- 1\_\_\_\_\_ There are gaps in our scientific knowledge and research capabilities
- 2\_\_\_\_\_ Our groundwater monitoring network is ageing and has limited coverage

**Please tell us any other challenge you think is affecting the use of information and data to manage groundwater resources.**

All these three challenges are actually equally important and are highly connected. Please see our attached extended response in relation to this question

**How important is it for you to have access to more information and data about groundwater management and use?**

- Not at all important
- Of minor importance
- Neutral
- Important
- Very important

**How interested are you in finding out more about how groundwater is managed and used?**

- Not at all interested
- Of minor interest
- Neutral
- Interested
- Very interested

**What ways could the department use to communicate with you and others in your community about groundwater management?**

**Please tell us what type of information and data about groundwater resources you would like available on our departmental website?**

The department has put forward a range of draft actions to improve the use of data and information to make groundwater management decisions. The following questions will review each of the draft actions and their sub-actions.

### **Action 3.1 - Develop a groundwater knowledge plan to improve how we use groundwater information to make decisions.**

**To what extent do you agree with this draft action?**

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

### **Action 3.2 - Better share and integrate groundwater information.**

**To what extent do you agree with this draft action?**

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 3.2?

	Not at all important	Of minor importance	Neutral	Important	Very important
Expand the range of knowledge and insights products including information systems, platforms and interfaces for storing, managing, accessing and interrogating groundwater data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Improve and diversify how we communicate information on groundwater resources and their management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Support strategic planning and decision-making by councils and groundwater users with improved access to information on groundwater and its management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Develop a unified framework to consolidate and analyse all groundwater data across all relevant agencies and groundwater users and impacting activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Support data and database integration across agencies to address data gaps and improve customer service delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Action 3.3 - Improve our understanding of groundwater resources.

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 3.3?

	Not at all important	Of minor importance	Neutral	Important	Very important
Expand our multi-disciplinary understanding of groundwater	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Improve our groundwater models where required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Increase our capacity and capability to apply leading groundwater science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Action 3.4 - Expand our groundwater data collection.

To what extent do you agree with this draft action?

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How important to you are each of the following sub-actions required under Action 3.4?

	Not at all important	Of minor importance	Neutral	Important	Very important
Improve our groundwater monitoring infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Improve our groundwater monitoring programs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Please tell us any other suggested actions you think we should consider in Strategic Priority 3.

Please see our extended response in relation to:

- better use of existing data
- explicitly using quantified uncertainty for decisions
- developing opportunities for capacity building in groundwater science

If you have any further feedback, please provide any final comments or upload additional material here.

Please see attached extended response from DARE  
DARE ITTC

## About you

We appreciate your time in responding to this survey. Before you submit your survey response, we would appreciate your feedback to help us more broadly understand our audience. This enables us to communicate more clearly and to customise messages to the community. Please choose 'Prefer not to say', if you would rather not answer a question.

The information you provide will only be used for the purposes of this survey, to assist us in preparing the final NSW Groundwater Strategy and in the development of new groundwater policies and plans for NSW.

### Personal information

Please note, your personal information will only be shared if you granted permission for this to occur.

Name [REDACTED]-----

Email [REDACTED]-----

Your business name (if you are responding on behalf of an organisation)

DARE ARC Industrial Transformation and Training Centre Data Analytics for Resources and the Environment

**How did you hear about this survey?** Select all that apply.

- Community group
- Department's website
- Email or e-newsletter from the department
- Newspaper
- NSW Government announcement
- Radio
- Social media - Facebook
- Social media - Instagram
- Social media - LinkedIn
- Television
- Word of mouth
- Work in the Water industry
- Other (please specify) -----
- Prefer not to say

**What age bracket do you fit into?**

- Under 18 years
- 18 - 24 years
- 25 - 34 years
- 35 - 44 years
- 45 - 54 years
- 55 - 64 years
- 65 - 74 years
- 75 + years
- Prefer not to say

**How do you describe your gender?**

- Female
- Male
- Non-binary
- Other
- Prefer not to say

**Do you speak a language other than English at home?**

- Yes (please specify) \_\_\_\_\_
- No
- Prefer not to say

**Do you identify as a person with a disability?**

- Yes
- No
- Prefer not to say

Enter your postcode:

