# New South Wales Strategic Water Information and Monitoring Plan

## Final report 2012

July 2012

Publisher

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*New South Wales strategic water information and monitoring plan*
*Final report 2012*

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**Important note**

Some of the NSW agencies mentioned in this report are now part of larger departments under the current NSW Government. The NSW Office of Water is now part of the Department of Primary Industries which is part of Trade and Invesment. Industry and Investment NSW is now NSW Trade and Investment. The Department of Environment, Climate Change and Water is now the Office of Environment and Heritage.

Acknowledgements

Written by David Malone, Laura Torrible and John Hayes.

With input from:

Bega Valley Shire Council

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NSW Trade and Investment

NSW Hunter Water Corporation

Manly Hydraulics Laboratory within Department of Finance and Services

MidCoast Water

Murray Catchment Management Authority

Murrumbidgee Irrigation

NSW Office of Water

Port Macquarie Hastings Council

Shoalhaven City Council

State Water Corporation

Sydney Catchment Authority

Sydney Water Corporation

Wyong Shire Council

# Foreword

*The issue*

In recent years water has become a pressing public policy issue for Australian society. As water demand increases and supply dwindles, the strain on existing water supplies has reached new heights. Protracted drought and mounting evidence of climate change have added momentum behind a growing community and political will to see improvements in both our understanding of water resources and the way we manage them.

*The challenge*

Better management of water poses a national challenge, requiring a coordinated response. Our ability as a community to reach agreement on the tough issues relies on access to accurate, reliable water information that is freely available and of the highest standards. Key to making these decisions and arriving at sound policy is a definitive water data source that stands above reproach.

*Australian Government response*

Aligned with this need, the Australian Government assigned the Bureau of Meteorology (the Bureau) responsibilities under the *Water Act 2007* to compile and deliver comprehensive water information for the country. As part of the Australian Government's long term framework for water security, Water for the Future, $450 million was allocated to the Bureau over 10 years to deliver the Improving Water Information Program. This program includes development and maintenance of an integrated, national water information system which will be freely accessible to the public. Details of the full suite of Bureau objectives and deliverables can be found at www.bom.gov.au/water.

*A partnership model…*

Vital to the success of the Bureau's mission is the partnership and cooperation of all State and Territory Governments and all water data collecting organisations in each jurisdiction. One of the vehicles for effective collaboration is the Jurisdictional Reference Group for Water Information (JRGWI), established to provide regular input to the Bureau's activities, and bringing to the table the experience and wisdom of respected senior officials from across the water sector.

*…and putting it into practice*

Between 2007 and 2012 the Bureau has administered the Modernisation and Extension of Hydrologic Monitoring Systems Program (the M&E Program), an $80 million fund available to organisations named under the *Water Regulations 2008*. The M&E Program has been aimed at improving technologies employed by those who collect water information, and enabling better approaches to data transfer and standardisation. Coordination activities have also been supported through the M&E Program in each State and Territory, bringing together key stakeholders to distill State/Territory priorities in water data collection, and to set these out in a series of Strategic Water Information and Monitoring Plans (SWIMPs).

*Strategic plans…*

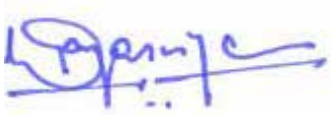
The SWIMPs provide a framework for describing where we are going and how we will get there. Each SWIMP has been produced with a whole of jurisdiction focus to encapsulate the current state of play in water information and monitoring, describe the gaps, issues and opportunities that exist, and articulate a series of priorities, strategies and actions that will bring us closer to the end vision of better water information for all.

*…and how they contribute to the solution*

Through the M&E Program the Bureau has assisted the States and Territories to get closer to our agreed view of what constitutes a fit-for-purpose hydrologic observing system in each jurisdiction. The Bureau has looked to the SWIMPs to provide guidance on how best to invest M&E Program funds to achieve this goal. In this regard, the SWIMPs are a vital product.

