

Queensland Integrated Waterways Monitoring Framework

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Summary

The *Queensland Integrated Waterways Monitoring Framework* is a comprehensive model for waterways monitoring in the state. The framework provides best practice waterways monitoring processes and procedures that improve the quality, efficiency, coordination and integration of monitoring coordinated by Queensland Government agencies and other organisations.

The framework encompasses a broad range of activities including monitoring, modelling, assessment and reporting on the pressures and condition of priority waterways. Information obtained from programs within the framework will be incorporated into policy-making processes and 'on the ground' management, thereby improving management of water resources and environmental values. Existing state and regional programs are being aligned with the *Queensland Integrated Waterways Monitoring Framework*. The design of any future monitoring programs will comply with the framework structure.

To improve data confidence, a whole-of-government monitoring and sampling manual and a common web portal have been developed to increase availability of monitoring information.

The framework is being implemented across water quality, water quantity and aquatic ecosystem health programs and will continue to be refined and improved. An important benefit of the framework is the introduction of consistent and appropriate indicators and techniques. This will ensure that data collected by a variety of organisations is able to be collectively analysed and reported at local, regional and state levels. This will greatly improve the efficiency of waterways monitoring programs and access to waterways information, leading to increased community, industry and government knowledge and understanding of waterways condition that results in improved land and waterways management.

1. Introduction

Queensland is a large state with diverse waterways, ranging from ephemeral streams to tidal wetlands and the Great Barrier Reef lagoon. Many waterways are complex and unique ecosystems supporting a wide variety of natural life-forms. Many provide water for drinking, recreation, agriculture and industry. Waterways monitoring provides important information on the condition of waterways to support decision making to manage water resources, catchments and the environment. The Queensland Government conducts different waterways monitoring processes, with programs established for multiple purposes.

The Queensland Government has identified a need to improve the coordination and comprehensiveness of waterways monitoring programs and improve how data is shared and used to improve water quality and ecosystem health. This comprehensive framework has been developed and is being implemented to ensure that all programs are integrated and the data can be used for multiple applications.

Within the Queensland Government several departments have responsibilities for waterway monitoring, including the Department of Natural Resources and Mines (DNRM), the Department of Environment and Heritage Protection (EHP) and the Department of Science, Information Technology, Innovation and the Arts (DSITIA). A collaborative approach to waterway monitoring between the relevant departments is the key to effective integrative management of Queensland's waterways.

1.1 Framework overview

The *Queensland Integrated Waterways Monitoring Framework* is about monitoring and reporting on priority waterways including their physico-chemical, biological and ecosystem condition. The results generated from the programs within the framework will be used for improved policy and management of water resources and environmental values. The framework acknowledges the important link between water quality and quantity.

An integrated framework is important to effectively manage waterways for human use values such as recreation and consumption. . It determines the values to be protected and monitors the outcomes of management and policy implementation, resulting in a continuous cycle of improvement. The *Queensland Integrated Waterways Monitoring Framework* includes policy and management outcomes and will guide the design and implementation of waterways monitoring by the Queensland Government. Figure 1 illustrates the framework structure.

Developing the *Queensland Integrated Waterways Monitoring Framework* involved experts from a wide range of water quality and aquatic ecosystem related disciplines such as water quality monitoring, modelling, remote sensing and Geographic Information Systems (GIS). It has accelerated the alignment of existing waterways monitoring programs and ensured different Government agencies continue to work collaboratively.

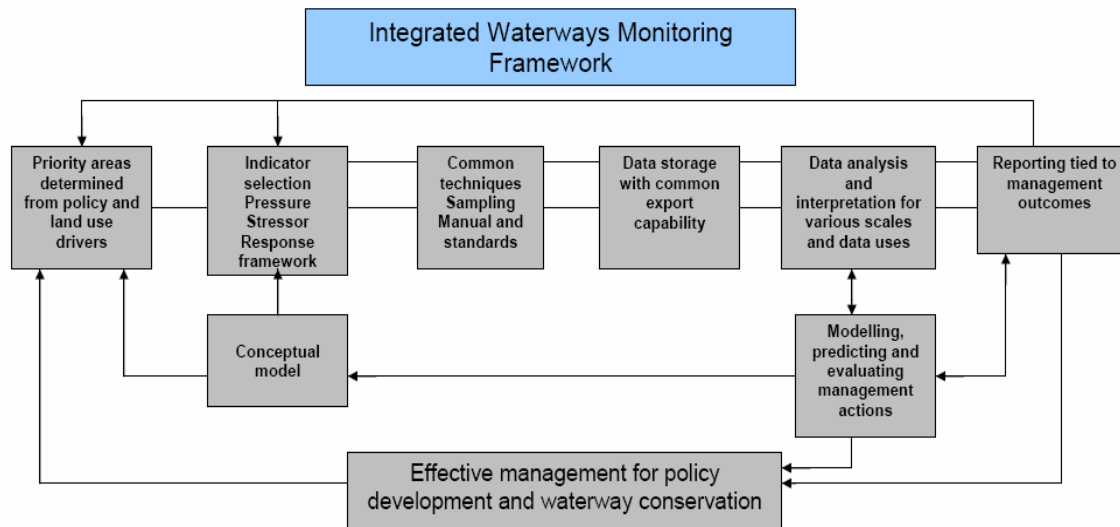


Figure 1: Queensland Integrated Waterways Monitoring Framework

1.2 Description of the framework

Waterways monitoring will focus on priority areas in which significant policy outcomes are required. Monitoring required across the state for the purposes of the *Water Act 2000*, and under the *Environmental Protection Act 1994* will be maintained and the data will also be used for regionally integrated monitoring approaches.

Indicators will be selected using a Pressure Stressor Response (PSR) approach, based on conceptual modelling of the waterways and the pressures they face. Under the PSR approach, land-based pressures and changes to them are monitored and/or modelled as part of integrated waterways monitoring, rather than solely using traditional in-stream indicators. In addition, ecosystem response is also monitored and incorporated.

