Department of Climate Change, Energy, the Environment and Water

NSW Water Quality Monitoring Framework

Schedule E: Early Warning System

June 2026

NSW GOVERNMENT

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the traditional custodians of the land and pays respect to Elders past, present and future.

We recognise Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to place and their rich contribution to society.

Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

NSW Water Quality Monitoring Framework

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Copyright and disclaimer

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Glossary

Term	Description
AGI	Australian Government Initiative
ANZECC	Australian and New Zealand Environment and Conservation Council
APHA	American Public Health Association
API	Application Programming Interface
BoM	Bureau of Meteorology
CPHR	Conservation, Programs, Heritage and Regulations (DCCEEW Branch)
Data Custodian	Organisations collecting water quality data and providing it to the Integrating Authority under the Framework.
DO	Dissolved oxygen
DPIRD	Department of Primary Industries and Regional Development
Early warning system	For the purposes of the Framework, an early warning system is a coordinated set of monitoring, assessment, communication and governance processes that provide timely information about emerging water quality risks to support preparedness, expert interpretation and response.
EPA	NSW Environmental Protection Authority
FAIR	Findable, Accessible, Interoperable and Reusable
Integrating Authority	The group or agency responsible for overseeing the Framework and the integration, sharing and publishing of data
ISO	International Organisation for Standardisation
MDBA	Murray-Darling Basin Authority
MHL	Manly Hydraulics Laboratory
NSS	Australian Government, National Statistical Service
NSW	New South Wales
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
NSW SEED/SEED	NSW Sharing and Enabling Environmental Data (Portal)
NWQMS	National Water Quality Management Strategy

Term	Description
OCSE	NSW Office of the Chief Scientist and Engineer
Pilot Group/Pilot Stakeholder Agencies	The primary group of agencies involved in the development and implementation phases of the Framework
PIRMP	Pollution Incident Response Management Plan
QA/QC	Quality Assurance/Quality Control
SCARMS	Sydney Catchment Aquatic Real-time Management System
SME	Subject Matter Expert
SPSE	Strategic Policy, Science and Engagement Group (DCCEEW Branch)
Statutory Obligations	Legal duties that are required from the involved organisations/institutes or individuals
Technical Solution	The combination of processes and digital platforms that will enable better data sharing under the Framework.
WQMF	Water Quality Monitoring Framework

1 Background

The NSW Water Quality Data Framework project (the Framework) is aimed at improving the collection, sharing, and publication of water quality data across NSW.

It is being developed as part of the NSW Government's broader response to the Office of the Chief Scientist and Engineer's review of the Menindee fish death event. Delivery of full responses and commitments are progressing through the Restoring the Darling–Baaka River program.

The Framework also aligns with the NSW Water Strategy's priority to improve the health of river, floodplain, and aquifer ecosystems.

The Framework is a central component of the NSW Water Quality Governance Roadmap.

Water quality data is currently collected, stored, and used by various government agencies and organisations. However, there is a need to improve data visibility among these agencies and enhance transparency and data accessibility with the wider community.

The principles of the Framework are a commitment to:

- open data and transparency and to the NSW Government's open data framework
- the Framework's agreed standards and protocols for data collection, management and publication and to continual improvement and development of these standards
- sharing metadata that is discoverable and sufficient for publication
- FAIR data principles (Findable, Accessible, Interoperable and Reusable)
- the vision of any person being able to easily access information on the quality of the water in their local area, or area of interest, through any connected device.

This schedule provides guidance to agencies and organisations monitoring surface water quality to develop and improve data management and response practices that underpin effective early warning systems.

2 Introduction

For the purposes of the Framework, an early warning system refers to a coordinated set of monitoring, assessment and communication processes designed to support preparedness and decision making under uncertainty. Early warning systems do not predict with certainty or prevent all incidents. Rather, they improve situational awareness and decision making under conditions of uncertainty and variability.

This schedule works in conjunction with other Framework documentation, notably:

- Schedule A: Data sharing and governance
- Schedule C: Data sharing process to organise, improve and share water quality data.

Schedule E describes the range of early warning systems currently used in NSW to identify, track and interpret emerging water quality risks. These systems form a key operational component of the

NSW Water Quality Monitoring Framework, which aims to improve the consistency, discoverability and accessibility of water quality information across the state for timely decision-making.

It is important to note that an early warning system does not necessarily indicate that a water quality incident will occur. Natural variation in environmental conditions, water quality behaviour and catchment processes means that many warnings will not progress to incidents. As a result, expert interpretation is essential to determine when a signal truly represents an elevated risk and whether escalation, additional monitoring or public communication is warranted.