*The future*

In closing, the Bureau appreciates the energy and expertise that has been applied in the preparation of this SWIMP, and thanks all of the officers that have participated in its development and review. Our special thanks go to the lead authors of the SWIMP, David Malone, Laura Torrible and John Hayes.



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Bureau of Meteorology

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# Abbreviations

| | |
|---|---|
| ADCP | Accoustic Doppler Current Profilers |
| AHD | Australian Height Datum |
| AWRC | Australian Water Resources Council |
| AWRIS | Australian Water Resources Information Service |
| AWRIS | Australian Water Resources Information System |
| AWS | Automatic Weather Station |
| BI | Business Intelligence |
| Bureau | Bureau of Meteorology |
| CMA | Catchment Management Authority |
| COAG | Council of Australian Governments |
| DECCW | Former NSW Department of Climate Change and Water, see OEH |
| DEM | Digital Elevation Model |
| DPI | NSW Department of Primary Industries (includes Forests NSW) |
| EC | Electrical Conductivity |
| EDW | Enterprise Data Warehouse |
| ERTS | Event-reporting Radio Telemetry System |
| FTP | File Transfer Protocol |
| GA | Geoscience Australia |
| GAB | Great Artesian Basin |
| GDE | Groundwater Dependent Ecosystem |
| GDS | Groundwater Data System |
| Geofabric | National Hydrological Geospatial Fabric |
| GMA | Groundwater Management Area |
| GSM | Global System for Mobile communications |
| GW | Groundwater |
| GWCWA | Gosford-Wyong Councils Water Authority |
| HWC | Hunter Water Corporation |
| I&I | Former NSW Dept Industry and Investment, see DPI |
| IP | Internet Protocol |
| IPART | Independent Pricing and Regulatory Tribunal |
| LAS | Licensing Administration System |
| LiDAR | Light Detection and Ranging |
| LIMS | Laboratory Information Management System |
| LPI | Land and Property Information (withing the NSW Dept Finance and Services) |
| M&E program | Monitoring and Evaluation Funding Program |
| MDB | Murray-Darling Basin |
| MDBA | Murray-Darling Basin Authority |
| MER Strategy | NSW Natural Resources Monitoring, Evaluation and Reporting Strategy. |
| MHL | Manly Hydraulics Laboratory ( within the NSW Dept Finance and Services) |

| | |
|---|---|
| MI | Murrumbidgee Irrigation |
| MIA | Murrumbidgee Irrigation Area |
| MPMS | Sydney Water's Monitoring Process Management System |
| NAP / NHT2 | National Action Plan for Salinity and Water Quality (NAP) and Natural Heritage Trust, program 2 |
| NOW | NSW Office of Water |
| NSW FWC | NSW Flood Warning Centre within the Bureau of Meteorology |
| NTICI | National Topographic Information Coordination Initiative |
| NWC | National Water Commission |
| NWI | National Water Initiative |
| NWMS | National Water Market System |
| OEH | NSW Office of Environment and Heritage |
| OHS | Occupational Health and Safety |
| PSTN | Public Switched Telephone Network |
| QA | Quality Assurance |
| RTA | Former Roads and Traffic Authority, now incorporated to NSW Roads and Maritime Services |
| SCA | Sydney Catchment Authority |
| SCADA | Supervisory control and data acquisition |
| SCC | Shoalhaven City Council |
| SES | State Emergency Service |
| SQID | Stormwater Quality Improvement Devices |
| SQL | Structured query language |
| SRTM | Shuttle Radar Topographic Mission |
| STP | Standard Transfer Protocol |
| SW | Sydney Water |
| SWC | State Water Corporation |
| SWIC | Strategic Water Information Coordinator |
| SWIMP | Strategic Water Information Monitoring Plan |
| SWMA | Surface Water Management Area |
| TDS | Total Dissolved Solids |
| The Bureau | Bureau of Meteorology |
| TRG | Technical Reference Group |
| WA | *Water Act 1912* (NSW) |
| WAL | Water Access Licence |
| WDTF | Water Data Transfer Format |
| WMA | *Water Management Act 2000* (NSW) |
| WQ | Water quality |
| WSP | Water Sharing Plans |

# Executive summary

Water management is one of the great issues facing all Australian states including NSW. Hydrological conditions vary significantly across NSW, from the high precipitation areas of the states east coast to the semi-arid and arid regions of the states western slopes and western division. Around 70 percent of NSW lies within the Murray Darling Basin (MDB) so management of water is important to the other Basin states and impacts on water management in the MDB overall.