Integrating data from a wide range of sources requires confidence and compatibility in the methods used. A comprehensive sampling manual has been developed under the Environmental Protection (Water) Policy 2009 for use by Queensland Government officers and industry regulated by the Queensland Government. It will be strongly encouraged for regional natural resource management (NRM) bodies, particularly where funding has been provided by the Queensland Government.

It is not necessary for data from an integrated program to be collated in one single database, provided the data can be compared and information shared between users. However, comparisons could be made using for example, ABCD report card ratings, which can be collated at multiple scales. The Queensland Government has developed a web portal which provides the user with access to waterways monitoring information from across Queensland.

Modelling is a crucial component of any integrated waterways monitoring framework because of the need for predictability and evaluation of the changes in pressures (e.g. land management practices) and their outcomes for ecosystem health.

Reporting will be tied to management outcomes and responses, such as fit for purpose. For example, reporting of flow information is needed in a real-time graphical representation. Reporting of regional waterways health values requires a more considered evaluation of the pressures (e.g. land use and management), stressors (e.g. levels of nutrients) ecological responses (e.g. aquatic ecosystem health) and some evaluation of management responses (e.g. changes in land management). The same data may be used in multiple reports.

1.3 Outcomes of integrated monitoring

Aspects of existing monitoring programs have been improved and aligned with the framework. As a result, the same approaches to reporting requirements, data management, monitoring frameworks and sampling techniques have been adopted.

Regional integration of monitoring will occur in priority areas where there are significant policy issues and an associated risk to the waterways. Data gathered through statewide programs will be collated with other relevant monitoring information—including land-based indicators and more detailed in-stream monitoring programs—to develop regionally based reporting products. Regionally based integration of programs will provide information for managers and policy makers at local, state and national levels of government. The monitoring results will be available to all parties enabling them to form a complete picture of the condition of waterways in the area of interest. While waterway monitoring programs need to retain their separate, purpose driven identities and focus, they will have consistent and complementary methods and reporting, guided by the framework (Figure 2).

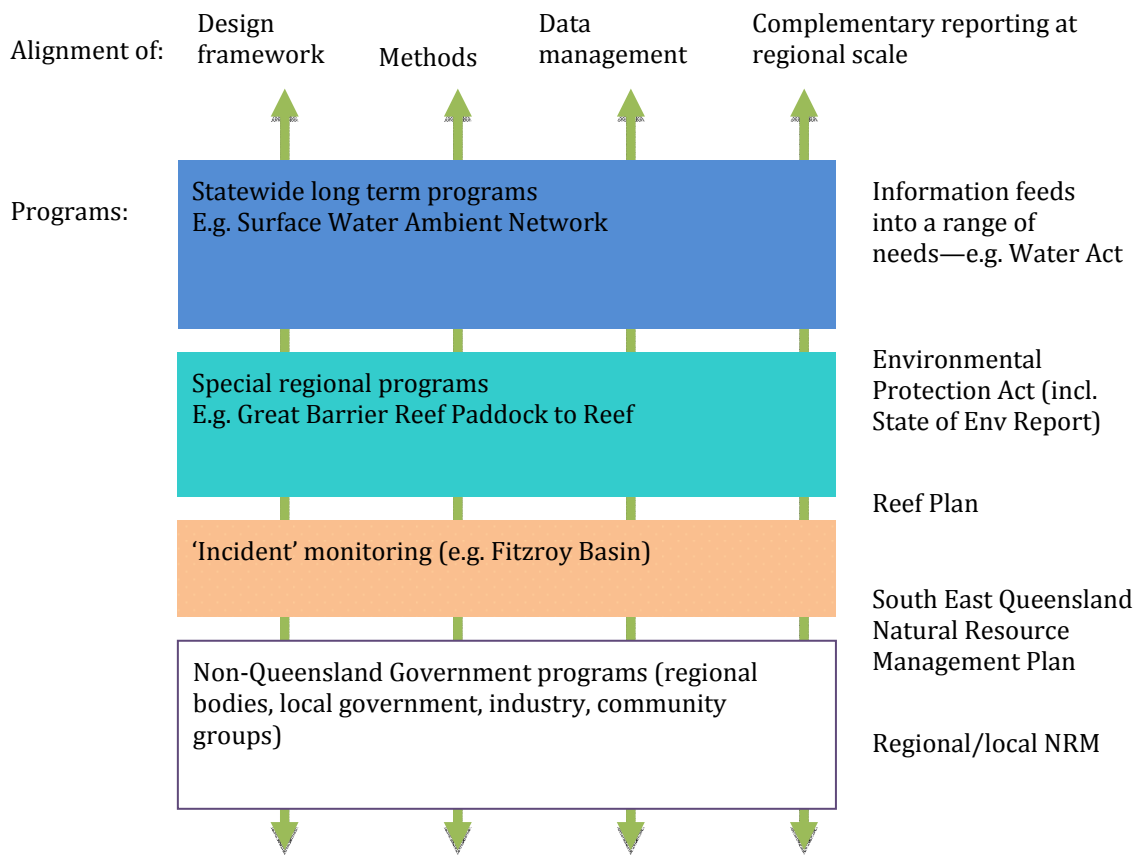


Figure 2: Demonstrating the integration of separate programs across Queensland

A critical component of an integrated framework is the cooperation between monitoring and modelling and policy and management staff to ensure that monitoring program information is effectively used to improve the management of waterways.

The framework applies to all waterways monitoring programs including major incident based investigation monitoring. In addition to the alignment and integration of programs, the government will continue to respond to any major incidents and to changed policy priorities.

This is part of a long-term commitment by the Queensland Government to ensure continuous improvement of waterways monitoring arrangements which will result in integrated programs which will support common and multiple reporting requirements.

