



NSW Aquifer Interference Policy

From the eyes of a regulator

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Hydrogeology

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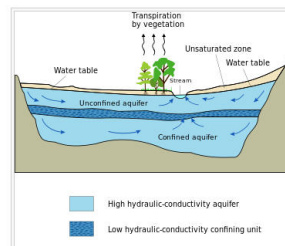


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Hydrogeology (*hydro-* meaning water, and *-geology* meaning the study of the [Earth](#)) is the area of [geology](#) that deals with the distribution and movement of [groundwater](#) in the soil and rocks of the Earth's [crust](#) (commonly in [aquifers](#)). The term **geohydrology** is often used interchangeably. Some make the minor distinction between a [hydrologist](#) or engineer applying themselves to geology (geohydrology), and a [geologist](#) applying themselves to [hydrology](#) (hydrogeology).

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NSW Aquifer Interference Policy

- Commenced September 2012
- Followed on from several years of earlier development and an election commitment
- Applies across the state
 - *Water Management Act 2000*
 - *Water Act 1912*
- Provides clear and objective guidance to ensure project impacts are properly managed

NSW Aquifer Interference Policy – key points

- Account for all water taken, including post closure
- Assess impacts
 - Water table
 - Water pressure
 - Water quality
- Understand and quantify risks, outline mitigation and risk management strategies

AIP: Accounting for water

- Must account for all water for regardless of quality
- All affected water sources must be considered
- Water licences may be required in multiple sources and multiple water sharing plans
- Assessment against rules of water sharing plan
- Must account for ongoing take
- Passive inflow and seepage is considered take

AIP: Accounting for water - tips

- Clear and unambiguous tables
- Consolidated summary – surface & groundwater
- Indication if water is required for operation or is incidental
- Annual & maximum, year by year if possible
- Present information in a consistent format
- Ensure management against existing water licences is clear

AIP: Assessing the impacts

- Groundwater types
 - highly productive (as mapped – not site specific)
 - less productive
- Aquifer types
 - Alluvial
 - coastal sands
 - porous rock
 - fractured rock

AIP: Assessing the impacts

- Impact types
 - water table
 - water pressure
 - water quality
- Impacts on water dependent assets
 - water supply bores
 - groundwater dependent ecosystems
 - groundwater dependent culturally significant sites
 - highly connected water sources (incl surface water)



AIP: Assessing the impacts

- Level 1 impacts are defined as acceptable
- Level 2 impacts will need additional work

Table 1 – Minimal Impact Considerations⁽¹⁾ for Aquifer Interference Activities

Highly Productive Groundwater Sources			
	Water Table	Water Pressure	Water Quality
1. Alluvial Water Sources These considerations apply to all highly productive alluvial groundwater sources except those listed at item 1.1	1. Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" ⁽²⁾ variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan; or A maximum of a 2m decline cumulatively at any water supply work.	1. A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" ⁽²⁾ pressure head above the base of the water source to a maximum of a 2m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	1. (a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity; and (b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected ⁽³⁾ surface water source that is defined as a "reliable water supply" ⁽⁴⁾ is not an appropriate mitigation measure to meet considerations 1. (a) and 1. (b) above.
	2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies ⁽⁵⁾ will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2m decline cumulatively at any water supply work then make good provisions should apply.	1. A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the top of the relevant aquifer ⁽⁶⁾ to a maximum of a 3m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works, unless make good provisions apply, unless make good provisions apply.	(c) No mining activity to be below the natural ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial water source - whichever is the lesser distance) of a highly connected surface water source that is defined as a "reliable water supply". (d) Not more than 10% cumulatively of the three
1.1 Lower Murrumbidgee Deep Groundwater source			



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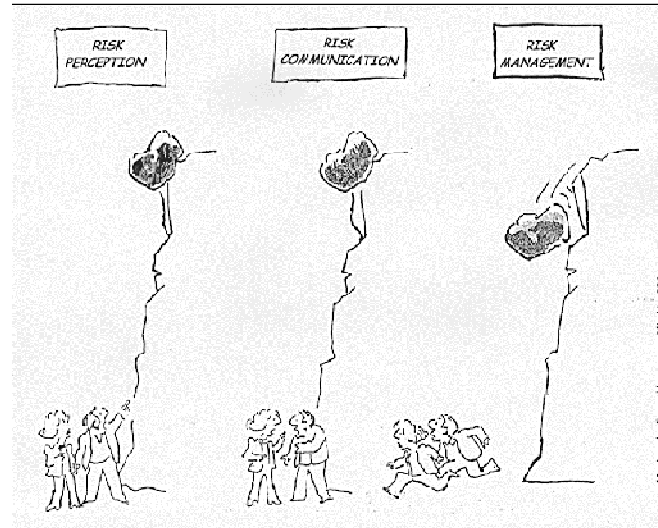
AIP: Assessing the impacts - tips