All areas, including the coastal zone that supports the major population of NSW, experience periods of drought and flood.

Water resource management involves dealing with complex issues including:

- sharing water between competing interests (irrigators, urban communities and the environment)
- managing the resource during extreme events such as floods and droughts
- providing information about the quantity and quality of the resource to the community
- supporting research to better understand the resource location, extent and movement.

For decisions on these matters to be scientifically based, significant quantities of data need to be collected, processed and disseminated to government and other stakeholders.

## Strategic Water Information and Monitoring Plan

The Bureau of Meteorology administers a program that aims to build an integrated, national water information system to meet national water planning needs into the future (see Foreword). A key component of this is an $80 Million dollar Modernisation and Extension Program (M&E Program) that has provided funding over five years (2007-2012) to projects in NSW that have improved data collection, storage and coordination activities for organisations involved with the collection of water data. The preparation of a Strategic Water Information and Monitoring Plan (SWIMP) is essential for the efficient delivery of the program. The SWIMP describes the purposes for monitoring, data collection technologies and data dissemination systems used in NSW. It also identifies gaps in data and systems that contribute to the identification of priorities for funding.

Over the five years of the M&E Program, 18 NSW water organisations have received around $21 million in funding to upgrade their water information systems including their ability to disseminate that information to the Bureau and stakeholders. Much has been achieved in this five year period and the benefits and outcomes of the M&E Program are described in this report. It is estimated that around 70 percent of the identified improvements have been completed. This implies that not all the work is done and some outstanding work requires funding either from Federal or state government sources.

As the M&E Program is now finished, the conclusions from SWIMP 2012 have been integrated into a *NSW Strategic Investment Plan for Water Monitoring (2012-2017).* This plan will describe where capital investment is still required in order to build the information systems necessary to underpin water resource management into the future in NSW.

## Report structure

The SWIMP has been prepared in four sections

**Section A** identifies the important reasons water information is collected and reported on in NSW. These are the *NSW information drivers* and underpin the strategic and operational issues as well as challenges facing water managers in NSW.

**Section B** provides information on NSW data collection networks and management systems. Descriptions are included of the monitoring network policies that ensure the networks are cost-efficient, effective and appropriate for NSW needs. This section also includes a review of the completed M&E funding program, and points to future funding needs.

**Section C** is a data gaps analysis of strategically important water monitoring activities, linking the data gaps with the NSW *information drivers*. This section also reports on how the five M&E funding rounds have contributed to resolving most of the gaps.

**Section D** is a strategic overview of the key areas for investment in water monitoring. This section of the report brings together the outcomes of Sections A, B and C, and leads to a list of prioritised actions. These actions have been developed into projects by the various water agencies and organisations in NSW, and have been integrated into the NSW Strategic Investment Plan for Water Monitoring (2012-2017).

In addition, a supplementary report titled *Water inventory and observation networks in New South Wales*, provides significant detail on the Inventory of monitoring sites and the organisational monitoring frameworks. The updated supplementary report has been submitted with the Final SWIMP 2012.

## Contributing organisations

Within NSW, it has been estimated that over 97 per cent of the water monitoring and data management activities are undertaken by eight key State agencies plus the Bureau of Meteorology NSW (Flood Forecasting Division). The focus for developing the SWIMP has been to concentrate on this 97 per cent of data and to link to other water data collectors where relevant and possible.