1.4 Application

Alignment of Queensland Government activities with the *Queensland Integrated Waterway Monitoring Framework* is underway and ongoing. There is the benefit that some elements of the framework are already well established in a number of programs.

The Great Barrier Reef Paddock to Reef water quality monitoring and modelling program – overseen by the Department of the Premier and Cabinet – is based on the pressure–stressor–response model, with monitoring conducted in accordance with the *Monitoring and Sampling Manual, Environmental Protection (Water) Policy 2009*. The program integrates the monitoring results from various stakeholders and across multiple scales in order to measure progress towards Reef Water Quality Protection Plan (Reef Plan) targets.

The framework will assist in the integration of monitoring conducted by other organisations across Queensland such as local government, regional NRM bodies and industry and community groups. Many of these organisations collect valuable information on the condition of waterways at paddock, local and catchment scales and would greatly complement statewide reporting.



2. Purpose of Queensland Government waterways monitoring

Waterways monitoring is undertaken for a number of reasons including the provision of information to government for policy and investment decision making, to underpin natural resource management decisions by government and stakeholders, to assess impacts on the environment and to educate and inform stakeholders and the community.

Key legislative and policy drivers for Queensland waterways monitoring include Australian and Queensland government legislation, government agreements and specific strategies to protect particular waterways such as the South East Queensland Healthy Waterways Strategy. These drivers are an essential part of the design of the integrated framework and statewide and regionally based integrated monitoring programs. Examples of policy drivers are discussed below. Table 1 indicates the links between policy drivers, assets, threats and reporting requirements.

2.1 Legislative drivers

Water Act 2007 (Commonwealth)

The Act establishes the Murray–Darling Basin Authority to manage water resources in the area. The authority has a range of functions including measuring, monitoring and recording the quality and quantity of the basin’s water resources. The act empowers the Bureau of Meteorology to collect a range of water information from relevant organisations and to use this information to conduct water resource assessments and national water accounts. It requires the Murray–Darling Basin Authority to prepare a strategic plan for the integrated and sustainable management of water resources in the Murray–Darling Basin. The plan is referred to as the Basin Plan.

Fisheries Act 1994 (Queensland)

The Act provides for the use, conservation and enhancement of the community’s fisheries resources and fish habitats in a way that seeks to apply and promote ecologically sustainable development. Monitoring may be conducted in order to determine the impact of the development on the resources or habitats within and adjacent to the development area.

Environmental Protection Act 1994 (Queensland)/Environmental Protection (Water) Policy 2009 (Queensland)

The Act aims to protect Queensland’s environment while allowing for development in ways that maintain ecological processes. This may be achieved through the implementation of an integrated management program that is consistent with ecologically sustainable development. Monitoring is conducted in order to establish the state of the environment and to determine environmental objectives, as well as to measure the impact of the release of contaminants. Reporting is conducted through the four-yearly State of the Environment Report.

Coastal Protection and Management Act 1995 (Queensland)

The objective of the Act is to provide for the protection, conservation, rehabilitation and management of the coast including its resources and biological diversity. The chief executive of EHP must consider the water quality of wetlands or systems when assessing development in the coastal zone. How the waterway’s water quality will be monitored and maintained needs to be considered in the application of an artificial waterway construction. The Act specifically requires the incorporation of information relating to the coastal zone to be incorporated into the State of the Environment Report.

Water Act 2000 (Queensland)

Section 35 of the Act requires the provision of information for planning purposes, regularly measuring and keeping publicly available records of the volume and quality of water, the water requirements of and impacts of water management on natural ecosystems and information about future water requirements. DNRM is responsible for implementing this provision.

Section 39 of the Act requires the development of water resource plans (WRPs). Water and natural ecosystem monitoring is a requirement of each WRP. The Minister must prepare a report on each WRP including a summary of findings and monitoring for the plan.

2.2 Agreements, strategies and plans

Reef Water Quality Protection Plan (Reef Plan)

The Reef Plan is a joint commitment of the Queensland and Australian governments. It identifies actions to help minimise risk to the reef from a decline in the quality of water entering from the adjacent catchments. Monitoring is required in order to gauge the efficiency and effectiveness of Reef Plan in achieving its goal. A report on the condition of the reef is produced annually documenting the progress towards plan targets.

Murray-Darling Basin Agreement

The agreement provides the process and substance for the integrated management of the Murray-Darling Basin, involving the Australian, New South Wales, Victorian, South Australian and Queensland governments. Monitoring activities in Queensland are used to provide information on the whole of the Murray-Darling Basin.

Lake Eyre Basin Intergovernmental Agreement

The agreement is a joint undertaking of the Australian, Queensland, South Australian and Northern Territory governments. Its purpose is to ensure the sustainability of the Lake Eyre Basin river systems, in particular to avoid or eliminate cross-border impacts. Under the agreement, the Lake Eyre Basin Ministerial Forum is required to review the condition of all watercourses and catchments within the Lake Eyre Basin Agreement Area. Lake Eyre Basin Rivers Assessment is a monitoring program designed to assess the conditions of watercourses and catchments within the agreement area.