- Clearly identify sensitive receptors
 - Water users
 - GDEs
 - Town water
 - Etc
- Who or what could be impacted?
- GDEs – address all GDEs, not just high priority
- Water quality – categorise the existing beneficial uses



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AIP: Risk management



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AIP: Risk management

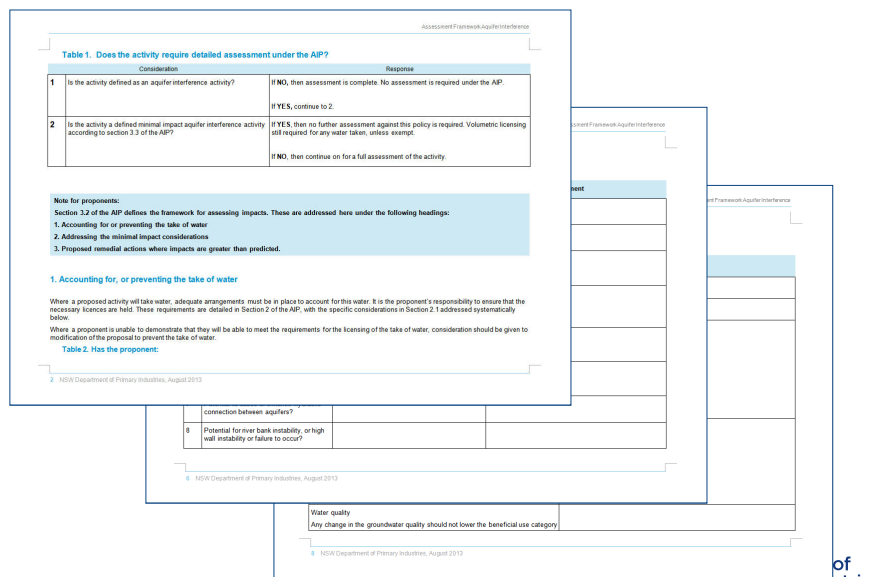
- Understand the risks
- Minimise risks (avoid, prevent, reduce)
- Plan remedial actions
- Ensure appropriate conditions
- Update modelling as data improves
- Monitoring
- Security deposits
- Penalties



AIP: Risk management - tips

- Understand and define uncertainty, sensitivity
- What are the potential impacts if modelling is not perfect?
- How could these impacts be managed?
- What monitoring is required?
- Need an understanding of feasible and available mitigation options up front.
 - Details of application of measures can be deferred to post-management plan, but we need to understand that feasible options exist.

AIP Assessment framework



Modelling

- Bad data = bad model
- Understand and use the Australian GW modelling guidelines
- Consider alternative conceptualisations
- Classify, and justify model confidence classification according to guidelines
- Peer review – use template
- Provide information on ongoing review and validation of model – and what will be done if predictions are a long way out