The eight contributing NSW agencies are:

- NSW Office of Water
- Sydney Water Corporation
- Sydney Catchment Authority
- State Water Corporation
- Manly Hydraulics Laboratory
- Office of Environment and Heritage
- Department of Primary Industries NSW
- Hunter Water Corporation

In SWIMP 2009, the water monitoring activities of local government organisations were also included as key data holders in NSW through the Bureau's NSW flood forecasting activities. Similarly, the NSW Office of Environment and Heritage has provided advice on monitoring

activities undertaken by Catchment Management Authorities (CMAs) through the State's Monitoring, Evaluation and Reporting Program.

## Participation

All NSW organisations named in the *Water Regulations 2008* (Cwlth) were contacted and asked to contribute to this report by producing their own Organisational SWIMP. The 16 organisations that submitted an Organisational SWIMP are listed in Appendix 1.

## Strategic water management issues in NSW

NSW is faced with major water management issues arising from the following challenges:

- Environmental sustainability
- Extreme drought and other extreme events
- Intense and increasing competition for water
- Maximisation of the productive use of water
- Finite water resources.

The State's various water monitoring programs are being designed and adapted to provide the necessary information to describe the quantity, quality, distribution and variability of the State's water resources to meet these management challenges. The following six water information drivers have been developed to guide the current and ongoing management of NSW water monitoring networks, namely:

- Planning for future sharing of the resource
- Operational management
- Compliance
- Public interest
- Water accounting and assessment
- Special-purpose water monitoring.

All organisations were asked to link their funding requests to these information drivers. This detail is presented in Appendix 1.

## Conclusions

SWIMP 2012 provides a framework for the management of water resources information and monitoring in NSW. It describes in detail the water information drivers, the monitoring networks, gaps, issues and priorities for ongoing improved water information delivery to the community.

The key conclusions of the SWIMP 2012 focus on the outcomes the M&E funding has achieved for NSW, and the priorities for future focus and funding that will ensure the monitoring network remains vital and efficient and relevant to planning and management requirements. Significantly, evaluation of new technologies funded under M&E has clearly demonstrated their worth in improving the efficiency of data collection and storage. Further

investment in these technologies is now required to achieve full benefit from their implementation.

In NSW every organisation that received funding has closed at least one gap in data or systems as a consequence of the M&E program. The significant gains are detailed in Section B and strategic outcomes are listed in section 3.4. In addition NSW has state specific gaps relating to monitoring for the implementation and performance assessment of water sharing plans, biological data, licensing and modelling. Asset management is also a significant issue for NSW.

While much has been achieved over the M&E five year program, some projects were not funded and some gaps in data and systems were only partially addressed. A Strategic Investment Plan in Water Monitoring (2012-2017) has been developed and identifies this outstanding work, and estimates the cost to complete the work on a priority basis. The key recommendation of this report is that a *'NSW Asset Management Plan for Water Resources Monitoring to 2017'* be prepared Options as to whether this should be undertaken on a state basis or individual agency will require management discussion and decision. A budget of approximately $10M over the next five years will be required to maintain the monitoring systems at their present performance level, with some projects yet to be finally costed. This applies to those organisations that have contributed to this Strategic Investment Plan.

Finally, it is clear that NSW is faced with ongoing coordination activities to continue to support the Bureau's Improved Water Information Program. Although the M&E program is now completed, it is envisaged that water monitoring organisations in NSW maintain their current co-oridinated approach. Working together provides efficiencies with improved transfer of knowledge and uptake of new technologies.

A more detailed discussion on the issues and piorities for water monitoring priorites in NSW can be found in section 5.5 (Section D Priorities).

# 1 Introduction – SWIMP process and updates

SWIMP 2012 builds on the three preceding SWIMP reports in 2009. 2010 and 2011.

New material in this final report includes project results from M&E Round 5. In particular SWIMP 2012 includes:

- a summary of the benefits from the investment of 5 rounds of M&E funding for NSW
- a detailed review of the outcomes of the first five rounds of M&E (Section B)
- forecasts on where future funding will be required in NSW to maintain or build on the monitoring network that has been substantially supported in the last five year
- detailed analysis of the impact that the M&E program has had on closing gaps in data and systems (Section C)
- Table 21 and Table 23 Section D, lists projects nominated by data collecting agencies, organisations and departments in NSW that are high priority for funding over the next 5 years.