Table 1: Policy drivers for waterway monitoring and reporting requirements

Policy driver	Assets	Potential threats	Reporting
<i>Water Act 2007 (Commonwealth) and Water Regulations 2008 (Commonwealth)</i>	Water quality, river health and salinity in the Murray–Darling Basin and water quality across Australian waterways	Over-allocation of water resources, salinity and climate change	The Bureau of Meteorology intends to publish and make water information freely available via the Australian Water Resource Information System (AWRIS)—an online information tool that is freely accessible to the public
<i>Fisheries Act 1994 (Queensland)</i>	Queensland fish habitats and fisheries resources	Unsustainable development and practices	Reporting is conducted through State of the Environment reporting every four years
<i>Environmental Protection Act 1994 (Queensland)/Environmental Protection (Water) Policy 2009 (Queensland)</i>	Queensland's environment (aquatic ecosystems including riparian and foreshore areas)	Urban storm water quality, sewerage system release, other point source pollution, other human disturbances	Reporting is conducted through State of the Environment reporting every four years
<i>Coastal Protection and Management Act 1995 (Queensland)</i>	Coastal ecological systems including coastal wetlands	Unsustainable development and practices	Reporting is conducted through State of the Environment reporting every four years
<i>Water Act 2000 (Queensland)</i>	Queensland water resources and water ecosystems	Unsustainable development and practices	Keeping publicly available records of the volume and quality of water is a requirement under the <i>Water Act 2000</i> . A report must be prepared on each water resource plan including a summary of findings and monitoring for the plan
Reef Water Quality Protection Plan	The quality of water entering the Great Barrier Reef from adjacent catchments	Non-point source pollution from broad-scale agricultural land use	A report card on the condition of the Great Barrier Reef will be produced annually through the Department of the Premier and Cabinet
Murray–Darling Basin Agreement	Sustainable use of the water, land and other environmental resources of the Murray–Darling Basin	Over-allocation of water resources, salinity and climate change	Monitoring activities in Queensland provide information for an annual whole-of- Murray–Darling Basin Salinity Management Strategy annual report and the Sustainable Rivers Audit
Lake Eyre Basin Intergovernmental Agreement	Lake Eyre Basin river systems including all watercourses and catchments within the agreement area	Rising demands for water in southern Australia	Communication needs, including annual reporting to the Basin community on the progress in implementing the Agreement

3. Priorities for monitoring in Queensland

A key element of the *Queensland Integrated Waterways Monitoring Framework* is the identification of priority geographic areas facing pressures on their waterways. This will ensure new and emerging risks to waterways across Queensland are identified and appropriate monitoring and management strategies are in place.

The following areas have been identified as current priorities for integrated waterway monitoring in Queensland:

- Great Barrier Reef catchments
- South-east Queensland
- Queensland Murray-Darling Basin
- Fitzroy region.

Further information on each of these priority areas, including current monitoring activities and future refinements, is outlined below. Monitoring will continue in regions not currently identified as a priority. This will ensure that the science and knowledge is available for securing water availability, quality and aquatic ecosystem health.

3.1 Great Barrier Reef catchments

The geography of the catchments adjacent to the Great Barrier Reef vary significantly from built-up urban areas to rural agricultural regions and to highly diverse natural ecosystems. The Great Barrier Reef is the world's largest coral reef system stretching some 2000 km along the Queensland coast. Catchments which flow into the reef lagoon extend from Cape York in the far north to the Burnett and Mary Rivers in the south. Pressures on catchment and reef lagoon ecosystems are closely related and include certain agricultural practices, major industry and mining, urban development, water use and pest fish and aquatic weeds.

Long-term state level programs are conducted in the Great Barrier Reef catchments. These include the Surface Water Ambient Network (SWAN) which monitors the ambient condition of the state's freshwater systems, the Estuarine Ambient Monitoring Program which monitors estuarine systems from Rockhampton south to the Tin Can Bay Inlet and DSITIA's Stream and Estuary Assessment Program (SEAP) which incorporates the monitoring of several programs to provide an ecosystem health assessment of Queensland's biogeographic provinces. More intensive regionally-specific monitoring is also conducted by the Queensland Government through the Reef Plan Event Monitoring Program. This program measures loads of sediment and nutrients at numerous sites across the reef catchments to gauge the success of Reef Plan implementation. Apart from the Queensland Government, many regional natural resource management bodies along with local government, industry and community groups conduct waterway monitoring programs, focussed at paddock and catchment scales, to support healthy waters management plans and other initiatives for catchment and Reef health. The Great Barrier Reef Marine Park Authority conducts marine monitoring using various indicators to assess the condition of the reef itself.

Coordinated monitoring and evaluation of water quality in the Great Barrier Reef catchments and lagoon is crucial for measuring the success of government driven management initiatives such as Reef Water Quality Protection Plan 2009 (Reef Plan). The design of a Paddock to Reef monitoring program as part of Reef Plan ensures alignment of monitoring and modelling at different scales and locations, improve paddock scale water quality monitoring to measure effectiveness of management practices and ensure the strategic location of monitoring sites in key areas (see Figure 3). It should also improve gauging

station/loads monitoring in coastal rivers and some smaller catchments. This Paddock to Reef monitoring is a good example of integration across scales, which applies elements of the *Queensland Integrated Waterway Monitoring Framework*.