Early warning systems can operate using multi-level trigger processes, where increasing levels of risk correspond to escalating responses. Lower-level triggers may prompt increased monitoring or internal alerts, while higher-level triggers may initiate response plans, inter-agency coordination or public communication. This supports adaptive management, allowing responses to be scaled proportionally to risk.

Monitoring programs across NSW are designed to meet specific objectives and local conditions, resulting in variation in parameters measured, methods applied and data management practices. As such, it is not practical to prescribe a single set of standards for how water quality data is collected, managed or shared. Early warning systems instead provide a framework for response to monitoring data. By establishing agreed parameters, trigger thresholds and escalation pathways within a response plan, agencies can ensure that emerging risks are identified, communicated and managed in a consistent, timely and coordinated manner, regardless of differences in underlying monitoring approaches.

In the same way, not every water quality incident can be prevented.

Only two rivers in NSW currently have a water allocation dedicated to influencing water quality outcomes: Menindee Lakes and Lower Darling River and Lachlan River.

In most systems, responses focus on monitoring, preparedness and coordinated communication rather than direct intervention.

An early warning system flags emerging risks and is linked to a clear incident response plan, ensuring that when trigger thresholds are reached, roles and actions are already defined and can be executed without delay.

An early warning system includes the following core components:

- A monitoring network capable of detecting relevant parameters at appropriate temporal and spatial resolution.
- Examples of defined trigger thresholds linked to specific parameters, at which alerts are escalated.
- Communication and notification protocols that specify who is notified, by whom and within what timeframe, when a trigger is reached.
- Linkage to incident response plans, so that when a trigger is reached, the appropriate response is clearly defined and can be executed without delay.
- Roles and responsibilities that are documented and understood across all participating agencies.
- A process for review and continuous improvement.

3 Preliminary scope

In alignment with the overarching Framework, this document prioritises surface water quality data and its application in operational early warning systems to identify emerging water quality risks and inform evidence-based assessment and action.

This schedule provides guidance on the design, operation and continual improvement of water quality early warning systems. It describes the key components, processes and considerations required to identify emerging water quality risks and support timely, coordinated assessment and response.

The scope of Schedule E is deliberately limited to water quality early warning systems. It does not:

- mandate a single technical solution, monitoring network or decision-support system
- address the development of technical platforms, systems or databases
- address broader strategic initiatives, such as integrated catchment management
- address detailed roles and responsibilities for data management and governance (refer to Schedule A)
- guarantee the prevention of water quality incidents or impacts
- replace agency-specific statutory responsibilities or existing incident response arrangements
- define detailed incident response actions or clean-up procedures.

Response actions for mass fish deaths or fish clean-up are outside the scope of this schedule. For further information, refer to the Protocol for investigating and Reporting Fish Kills.

For more details on the broader scope, governance arrangements, and system-level initiatives, refer to the Water Quality Monitoring Framework Overview document.

3.1 Water quality monitoring for early warning systems

Effective water quality monitoring with an early warning system relies on a combination of real-time data capture, appropriate site selection, and the integration of historical evidence. The design and implementation of monitoring programs should follow the detailed technical guidance provided in Schedule B: Data Standards and Protocols, including requirements for instrumentation, sampling frequency, and selection of representative monitoring sites.

Roles and responsibilities for data management such as data custodianship, ownership, quality assurance, reporting obligations, and information-sharing pathways are set out in Schedule A and should be followed when establishing or maintaining any monitoring program.

Where available, historical water quality data and documented past events (e.g., algal blooms, hypoxic blackwater, fish deaths) should be incorporated as they support the understanding of local risk profiles and establish baseline variability for the specific location.

All monitoring activities should align with relevant national frameworks including the National Water Quality Management Strategy (NWQMS), ensuring consistency in measurement methods, quality control, and interpretation of results.

3.2 Trigger thresholds

Trigger thresholds should be developed and approved by suitably qualified scientific professionals, considering the local ecological, hydrological, and geomorphic conditions of the monitoring location. Thresholds should be evidence-based, site specific, and sensitive enough to detect early warning signals without generating unnecessary false alarms. Ideally the trigger thresholds and available management actions would be documented in an incident action plan or resource management for the location.

Where possible, water quality thresholds should draw on widely accepted standards and scientifically validated guidelines such as those from the International Organization for Standardization (ISO), the Australian and New Zealand Environment and Conservation Council (ANZECC), and the National Water Quality Management Strategy (NWQMS). These benchmarks provide consistency across jurisdictions while still allowing for refinement based on local characteristics.

Triggers may be set for indicators such as algae (including chlorophyll or cyanobacteria counts/biovolumes), dissolved oxygen (DO), and general water quality parameters relevant to the risk at that location.