Other additions to SWIMP 2012 are:

- further analysis of the benefit of the M&E program on the monitoring of the 2012 flood events in NSW (section 3.2.5), including use of ADCP's.
- updates on the development of water monitoring standards including the need for improved metadata (GAP 49),
- description of the NSW Strategic Investment Plan, and contributing organisations.
- update on the status of the Murray Darling Basin Plan
- update on the National Water Market System in NSW
- updates of three major projects under the Federal Governments Sustaining the Basin initiative that contain a significant water monitoring component (sub section 2.9.3)
- update on the metering projects in the Hawkesbury Nepean and the Murray Pilot.

# 2 Section A – Water management issues and drivers

## 2.1 Introduction

Section A provides a background to the water management issues in NSW and how these are linked to the States important water information drivers. These drivers are described in Sections 2.6 and 2.7 and underpin the strategic and operational issues and challenges facing water managers in this State.

Section A concludes with a brief discussion on Creative Commons and the NSW perspective on open access to data.

## 2.2 Background

Reliable water information is a basic tool for effective water management and better use of our water resources. In many river basins, the hydrological cycle is being modified both quantitatively and qualitatively. Human activities such as landuse change, urbanisation, population growth and movement, water storage, inter-basin transfer, irrigation and drainage have major impacts on both the quantity and quality of the resource. It is also possible that global climate change could be having an impact on water resources throughout the world although in Australia this is very difficult to distinguish amongst the high natural climate variability. As such, it may no longer be assumed that information collected in the past is a sufficient or reliable indicator of recent or future conditions.

Measurements are the only reliable indicator of the current status and trends in the availability of surface and groundwater to enable the rational management of the various water issues.

## 2.3 The need for data

The rational development and management of water resources depends to a considerable degree on the ready availability of hydro-meteorological data and also on the information that the data can yield. If policies and management practices are to have a scientific base, large volumes of data need to be collated, organised, analysed and disseminated. The more this data is used the greater the return on the States investment in collecting it.

In 1991, the NSW Water Resources Council approved the *NSW Cooperating Agency Policy on Water Data Management* (Wright & Malone 1991). The policies adopted considered data management practices of the time in the United States (USGS) and New Zealand (NIWA). The Cooperating agencies policy stressed the need and opportunity to introduce cooperative arrangements between agencies for the sharing of water resources data and provide adequate access to data by the public. An example of these cooperative arrangements was the publication in 1990 of *Pinneena,* a CD-ROM of the majority of NSW surface water data. This was made available to all stakeholders and the practice continues today with the production in 2010 of the 20$^{th}$ Anniversary Edition Pinneena (now on DVD).

Within NSW, water data is collected and archived by many government agencies to meet various statutory obligations.

The objectives of water data collection include:

- providing data and statistics for water resource assessments
- enabling sophisticated water planning models to be developed and applied to answer very specific questions around water management planning and operations
- detecting and monitoring environmental changes and trends
- enabling publication of data and summary statistics
- promoting and stimulating hydrological research
- promoting good practice in data management and dissemination
- providing information for the emergency agencies and the public to determine the current status of conditions of rivers and streams in the State.

It is proposed that during further rounds of the SWIMP, the NSW Cooperating Agency Policy on Water Data Management will be updated to take into account the *Water Regulations 2008* (Cwlth).

## 2.4 Data categories

The Bureau has classified the data to be provided by the juristictions into ten categories as follows:

Category 1 – Surface water resource information

Category 2 – Ground water resource information

Category 3 – Information on major and minor water storages

Category 4 – Meteorological information

Category 5 – Water use information

Category 6 – Information about rights, allocations and trades in relation to water

Category 7 – Information about urban water management

Category 8 – Information about water restrictions

Category 9 – Water quality information

Category 10 – Descriptive and reference information about water information in other categories

## 2.5 Data collectors

There are many groups and individuals that require data from water monitoring activities. Some of the main users and uses for these services in NSW are listed below.