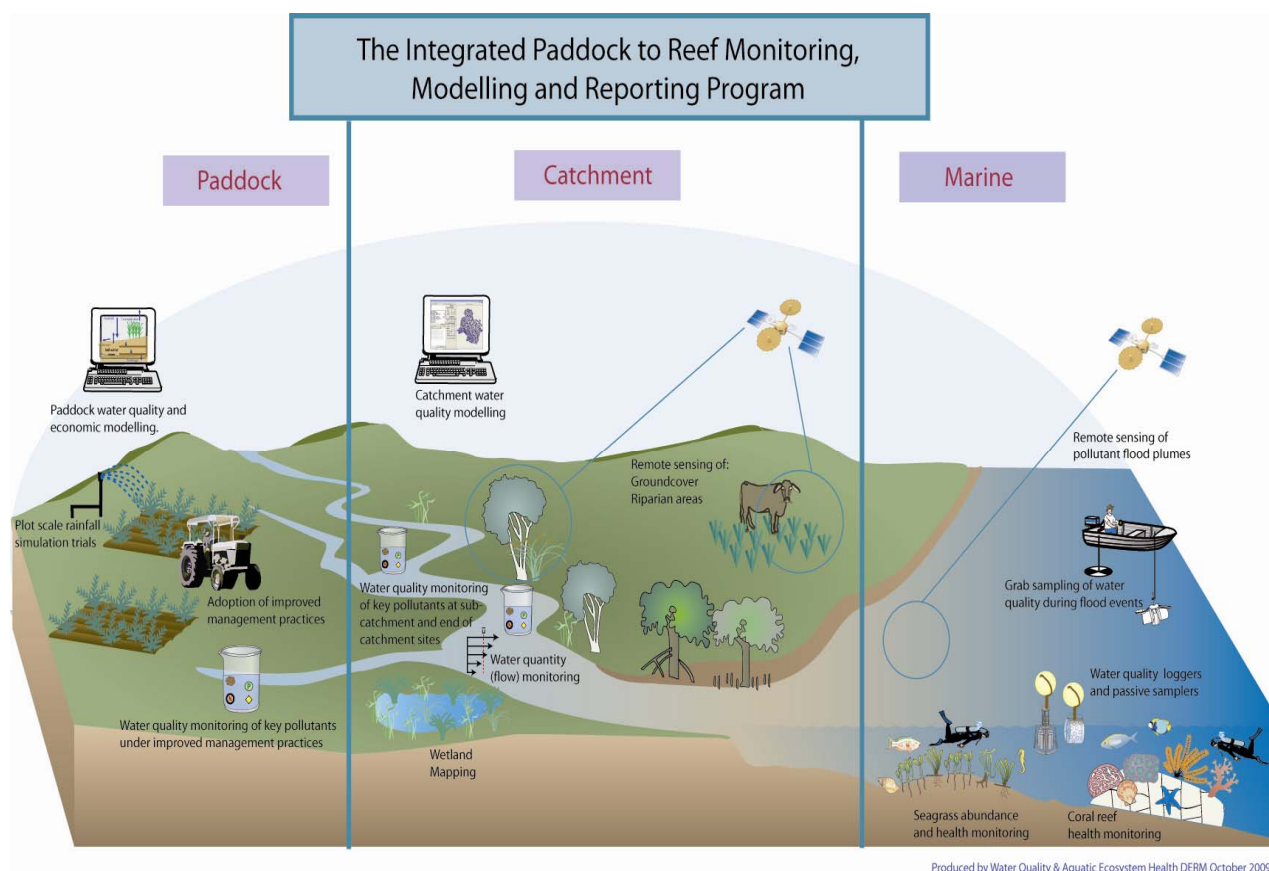



Figure 3: Framework for the Paddock to Reef monitoring and reporting program (DERM 2009)

3.2 South-east Queensland

South-east Queensland runs from Noosa Heads in the north to the New South Wales border in the south and the foot of the Great Dividing Range in the west. The region is one of the most densely populated and urbanised areas in Australia with the population currently standing at approximately 2.8 million people. The region is home to the Brisbane and Logan Rivers along with several smaller coastal systems and the Moreton Bay Marine Park. Despite the high level of development, south-east Queensland contains a diverse range of aquatic ecosystems which provide habitats for an array of species.

There are multiple pressures on the region’s waterways and Moreton Bay such as urban development, major industry, certain agricultural practices and water use. Pest fish and aquatic weeds also pose a threat to river and creek ecosystems.

Long-term statewide programs such as SWAN and SEAP are conducted within the south-east Queensland region. Due to the significant pressures on the region, regionally-specific intensive monitoring is also conducted through the Ecosystem Health Monitoring Program (EHMP). EHMP provides a comprehensive assessment of the condition of riverine, estuarine and marine waters within the region. The program is implemented through a special collaboration between local and state government, industry, traditional owners, universities and research institutions such as CSIRO. The purpose of EHMP is to evaluate the effectiveness of management actions aimed at improving and protecting south-east



Queensland waterways using a variety of indicators including ambient and load-based monitoring. In addition, the regional NRM body, community groups and local government coordinate community-based waterway monitoring activities throughout the region focussed on catchment and local scales.

3.3 Queensland Murray-Darling Basin

Located in southern Queensland, the region incorporates the catchments of the Condamine, Maranoa and Balonne Rivers as well as the Border Rivers and associated rivers from their confluence to the New South Wales border. The population of the region is approximately 180 000 with major centres including Toowoomba, Warwick, Dalby, Goondiwindi, Stanthorpe, Chinchilla, Roma and St George. Land use in the region is dominated by cattle and sheep grazing along with considerable areas for food and fibre production. Within the region there are several nationally significant wetlands, particularly within the lower Balonne River system.

There are multiple pressures on the region's waterways including mining, water use, urban development, certain agricultural practices, major industries and pest fish.

Long-term statewide programs such as SWAN and SEAP are applied within the Queensland Murray–Darling region. Due to the significant pressures on the region, more intensive monitoring is also conducted through the Sustainable Rivers Audit which looks at the overall condition and trends of river health in the Murray–Darling Basin using biological and hydrological indicators. The data collected contributes to the assessment of the condition of the whole Murray–Darling Basin across the states. In addition, regional NRM bodies and Landcare groups coordinate community-based waterway monitoring activities throughout the region focussed on catchment and local scales, often working in partnership with the Queensland Government.

3.4 Fitzroy region

Located on the Tropic of Capricorn, the Fitzroy catchment is the largest river catchment draining into the Great Barrier Reef lagoon and the east coast of Australia. The population of the region is approximately 200 000 with major centres including Rockhampton, Gladstone and Emerald. Land use in the region is dominated by cattle grazing with significant areas of cultivation and mining.

There are multiple pressures on the region's waterways including mining, water use, certain agricultural practices, urban development and pest fish.

Long-term statewide programs such as SWAN and SEAP are applied within the region, as is the Reef Plan Event Monitoring Program. In addition, the regional NRM body and Landcare groups coordinate community-based waterway monitoring activities throughout the region focussed on catchment and local scales, often working in partnership with the Queensland Government.