Thank you for completing this survey. Please email to [nsw.groundwaterstrategy@dpie.nsw.gov.au](mailto:nsw.groundwaterstrategy@dpie.nsw.gov.au)

DARE [REDACTED]

## Draft NSW Groundwater Strategy Response

ARC Industry Transformation and Training Centre in Data Analytics for Resources & Environments

August, 2022



Australian Government  
Australian Research Council



THE UNIVERSITY OF  
SYDNEY



UNSW  
SYDNEY



THE UNIVERSITY OF  
WESTERN  
AUSTRALIA



MACQUARIE  
University  
SYDNEY - AUSTRALIA



Australian  
National  
University

# DARE Centre Draft NSW Groundwater Strategy Response

Contact:

[REDACTED]

ARC Industrial Transformation and Training Centre in Data Analytics for Resources  
and Environments

[REDACTED]

[REDACTED]

August 12, 2022

## 1 Background

DARE is an ARC funded Industrial Transformation Training Centre that is focused on developing Data Science approaches to identify, quantify, and incorporate uncertainty into decision making related to natural resources and the environment. Part of DARE's work has specifically targeted groundwater, given interest in this space from several of our industry partners and the fact that groundwater management tends to be characterised by large uncertainties. As the NSW Draft Groundwater Strategy highlights, groundwater is a crucial resource for NSW industry and agribusiness due to its reliability and quality, particularly in the context of the devastating droughts experienced in 2018/2019.

DARE applauds the NSW government for developing a long-term strategy in relation to groundwater given the timescales of variability in groundwater resources and the fact that the effects of management decisions can take many years to be visible. Long-term investment in monitoring infrastructure and science to support water sharing decisions will pay off over the period considered.

## 2 Acknowledging and working with uncertainty

DARE strongly believes that any decisions around the management of groundwater assets must be accompanied by the recognition, inclusion, and quantification of uncertainty. Uncertainty is common and unavoidable in all the complex processes found in natural landscapes. Uncertainty exists in the observations we make, the analyses we undertake and, in the decision-making process. Incorporating knowledge about uncertainty in decisions will make them more robust and

[REDACTED]

improve how decision makers can mitigate the risks posed by what we do not know. The NSW Draft Strategy (in particular strategic priority 3) makes reference to modelling and management decisions in the face of a range of possible climate scenarios. The strategy places an emphasis on developing and using the “best available models” with new, more representative datasets as a path forward in managing groundwater decision making risks. However, even with improved models and more data, uncertainty will remain. DARE therefore recommends explicitly acknowledging the presence of uncertainty within this section and the role uncertainty quantification can play in improving risk management around groundwater decision making.

**Quantified uncertainties will offer greater insight in differences between decision scenarios, better inform actions to mitigate risks around decisions, and therefore provide more confidence in chosen scenarios.**

Building on these comments, our submission focuses on three main points:

- Data science for efficient and effective groundwater monitoring.
- Decision making for an unknown future.
- Groundwater knowledge capacity building.

## **2.1 Efficient and effective monitoring (Action 3.4)**

In Action 3.4 the NSW Draft Strategy describes the need to upgrade and refocus the current monitoring network, which currently focuses on production aquifers in alluvial systems. This concentration creates a situation with many “known and unknown unknowns” in other areas of NSW. DARE supports the idea of improving the monitoring framework and applauds the recognition that there are many unknowns. However the decision on new monitoring, or even the retention or retirement of existing monitoring, can best be developed “conditional on the data”. The current data, if analysed within an uncertainty framework based on existing and well-established data science approaches, can point to those areas where the most information can be gained from new monitoring points.

Essentially, using standard Data Science approaches, we can combine the underground geological knowledge about formations and the observations in groundwater monitoring points, to develop a prediction model that can predict what the water level would be at any specific location and include the uncertainty around the prediction. If this uncertainty is large, this would point to an excellent location for a new monitoring point. We can, in the same way, predict the water level and uncertainty at all the existing monitoring wells and test how the uncertainty would change, if we remove this monitoring point. If this change is small, we can easily retire the monitoring point.

We therefore strongly recommend that the strategy includes that the upgrade and renewal of both groundwater level monitoring and groundwater quality monitoring is based on a data-informed framework and quantified uncertainty.