### 2.5.1 Government

Many state and federal government responsibilities depend on accurate surface water and groundwater data for proper execution. For example, activities associated with fisheries, forestry, navigation, interstate agreements, irrigated and dryland agriculture, crown lands, water rights and allocation all rely on water data and information. State governments as the owners and stewards of the resource, licence activities such as irrigation, pollution control and other consumptive and non-consumptive water uses that are even more dependent on surface water and groundwater data.

### 2.5.2 Water management

Federal and state government agencies and water supply authorities as well as industry and hydropower companies all use water data to operate discharge structures, control reservoir levels, divert water into irrigation canals, and control town water supply withdrawals, sewage and other discharge. These activities have serious and far-reaching financial and social implications. They should be based on the best possible data and information. Flow forecasting is a major use of water level and streamflow data, particularly for flood warning and protection.

### 2.5.3 Planning

Scientific, engineering and planning professionals use streamflow and groundwater data to analyse issues, project future conditions, determine impacts, assess alternatives and set policy for planning of a variety of large-scale water and other resource projects.

### 2.5.4 Environmental assessment

Government agencies, environmental consultants and interest groups often need surface water and sediment data and information as well as precise records to assess critical concentrations of pollutants and toxic chemicals in some situations. Managing environmental flows depends on accessing accurate surface water data including flow volumes and variability at specific locations.

### 2.5.5 Research

Professionals and scientists engaged in water-related research use water data as the basis of understanding fundamental hydrologic relationships and to define and assess catchment water balance. This research is vital to NSW long-term interests and cannot be carried out using approximations. High quality, accurate information is essential. Research into evaporation processes, for example, is important in water-short western regions of NSW, and research into the effects of bushfires and other land-use changes and interception activities on catchment runoff is necessary for water management planning and other programs. Further, the potential impacts of climate variability and possible climate change on water supplies need to be understood so that appropriate changes in water management can be implemented.

### 2.5.6 Interstate water sharing

Water-sharing agreements exist in legislation, where water systems are shared or where upstream systems have obligations to supply water to downstream jurisdictions. Many of our systems are large and span regions of significant climatic variability as well as having long travel times. This also applies to large regional groundwater systems, where impacts of water extraction and changing recharge can take many years to appear. Accurate, relevant and consistent water data and technologies improve the quality of water planning negotiations and outcomes at this scale.

### 2.5.7 Public use

Many private citizens and interest groups want access to water-related data and information for a wide range of situations such as planning recreational activities to preventing property damage caused by erosion or flooding, to building public confidence in governments and industries for water planning and real-time management.

### 2.5.8 Design and construction

Professional engineers must have accurate water data for a variety of hydraulic design projects such as dams, reservoirs, pipelines and canals. Safety during project construction and sound economic and environmental performance during their lifespan are important criteria for clients who depend on site-specific data, supplemented by regional information, to meet their needs.

## 2.6 Drivers for water information in NSW

Water management in NSW is becoming more sophisticated as greater demands are placed on the finite resource. Water distribution and supply now adhere to rules established in water sharing plans. In addition to specific rules to control access to river flows, environmental water is purchased and managed for specific ecological purposes. Water savings hold real value for users and the environment, and water trading is now a reality. To support these management initiatives and gain and maintain community trust in their implementation demands that the water data provided to support the processes is of appropriate and defensible quality. The data must also be available in a reasonable timeframe to support the decision-making process.

NSW is faced with major water management issues arising from these challenges:

- Environmental sustainability
- Extreme drought and extreme events
- Intense competition for water
- Productive use of water
- Finite water resources
- Climate change

- Understanding of water information content and context
- Capacity building.

Various water monitoring programs are being designed and adapted to provide the necessary information to describe the quantity, quality, distribution and variability of NSW water resources to meet these management challenges.