To support transparency and rapid detection, thresholds should be embedded in real-time monitoring platforms (e.g., WaterInsights tools or equivalent web-based systems) that enable automated alerts and continuous data visualisation.

3.3 Quality assurance and quality controls

Quality control and quality assurance (QA/QC) are critical to the effectiveness of an early warning system. Decisions about escalation, incident response and communication depend on confidence in the underlying data. Without appropriate QA/QC processes, early warning signals may be missed, misinterpreted or generate false alarms.

Quality assurance refers to the systems, procedures and standards put in place to ensure data collection and management processes are fit for purpose. Quality control refers to the operational checks applied to data to identify errors, anomalies or instrument issues before the data is used for decision making or shared with others.

QA/QC processes for early warning systems should be proportionate to the level of risk, the monitoring method used and the reliance placed on the data for operational decisions.

Key principles for QA/QC within early warning systems include:

- Monitoring equipment should be fit for purpose and appropriate for the environment in which it is deployed.
- Sensors and instruments should be maintained, calibrated and serviced according to documented procedures and manufacturer specifications.

- Data should be routinely screened for obvious errors, drift, sensor fouling or transmission issues, particularly for high frequency monitoring systems.
- Clear data quality flags or qualifiers should be applied to indicate provisional, validated or suspect data, particularly where automated telemetry is used.
- Where possible, automated QC rules (for example, range checks, rate of change checks or persistence checks) should be combined with expert review to identify anomalous values.
- Procedures for responding to suspected instrument failure or data quality issues should be documented and understood by operational staff.
- Where field sampling and laboratory analysis is used, appropriate QA/QC measures should be applied. This may include field replicates, blanks, calibration checks, sample preservation protocols and laboratory quality controls, consistent with relevant national standards (refer to Schedule B).

For early warning purposes, it is recognised that data may need to be used in near real-time, before full validation has occurred. In these cases, agencies should clearly identify provisional data and apply a risk-based approach to decision making, supported by expert judgement and, where necessary, corroborating information from other sources (for example, field observations or satellite imagery).

QA/QC processes should be documented and reviewed periodically to ensure they remain appropriate as monitoring technologies, data systems and management needs evolve.

3.4 Communication and notification protocols

Effective communication is a core component of a reliable early warning system. Clear and well-defined communication and notification protocols ensure that information about emerging water quality risks is shared promptly, consistently and with the appropriate parties.

Communication protocols should clearly define who is notified, by whom, when, and how, for each alert level or trigger. These protocols should be aligned with the roles and responsibilities outlined in Schedule A: Roles, Responsibilities and Governance.

Communication pathways should be established and agreed in advance, rather than developed during an escalating event. This supports timely escalation, consistent messaging to reduce ambiguity and helps ensure a coordinated response across agencies and organisations.

Key principles for communication and notification include:

- Notifications should occur as early as practicable once a trigger threshold is reached or an emerging risk is identified.
- Agencies should not delay communication while waiting for higher alert levels if early notification would support preparedness or coordinated assessment.
- Communication pathways should reflect the severity and potential consequences of the risk, with escalation pathways clearly defined.
- All notifications should be documented, including the date and time of notification, recipient details, alert level and the trigger or data that prompted the notification.

- Communication protocols should be regularly tested and reviewed as part of system evaluation and continuous improvement.

3.4.1 Advanced warning vs. public communication

Advanced warning to agencies and operational staff is distinct from public communication. Many early warning alerts are intended to support internal awareness, preparedness and coordination and will not require public messaging.

Advance warnings are issued in line with the roles, responsibilities and governance arrangements defined in Schedule A, using data assessed and interpreted consistent with Schedule B, and shared through agreed processes outlined in Schedule C.

Advance warnings are used to:

- Flag emerging or potential water quality risks.
- Prompt increased monitoring or expert assessment.
- Support preparedness, coordination and escalation planning.

Public communication should occur where there is a clear need to inform the community, such as when there is a direct or foreseeable risk to public health, recreational safety, drinking water supplies or environmental values, or when regulatory actions are triggered (for example, section 324 orders).

Decisions to issue public advisories are the responsibility of the relevant lead agency (refer to Schedule A) and should consider data confidence (Schedule B) and the need for coordinated messaging (Schedule C).

Advanced warning and public communication processes should be distinct but aligned, ensuring internal notifications support timely and coordinated public messaging where required.

3.5 Review and refinement

Early warning systems should be treated as adaptive tools and reviewed regularly to ensure they remain effective, fit for purpose and aligned with evolving risks, technologies and management needs.

Review and refinement should occur:

- Following a significant water quality incident or near miss.
- After prolonged monitoring periods where triggers were frequently reached or consistently not reached.
- When monitoring technologies and data platforms change.
- On a scheduled basis as part of routine governance and assurance processes.