The Queensland Government has an ongoing interest in the cumulative impacts of mining activities within the region with the establishment of the Fitzroy Water Quality Advisory Group. The group consists of a broad range of regional stakeholders from government, industry, environmental and community groups. The purpose of the group is to provide advice to the Queensland Government on future water quality issues for the Fitzroy River Basin.



4. Conceptual frameworks and indicator selection processes

Waterways monitoring in Queensland is undertaken for a wide variety of reasons and through different programs. Fit for purpose waterways monitoring programs are being aligned under the *Queensland Integrated Waterways Monitoring Framework*. Improved alignment will assist the development of regionally based integrated waterways monitoring programs.

Improving and aligning monitoring programs involves the review and reconciling of ‘fit for purpose’ monitoring programs under a common monitoring framework using similar conceptual models, a common suite of indicators, common reporting requirements, common sampling techniques and data management processes which permit free and rapid access by stakeholders to information. Common sampling techniques are discussed in section 5, access to stored data is discussed in section 6 and reporting requirements are discussed in section 7.

4.1 Pressure-stressor-ecological response conceptual models

Development of a standardised process for monitoring, with a common suite of indicators, requires a common monitoring framework using consistent conceptual models. Most Queensland Government water monitoring programs are based on a similar rationale—the pressure–stressor–ecological response (PSR) approach—which uses conceptual models to establish cause and effect linkages. The use of this approach allows for the development of management responses to modify pressures considered to be affecting on water resources and aquatic ecosystems. For example excessively high nitrogen loads in estuaries may lead to upgrades of sewage treatment plants to improve ecosystem health. A depiction of the PSR conceptual framework is provided in Figure 4.

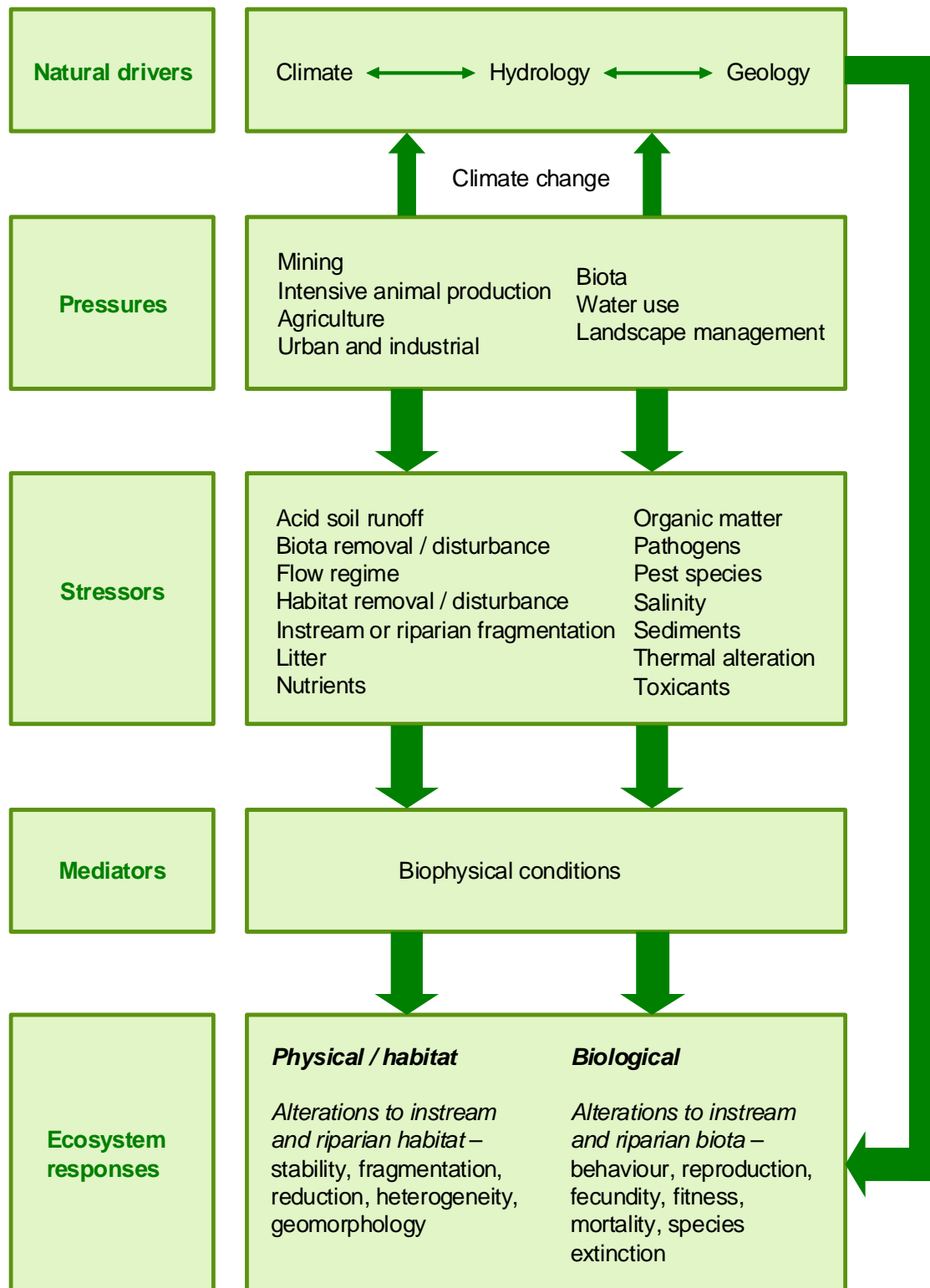


Figure 4: Pressure-stressor-response framework (adapted from Marshall et al. 2006)

For freshwaters, estuaries and other wetland types, generic statewide PSR conceptual models have been developed. These models underpin the selection of indicators for the collection of data at a variety of scales and can be adapted to fit the scales and purpose of all

end users. A common suite of conceptual models for wetland systems, for example estuarine and freshwater, is collated on the Queensland Government Wetlands Info website <http://wetlandinfo.ehp.qld.gov.au/wetlands/> . An example of a conceptual model is provided in Figure 5.