Table 2-1: Model confidence level classification—characteristics and indicators					
Confidence level classification	Data	Calibration	Prediction	Key indicator	Examples of specific uses
Class 3 Key indicators met: 3	- Spatial and temporal distribution of groundwater level observations adequately reflect groundwater behaviour, frequency in areas of greatest interest and where outcomes are to be reported. - Spatial distribution of bore logs and associated stratigraphic interpretations clearly define aquifer geometry. - Reliable measured groundwater extraction and injection data is available. - Spatial and temporal data is available. - Analysis testing data to define key parameters. - Groundwater and stage measurements are available with reliable baseline estimates of a number of points. - Reliable land use and soil response data available. - Reliable irrigation application data (where relevant) is available. - Good quality and adequate spatial coverage of digital elevation model to derive ground surface elevation.	- Adequate validation is demonstrated. - Current data only (per Chapter 5) or other calibration statistics are acceptable. - Long-term trends are adequately represented where these are important. - Seasonal fluctuations are adequately replicated where these are important. - Transient calibration is current, i.e. uses recent data. - Model is calibrated to include the calibration period. - Observations of the key modelling outcomes dataset is used in calibration.	- Length of predictive model is not excessive compared to length of calibration period. - Temporal distribution used in the predictive model is consistent with the observed calibration period. - Level and type of stresses included in the predictive model are within the range of those used in the calibration. - Model validation is demonstrated for scenarios and/or times outside the calibration period. - Steady-state predictions used when the model is calibrated in steady-state only.	- Key calibration statistics are acceptable and meet agreed targets. - Model predictive time frame is less than 10 times the duration of transient calibration. - Stresses are not more than 2 times greater than those predicted in calibration. - Temporal distribution in predictive model is the same as that used in calibration. - Mean relative error is less than 0.2% of total. - Mean parameter consistent with conceptualisation. - Appropriate comparison of model output with appropriate groundwater model to model the problem. - The model has been reviewed and assessed for purpose by an experienced, independent hydrogeologist with modelling experience.	- Suitable for predicting groundwater responses to arbitrary changes in aquifer stress or hydrological conditions, provided the model is used within the model domain. - Provide an indication for sustainable yield determinations for high-value regional aquifer systems. - Evaluation and management of potentially high-risk impacts. - Can be used to design complex mine dewatering systems, saltwater intrusion, schemes or water allocation plans. - Consistent interaction between groundwater and surface water bodies to a level of reliability required for decisions linkage to surface water impacts. - Assessment of complex, large-scale saline landscape parameters.
Class 2 Key indicators met: 3 Confid overall	Groundwater head observations are not available but may not provide adequate coverage throughout the model domain.	- Validation is either not demonstrated or is not demonstrated for the full model domain. - Calibration statistics are generally reasonable but may suggest significant errors in parts of the	- Transient calibration for a short time frame compared to that of prediction. - Model validation is demonstrated for scenarios and/or times outside the calibration period. - Steady-state predictions used when the model is calibrated in steady-state only.	- Key calibration statistics suggest poor calibration in part of the model domain. - Model predictive time frame is more than 10 times the duration of transient calibration. - Stresses are not more than 2 times greater than those predicted in calibration. - Mean relative error is less than 0.2% of total. - Mean parameter consistent with conceptualisation. - Appropriate comparison of model output with appropriate groundwater model to model the problem. - The model has been reviewed and assessed for purpose by an experienced, independent hydrogeologist with modelling experience.	- Prediction of impacts of proposed developments in medium value aquifers. - Validation and management of medium risk impacts.
	- Observations and measurements inconsistent or sparsely distributed in areas of greatest interest. - No available records of relevant groundwater extraction or injection. - Climate data only available from relatively nearby locations. - Little or no useful data on land use, soils or river flows and stage elevations.	- Calibration is based on an inadequate distribution of data. - Calibration only to a degree other than that required for prediction.	- Transient predictions are made where calibration is in steady state only. - Model validation suggests unacceptable errors where calibration dataset is extended in time and/or space.	- Model predictive time frame is more than 10 times longer than transient calibration period. - Stresses in predictions are more than 2 times higher than those in calibration. - Stress period or calculation interval is different from that used in calibration. - Transient predictions made but calibration is steady state only. - Cumulative mass balance closure error exceeds 1% or exceeds 5% at any point. - Model parameters violate the range expected by the conceptualisation with no further justification. - Unacceptable spatial or temporal discretisation. - The model has not been reviewed.	- Design of water supply for pumping trials. - Predicting long-term impacts in proposed developments in low-value aquifers. - Estimating discharge of treated effluents. - Understanding groundwater flow processes under various hypothetical conditions. - Provide field data collection of water volumes and rates required for mine dewatering. - Determining water relationships between various locations and rates and associated impacts. - As a starting point on which to develop more detailed models as more data is collected and used.

(*refer Chapter 5 for discussion around validation as part of the calibration process)

General tips – help us help you

- Don't make us solve a puzzle. Key points should be up front and centre.
- Use available templates and guidelines.
- Avoid extensive cross-referencing – it can be hard to manage and review.
- High quality maps and diagrams
- Visualisation assistance – x-sections, 3D
- Use standard and consistent bore numbers
- Responding to submissions – tabulated responses are great

More information

- Fact sheets
- Website
- Guidelines
- Assessment framework
- Guide to the AIP (coming soon!)