Reviews should assess:

- The adequacy of monitoring coverage, parameter selection and sampling frequency.
- The appropriateness and sensitivity of trigger thresholds.
- The effectiveness of communication and notification protocols.

- Data quality and timeliness, including the performance of QA/QC processes.
- The clarity of roles, responsibilities and escalation pathways.
- The adequacy and sustainability of funding arrangements.

Lessons learned from incidents, exercises, or system testing should be documented, recording the rationale for implementing management actions and assessing the success (or otherwise) of these actions and, where appropriate, used to refine thresholds, update protocols or improve coordination arrangements.

Review outcomes should be shared across participating agencies to support consistency, transparency and continual improvement across NSW water quality early warning systems.

4 Menindee: an example of inter-agency early warning and response processes

The Menindee and Barwon–Darling system is an example of how early warning systems can be implemented in practice, including inter-agency coordination and trigger-based escalation.

Water quality incidents and fish death events in NSW are managed through a multi-agency framework involving water, environment, fisheries, emergency management and public health agencies. Early warning systems play a critical role in supporting this framework by providing advance notice of emerging risks, enabling coordinated assessment, preparedness and escalation where required.

Inter-agency coordination is supported through a combination of formal governance arrangements and established operational relationships. These include basin-scale monitoring programs, regional advisory and coordination committees and incident-specific response plans.

Operational responses are primarily guided by the Protocol for Investigating and Reporting Fish Kills and the Extreme Events Policy, with responsibilities distributed across agencies in accordance with their statutory functions.

Following the Office of the Chief Scientist and Engineer's 2023 report into the Menindee fish deaths, early warning systems in the Menindee and Barwon–Darling regions have been improved. These include expanding the monitoring network, increasing spatial and depth profile coverage, and improving access to near real-time water quality data to support earlier detection and coordinated response.

As of early 2026, the Menindee early warning system relies on the following key components.

4.1 Menindee early warning system

To reduce the risk of further fish deaths in the Lower Darling-Baaka, the NSW Government implemented a water quality incident plan during 2023–24 summer. The plan established an early warning system based on real-time water quality data from monitoring stations in the Menindee Lakes and Lower Darling-Baaka, with defined triggers used to identify emerging risk and guide

coordination arrangements. Refer to the NSW Government response document for more information.

4.2 The Menindee dashboard and stratification model

The Menindee decision support system integrates real-time water quality data with Bureau of Meteorology weather forecasts and thermal stratification modelling (Figure 1). The system is used to assess and predict dissolved oxygen dynamics in the Menindee weir pool, particularly during periods of stratification and mixing events, which present an elevated risk of fish deaths.

Predicted declines in dissolved oxygen inform preparedness and response actions, with activation of the Incident Action Plan linked to a 3.5 mg/L dissolved oxygen trigger at Menindee township.