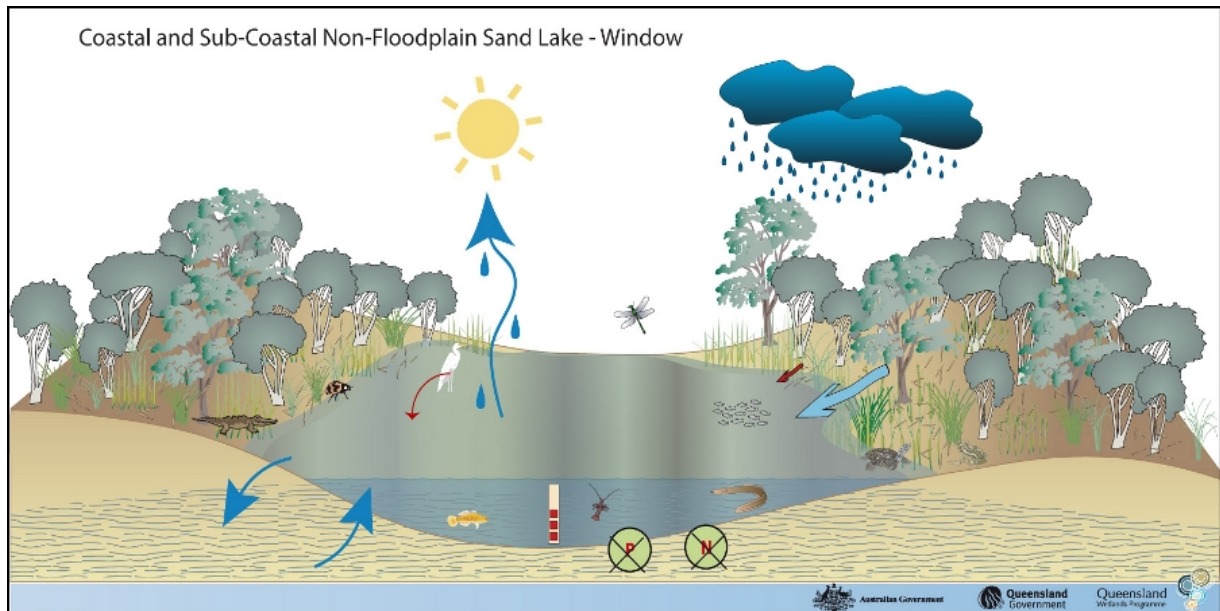


Figure 5: Example of conceptual model on the Queensland Government WetlandsInfo website

An added benefit of following this approach is the ability to identify the scale at which monitoring is required and to help to identify how monitoring by the Queensland Government, regional NRM bodies, local government, industry and other groups can be compatible and where data sharing is possible or appropriate. The PSR approach is being implemented across the state and will be used for all spatial scales at which monitoring takes place.

4.2 Effectively coordinated indicators tied to pressures

Queensland's regionally variable natural resource management issues and waterway monitoring needs make measuring a standard suite of indicators across the state inappropriate. This is because the links between indicators, pressures and environmental responses will often vary between regions. Use of inappropriate indicators would not provide the necessary information for an effective feedback loop to management or policy decision making.

Instead, a common suite of indicators has been developed from which the appropriate indicators may be selected for a particular waterways monitoring program. This approach is consistent with that used in the National Framework for the Assessment of River and Wetland Health (FARWH).

In addition, reporting resulting from the use of the PSR model enables comparison of results to expected levels such as those set in guidelines and reference values and enables the linking of results to pressures. This allows for the development of the required management response.

4.3 Tools for pressure and condition indicator selection and for data interpretation

Models to conceptualise how ecosystems respond to human activities have been used to assist with the PSR process. These models include the vulnerability–pressure–state–impact–risk and response model (VPSIRR) and drivers–pressures–state–impacts–responses model (DPSIR) (United Nations Environment Programme/Global Reporting Initiative–Arendal Maps and Graphics Library, 2002) which have been successfully trialled in estuaries and wetlands and frameworks, including in the Stream and Estuary Assessment Program (SEAP). DPSIR is the framework adopted by the European Environment Agency and the European Community Water Framework Water Directive. A system for classifying wetlands has been designed and conceptual models have been developed for each type to link pressures to condition. There is standard guideline material to assist users to interpret waterway monitoring data correctly and in a way that is tailored to their specific region of interest (*Australian and New Zealand Environment Conservation Council, Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000; Queensland Water Quality Guidelines 2009*).

5. Data collection and information management

A comprehensive whole of government sampling manual—the *Monitoring and Sampling Manual, Environmental Protection (Water) Policy 2009*—has been developed from existing relevant sampling manuals in use by Government departments. The manual provides the common techniques, methods and standards for sample collection, handling and data management for use by Queensland Government agencies, relevant persons and other organisations.

The manual is a handbook of recommended standard procedures for officers to follow when undertaking sample collection to ensure that those collected are representative of the material being analysed. The manual covers sample collection, their preservation and storage and secure transport to a laboratory for analysis. Where appropriate, procedures for making instrument-based measurements in the field are also covered. The environmental media covered (types of sample material collected) are water (both surface and ground), sediments and aquatic animal/plant tissues and whole samples. The role of reference sites, replicate measures and samples, and blank samples are covered in the manual together with workplace health and safety issues associated with collecting samples in the field. Use of the manual will help develop consistency and increased scientific rigour of sampling data that is available for interpretation.

The sampling manual does not address laboratory analytical techniques nor the methods appropriate for statistical analysis or data verification or storage of sample data, since these are specified in established data management protocols and standards. The laboratory techniques are addressed by internal quality assurance and quality control practices and standards and National Association of Testing Authorities accreditation of the laboratories used.