The suggested monitoring with uncertainty can be related to three other topics raised in the draft strategy. We generally support the emphasis in the draft strategy on the development of new knowledge on important processes such as groundwater-surface water interaction and recharge in general. And we support the efforts by the NSW Draft Groundwater Strategy to consider groundwater and surface water as a connected resource rather than two separate domains. However, improvement in the information in these areas, apart from increased monitoring, is also dependent on a better and more detailed mapping of the aquifers.

While several of the actions mention integration of information and developing new models, none of the actions is looking at making better use of the existing drilling data to map the underground, for example by using Data Science approaches. More generally speaking, just as new instruments and sensors are being developed, recently developed Data Science approaches can potentially extract new information and new insights from older data that currently is seen as uninformative.

## **2.2 Decision making for an unknown future (actions around strategic priority 1)**

The NSW Draft Strategy describes many actions to protect groundwater resources and the ecosystems that depend on them. Most of these actions highlight the need to improve information and decision making, and this feeds into the actions around strategic priority 1, but also has clear links to the actions around strategic priority 3, particularly in relation to improving models.

We are often faced with making decisions about an unknown future, and this has become more urgent due to climate change and ecosystem degradation. To make better decisions for groundwater stewardship, we agree that improved models and new data to improve those models are needed, particularly in relation to specific processes (such as groundwater surface water interaction and recharge) that are not fully understood.

However, as DARE, our recommendation is that quantified uncertainties in the modelling are needed to provide further opportunities to target investment in data collection. As highlighted earlier, quantified uncertainties will offer greater insight in differences between decision scenarios and therefore provide more confidence in the chosen scenario. DARE encourages the focus on a more multi-disciplinary approach (Action 3.3.1 and 3.3.2) in the Draft Strategy but believes that the current statements could be broadened. In the context of an increasingly data rich environment, we believe that there is a need for domain experts to work with specialists in the Data Science area. We therefore recommend that the NSW Draft Strategy includes reference to opportunities in data-driven or machine learning modelling as a further option to improve science for decision making.

Taking a more comprehensive approach to multi-disciplinary and broader view

of uncertainty in the strategy will create better opportunities to target monitoring, improve modelling and develop better water sharing decisions. All forecasting and modelling should incorporate some level of quantified uncertainties.

**Until recently quantified uncertainties have been seen as obscure, complex and difficult to compute. However, improved computing infrastructure available in NSW and several tools and toolboxes are now easily accessible or can be modified to suit specific needs. As a result quantifying uncertainties has become very achievable, even for complex problems.**

### 2.3 Groundwater knowledge capacity building (Action 3.3)

This section of the response is related specifically to Action 3.3.3, but also builds on the need to build capacity in quantifying uncertainties in models and in designing monitoring frameworks.

All actions listed in the NSW Draft Strategy are reliant on data and information describing complex interactions, people and landscapes. Many of the actions describe a need to improve models or increase data and information. The tools to do this are now accessible, and the computing technology is available. What is often missing is the human capacity and training.

There is a dearth of training opportunities for groundwater specialists in NSW at the university level. Only Flinders University in South Australia provides a specialist degree in this area<sup>1</sup>. This means that in NSW (and in fact on the Australian east coast) groundwater training is dependent on snippets within other degrees and “on the job training”. Importantly, there is also no comprehensive approach to uncertainty quantification in the training through strong interdisciplinary integration with Mathematics and Statistics.

The overall lack of opportunities is mainly because the demand for groundwater hydrologists is still relatively small across Australia and, as highlighted, uncertainty quantification is seen as difficult. In the current university funding environment this means that running training in these areas is seen as unsustainable by the University institutions.

As the NSW government develops its long-term strategy on groundwater, it is worth considering the excellent opportunities that exist to invest in specialised university-level training, especially if combined with significant Data Science and numerical simulation model training. There is potential to develop this in collaboration with industry to build significant new capacity for NSW, leading to increased capacity in the NSW Government and the private industry.

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<sup>1</sup>Postgraduate courses - Groundwater Hydrology - Flinders University

The cover image shows the Murray River, Australia's longest. The river is of significance for food production in several states, and as an important aquatic ecosystem.

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