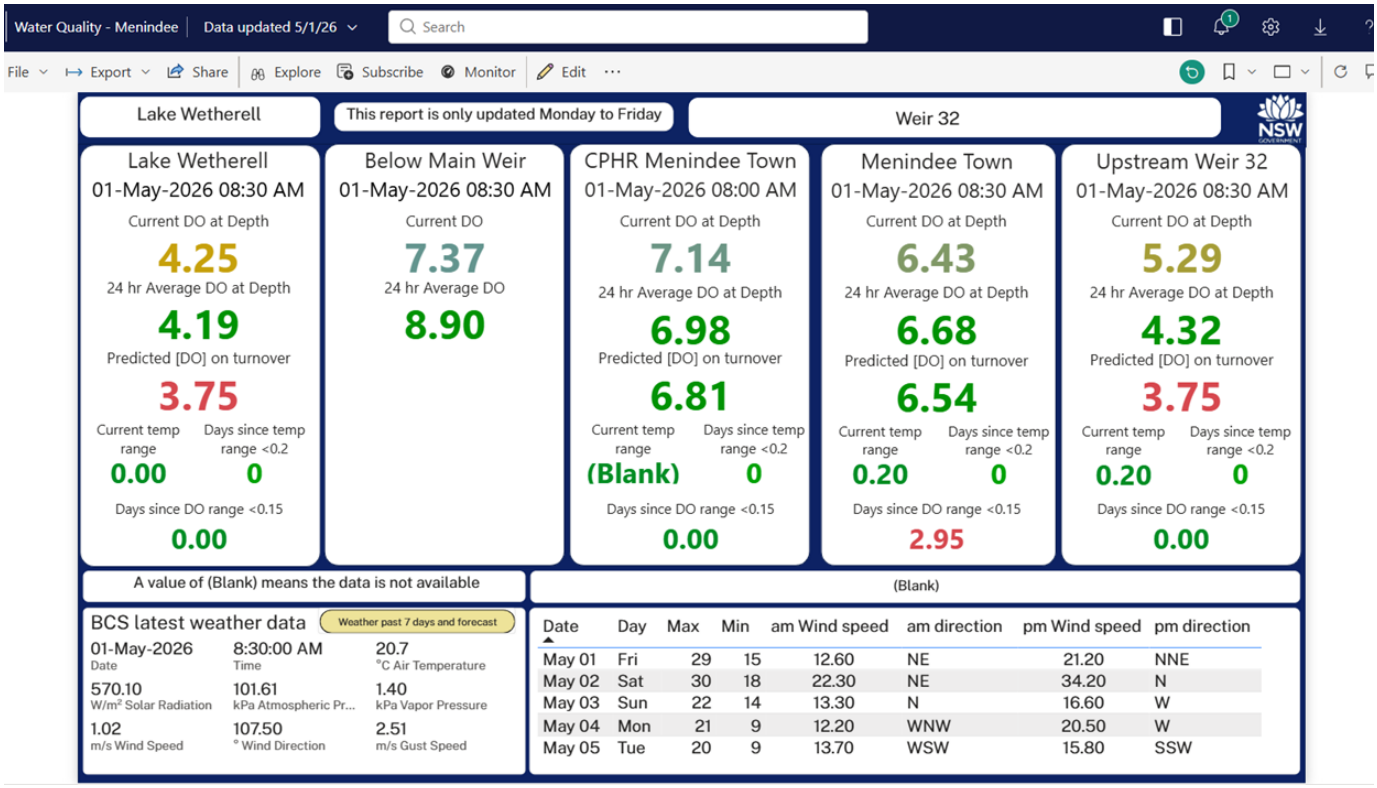


Figure 1: The Menindee decision support tool

4.3 Real-time water quality monitoring/WaterInsights

The backbone of the early warning system is a network of multi-depth monitoring pontoons and buoys (notably in the Menindee town weir pool). These sensors measure DO, conductivity, temperature, turbidity, pH, phycocyanin and chlorophyll at multiple depths. The data is accessible on the WaterInsights Portal (Figure 2). This is a public-facing dashboard providing "near real-time" data on river heights, flows, water quality data and current algae alert levels (Green, Amber, Red) across NSW. Real-time water quality data collected for the Darling-Baaka River Health Program is also publicly available and is used to assess fish health risks and guide flow management decisions.