The role of the manual is to provide a common set of guidelines for sample collection for government monitoring and compliance programs. It is envisaged that non-government monitoring programs, such as those conducted by regional NRM bodies, will utilise the standard sampling protocols where appropriate and where resources are available. Regional NRM bodies may also use the *Queensland Community Waterway Monitoring Manual 2007* which provides technical information and guidance for planning, implementing and interpreting waterway monitoring activities to ensure the rigour and validity of information. To

access the *Monitoring and Sampling Manual, Environmental Protection (Water) Policy 2009*, visit <http://www.ehp.qld.gov.au> .



6. Data access

Public access to waterways monitoring data and information has been improved through the establishment of the *Queensland Waterways Monitoring Portal* which provides a single point of access. The website provides information on Queensland monitoring programs, reports and data from Queensland Government as well as external organisations. The web portal allows for further incorporation of data and information over time through updates and system enhancements. The web portal can be accessed at <http://www.nrm.qld.gov.au/water/health/portal/index.html> .

7. Reporting and data interpretation needs

Queensland's waterways monitoring and reporting programs are designed to address a variety of policy and program drivers. Some are focused on developing policies and management practices for a particular region or area whereas others are more focused on public and user education on water quality contaminants and safety requirements. As different pressures and priorities occur, other purposes and objectives for reporting programs will emerge. Reporting in Queensland occurs at many spatial levels including:

- small scale such as compliance monitoring of a overflow from a point source and incident reporting
- regional scale such as the Ecosystem Health Monitoring Program (EHMP) Report Card for Moreton Bay and Reef Reporting
- statewide such as the State of the Environment reports
- nationally such as the framework for environmental water allocations for wetlands.

Important aspects of reporting on a monitoring program are the engagement of relevant stakeholders in understanding the interpreted data and its use to make informed decisions as part of an adaptive management process.

The Ecosystem Health Monitoring Program, which produces an annual Ecosystem Health Report Card for the waterways and catchments of south-east Queensland, is the most comprehensive and integrated waterways monitoring program in Queensland and is internationally recognised. Ongoing reviews of this program identified that the regional

reporting process for south-east Queensland involved stakeholders in both report development and management actions arising from the report. This has resulted in significant improvements in the management of waterways by a whole range of stakeholders and should be a feature of any fully integrated monitoring program.

The alignment of waterways monitoring programs is the foundation for integrated waterways monitoring programs. This enables the development of fit for purpose reporting that provides information for policy and management outcomes. One of the outcomes of effective alignment will be that data collected for one type of report (such as under the *Water Act 2000*) will also be able to be used for other reporting such as on a regional basis and scaled-up and used as part of a statewide report. Therefore data will be collected once and used in multiple reports so that cost effective monitoring produces reports that are suitable for government and the community needs.

In addition, use of common data collection and interpretation techniques and adoption of a common report card format will enable findings from reports from different monitoring programs on different scales to be interpreted collectively at a regional scale and used to provide information for management decisions. The approach to integrated reporting will be consistent with the approach of the National Framework for the Assessment of River and Wetland Health (FARWH).

7.1 Data interpretation and assessment

Alignment of reporting requires complementary evaluation and assessment approaches which allow, wherever possible, for a linear graduated assessment of ecosystem health e.g. report card format with ABCD grades. The experience from the South East Queensland Healthy Waterways Report Card is that government and community members find this style of assessment most informative. Most people are only interested in data that is interpreted in a rapidly assessable format and the use of a graduated assessment is easily interpreted. It is also important because it is able to be used to roll up regional reports into statewide assessments for reporting such as for the State of the Environment Report. At the same time, there must be scientific assessment of the analytical and assessment criteria and valid processes for defining the graduations in each program.

Scientific assessment and data interpretation methods vary for different programs. Major factors considered when selecting methods include the proposed data use, proposed data users—e.g. resource managers—and the target audience such as the general public. To encourage consistency where appropriate, data interpretation methods will be examined with a view to compiling a list of suitable methodologies for various purposes.

The framework will deliver effective data use and management systems via two processes—the use of existing data to identify gaps for future dedicated monitoring and good data management, quality and integration processes to drive consistency. The quality systems established in the sampling manual and data management procedures will provide a framework for effective integration of data.

The *Queensland Integrated Waterways Monitoring Framework* will require the development of quality science, which has been rigorously defined and peer reviewed to ensure the credibility and usability of integrated waterways monitoring. Conceptual models which illustrate causality, common methods of individual indicator selection, frequent and regular data collection to provide trend data and high quality presentations will be vital components of this science. In addition, depth will be added by incorporating social and economic information. In the initial stages of the reporting framework for an integrated monitoring program, benchmark condition data will be collected. Annual condition reporting will then be

supplemented with trend reports every few years. Variable and temporal influences associated with long-term trend assessment may mean that many years and in some cases many decades worth of data may be necessary to provide useful information.

Effective stakeholder involvement and strong partnerships are an integral part of the *Queensland Integrated Waterways Monitoring Framework*. Monitoring program design requires inclusion of stakeholders in agreement-based discussion meetings which will ensure the provision of fit for purpose reporting and that stakeholders are involved in the best possible reporting for their immediate needs.

7.2 Reporting and adaptive management

Reporting from a monitoring program is not an end in itself. Informing and educating stakeholders, the community and policy makers is a critical outcome from a reporting program and requires a specific, dedicated effort. This process forms an important component of project planning for all monitoring programs and constitutes part of a robust adaptive management framework (Figure 6).



Figure 6: Adaptive Management Cycle (South East Queensland Healthy Waterways)

8. Governance and coordination

The Queensland Integrated Waterways Monitoring Framework was developed by a committee of experts in the science and policy aspects of waterways monitoring from Queensland Government and GBRMPA. It is important that the committee membership continue to reflect the relevant Government agencies so that key monitoring issues are prioritised, and addressed in a whole-of-government collaborative approach where necessary.



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