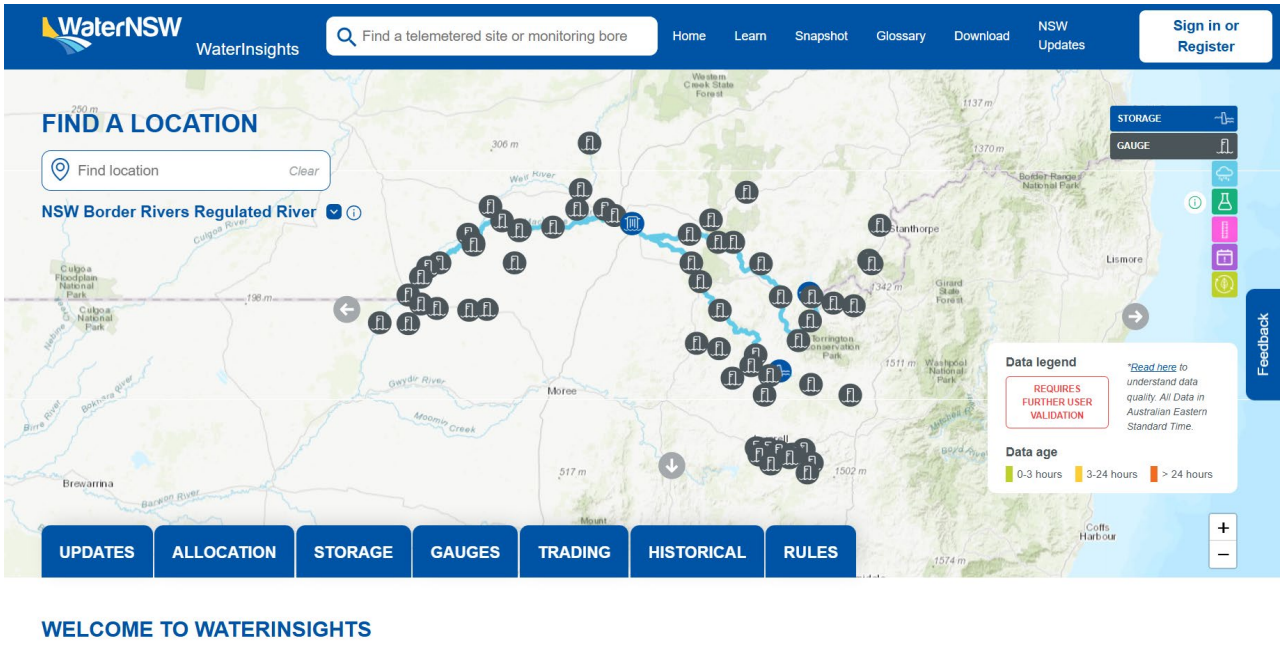


Figure 2: WaterInsights Portal

4.4 Cyanobacteria / blue-green algae monitoring

Cyanobacteria monitoring uses a combination of routine field sampling, laboratory cell counts and satellite imagery. Satellite imagery (Sentinel 2) is used to detect and track surface algal blooms over large spatial scales, particularly in lakes and wider slow-flowing river reaches.

This information supports water management decisions, including operational responses such as regulator closures (for example, the Lake Wetherell outlet) to limit the downstream movement of potentially toxic algae. However, satellite imagery is limited to surface detection, cannot identify sub surface blooms and is affected by cloud cover, meaning it must be interpreted alongside in situ monitoring and expert assessment. Current algal alerts can be publicly viewed from the WaterNSW algal alerts NSW map (Figure 3) or on WaterInsights.

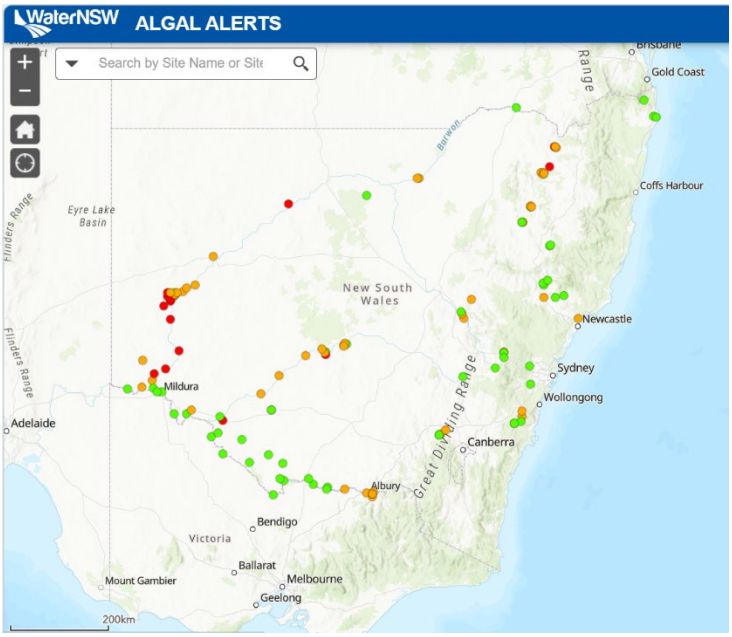
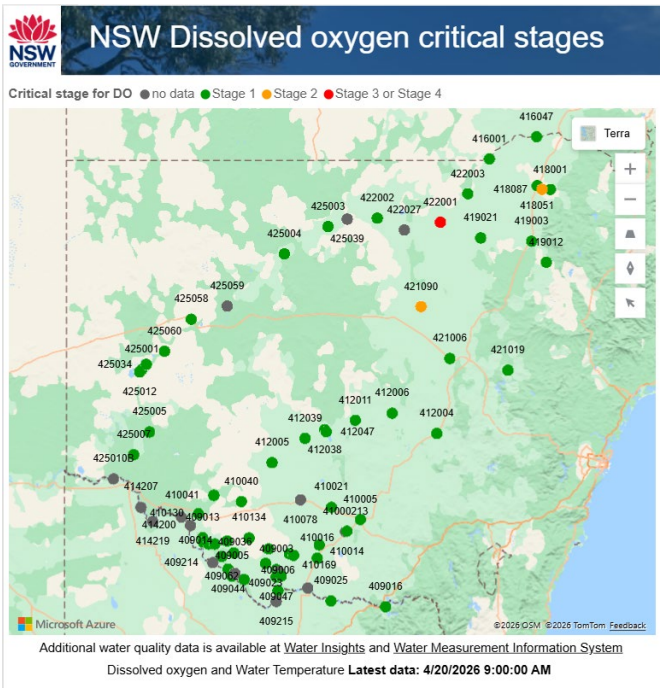


Figure 3: WaterNSW Algae Alerts NSW map

4.5 NSW dissolved oxygen Power BI dashboard



A dissolved oxygen Power BI dashboard is used internally by water quality officers to provide a statewide snapshot of dissolved oxygen conditions (Figure 4). Data from continuous dissolved oxygen monitoring sites is drawn from WaterInsights and presented using a staged risk framework, from Stage 1 (Normal) to Stage 4 (Critical). This dashboard supports rapid assessment, identification of emerging risks and detection of potential sensor or data issues, enabling early engagement with water managers where required.

Figure 4: NSW dissolved oxygen dashboard showing critical stages

4.6 Coordination, agreements and limitations

A range of formal and informal coordination mechanisms support early warning and response, including inter-agency committees, regional advisory groups, basin scale monitoring programs and water quality incident response plans (such as hypoxia specific arrangements).

While formal agreements exist in some contexts, coordination frequently relies on established professional relationships and informal communication pathways, which play an important role in information sharing and operational coordination.

There are situations where roles and responsibilities for response are not always clear, particularly where multiple agencies receive early warnings or monitor the same system. In some cases, the agency best placed to respond may also bear the costs and consequences of intervention, even where risks are shared. This highlights the importance of defining funding arrangements, cost-sharing mechanisms, and financial responsibilities as part of early warning system design.

Early warning systems are designed to flag emerging risk rather than trigger a response to every alert. Many warnings will not progress to incidents, and escalation decisions require experienced professional judgement. Effective early warning therefore depends not only on monitoring and triggers, but on clear governance, shared understanding of risk and proportionate responses aligned with incident likelihood and consequence.

5 Other early warning systems and processes

In addition to the systems described in earlier sections, several NSW Government agencies operate early warning systems and processes that contribute to the identification, interpretation and escalation of water quality risks. These systems vary in scope, formality and purpose and are generally designed to support agency specific operational or regulatory functions. Coordination between agencies occurs through a combination of formal protocols and established working relationships, as described in Schedule A: Roles, Responsibilities and Governance.

5.1 NSW DCCEEW Water Group – Surface Water Science unit

The DCCEEW Water Group, through the Surface Water Science unit, uses multiple tools and processes to identify and assess emerging water quality risks. These functions primarily support internal situational awareness, expert interpretation and advice to operational and policy teams.

Key early warning tools and processes include:

- Use of the WaterInsights Portal to access near real-time water quality and hydrological data.
- Subject Matter Expert (SME) analysis of monitoring data, trends and contextual information.
- Use of the Menindee decision support tools to assess hypoxic risk and forecast dissolved oxygen conditions.
- Dissolved oxygen dashboard derived from WaterInsights data.
- Notification of relevant implementation and operational teams where emerging risks are identified.

5.2 WaterNSW

WaterNSW operates agency specific early warning systems primarily focused on drinking water quality and operational risk management.

Key early warning systems and processes include:

- Sydney Catchment Aquatic Real-time Management System (SCARMS), a reservoir decision support system that integrates monitoring data and modelling to identify emerging water quality risks.
- Cyanobacteria (blue green algae) monitoring and alert systems, supporting early detection and operational response.
- Daily emails monitoring and alert processes to maintain situational awareness.
- Internal Water Quality Incident Response Plans, which defines escalation and notification processes, primarily for drinking water risks and NSW Health notification.

5.3 NSW Environmental Protection Authority

The NSW Environmental Protection Authority (EPA) primarily manages water quality issues caused by pollution from licensed activities. While this is generally outside the main focus of the Framework, EPA processes can support early warning where pollution is suspected.

Under the *Protection of the Environment Operations Act 1997*, licensed operators must have a Pollution Incident Response Management Plan (PIRMP) prepared in line with EPA guidelines. PIRMPs require sites to identify pollution risks and set clear steps for notification and response, including notifying the EPA and other relevant authorities.

Further information is available in the EPA guideline Pollution Incident Response Management Plans.

Reports of pollution and environmental incidents are also received through Environment Line, a 24-hour reporting service operated by DCCEEW. Environment Line provides a single point of contact for pollution reports and supports timely assessment and response by the EPA where regulatory action may be required.

Further information is available on the EPA Environment Line webpage.

5.4 NSW Department of Primary Industries and Regional Development – Fisheries

DPIRD Fisheries datasets, including estuarine and oyster-related monitoring, provide important contextual information for understanding ecosystem impacts during low dissolved oxygen events. Fisheries monitoring data, alongside fish kill reports submitted by the community and operational staff, supports early investigation of potential blackwater incidents and contributes to coordinated responses with water and environment agencies.

Reports of fish death incidents or observations can be made through the Fishers Watch Phoneline (1800 043 536), and potential blackwater events can be reported to the department at water.enquiries@dpie.nsw.gov.au.

5.5 NSW DCCEEW Science, Policy and Science Engagement (SPSE)

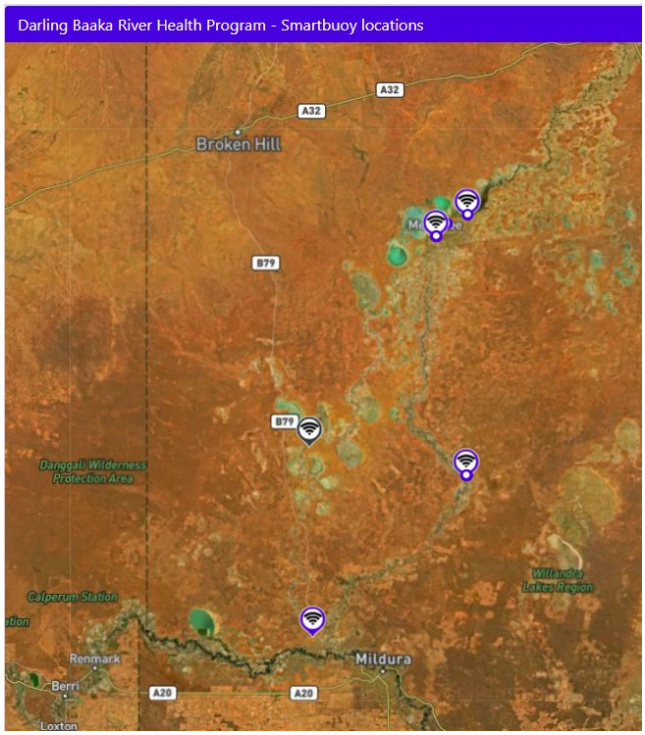


Figure 5: Darling-Baaka River Health Project smart buoy network

The Strategic Policy Science and Engagement (SPSE) unit within DCCEEW deploys a network of smart buoys under the Darling-Baaka River Health Project. Five telemetered loggers are currently operational across the project area (Figure 5), providing continuous depth-profile measurements of key water quality parameters including dissolved oxygen, temperature, turbidity and nutrients.

Monitoring is ongoing across varying flow and weather conditions, with buoy locations subject to change as project needs evolve. The dataset supports improved understanding of water quality dynamics and ecological health in the Baaka River system and contributes to early warning of conditions such as hypoxia and stratification that may pose a risk to aquatic ecosystems.

6 Key considerations

Early warning systems are a critical component of water quality risk management, improving situational awareness, preparedness and coordination across agencies. They help identify emerging risks earlier, support timely expert assessment and enable agencies to prepare for potential impacts. However, early warning systems do not guarantee that water quality incidents can be prevented, particularly in systems with limited options for active intervention.

Water quality risks in NSW rivers are highly variable and strongly influenced by local environmental conditions, geology, hydrology and climate. The primary value of early warning lies in earlier detection of emerging risk, informed expert assessment, and timely response coordination across agencies, rather than guaranteed mitigation of impacts. Clear roles for monitoring, coordination and response remain essential, particularly as the Framework is focused on surface water quality and does not extend to pollution regulation or incident management.

In many river systems, there are limited mechanisms available to remediate poor water quality once impacts occur. This reinforces the importance of prevention, early detection and preparedness over reactive response. Where intervention options do exist, such as targeted water deliveries to mitigate stratification or hypoxia, these are typically constrained by infrastructure, entitlement arrangements and competing objectives.

In this context, the following key considerations are intended to guide the application and ongoing development of early warning systems under the Framework.

- Early warning systems should align with the risk-based and adaptive management principles of the NWQM Strategy, which emphasises the use of monitoring data, guideline exceedances and expert judgement to inform management actions.
- Acknowledging there is no single standard model, early warning systems need to set realistic expectations based on local risk, capacity and purpose, rather than adopting complex solutions where they may not be required. Improvements can gradually be introduced over time in an adaptive management framework.
- Clear links between early warning and decision making are essential. While this Schedule does not define incident response arrangements, early warning systems should clearly document (according to the specific need and purpose of the system) who is responsible for assessment, coordination and advice when warnings are issued. This includes clarifying how multiple agencies work together when risks are shared and ensuring that roles and escalation pathways are understood in advance. These pathways need to be:
  - clearly documented and agreed in advance
  - regularly tested and reviewed
  - robust to staff changes, inconvenient incident times and system failures.

  Clear arrangements support timely decision making and reduce confusion during these events.
- Consideration may be given to recognising water quality remediation in high-risk water sources and exploring mechanisms to support timely cross-agency responses.

Early warning alerts that do not escalate to incidents still provide valuable information and should be reviewed to understand how well the early warning system performed, how decisions were made and whether improvements are needed. Sharing lessons learned from these reviews across agencies will help improve consistency, confidence and effectiveness of early warning systems over time.

7 References

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