The following six water information drivers have been developed to guide current and ongoing management of our water monitoring networks, namely:

- Planning for future sharing of the resource
- Operational management
- Compliance
- Public interest
- Water accounting and assessment
- Special-purpose water monitoring.

*Section A* describes these water information drivers in terms of the water management issues addressed and the questions they help answer. All the key water monitoring agencies were asked to link their bids for M&E Program funds to these strategic drivers. Some of this detail is presented in the Appendix 1 as *Organisational SWIMPS*. The detail of these documents has been integrated into the body of this report.

The following is the list of the information drivers for NSW. They have been interpreted in terms of water management challenges, issues and questions faced. The drivers rely on water data to make and support planning, policy and operational management decisions. Data to support these responsibilities is not always available and, in some cases, not available in a timely matter. Gaps in data are discussed in Section C and D.

## 2.7 Information drivers and management issues

### 2.7.1 Driver 1: Planning for future sharing of the resource

- Sustainability — for water users and the environment
- Drought and flood management
- Competition for water
- Climate variability and climate change
- Medium and long-term forecasting.

### 2.7.2 Driver 2: Operational management

- River operations — water delivery, short-term forecast, storage operation, including wetland watering, environmental contingencies, algae impacts, and access to river flows for industry
- Operations efficiencies — water loss estimation and management
- Flood operations — flood forecasting and emergency planning

- Environmental monitoring — flow variability, flow targeting, water quality, and estuary health.

### 2.7.3 Driver 3: Compliance

- Auditing of compliance — MDB Cap, water shepherding and water sharing plans
- Access rules (cease to pump, etc.) particularly for unregulated systems
- Groundwater use — pumping drawdown, interference, trading
- Drought sharing and flood plain harvesting.

### 2.7.4 Driver 4: Public information

- Reporting/internet — key stakeholders, e.g. river heights and flows, water quality, current storage levels, reliable and near real-time
- Recreation — e.g. water levels, predicted conditions
- Communication – Understanding of water information content and context.

### 2.7.5 Driver 5: Water accounting and water resource assessment

- Institutional Government requirements. NSW is a signatory to:
  - The National Water Initiative (including recent COAG updates)
  - interstate agreements including the Murray-Darling Basin Agreement, and the NSW QLD Border Rivers Agreement
- Federal and State Legislation (*Water Act 2007* (Cwlth), NSW Water Sharing Plans)
- Public disclosure of water management information
- Water Take — metering initiatives.

### 2.7.6 Driver 6: Special-purpose monitoring

- The NSW Office of Water and Manly Hydraulics Laboratory (MHL) are funded for water monitoring across NSW to support particular water management activities of other agencies, organisations and industry. Data collected by various agencies is stored with stakeholders.

## 2.8 Information drivers and strategic questions

The six water management information drivers listed above address current water management issues across NSW. Addressing these management needs will contribute to answering the following questions about water use and supply, and environmental water management.

**Driver 1**. **Planning for future sharing of the resource**

*Questions:*

a. How have water resources changed over time or over the period for which data has been collected?
b. How do we develop water policy to provide security and long term sustainability for rural use and long-term sustainability for ecological assets such as river channels, wetlands, floodplains and estuaries?
c. How do we test the impact and efficiency of our current policies?
d. Will the policy accommodate climatic variation and increasing demands on water as a finite resource?

**Driver 2**. **Operational management**

*Questions:*

a. How do we supply water to support productive use as well as meeting environmental needs? How do we measure success?
b. What can we do to make the community more flood resilient and emergency ready?
c. How do we minimise transmission and operational losses in moving water about the state?
d. Does the water quality meet community standards and expectations?
e. Do the water sharing arrangements support communities and people as well as the ecology of the rivers, estuaries floodplains?

**Driver 3. Compliance**

*Questions:*

a. Are we meeting our objectives under current rules, policies and agreements for water sharing in NSW?
b. How do we demonstrate this to our local and regional communities?

**Driver 4. Public interest**

*Questions:*

a. Where are the floodwaters now, and are regular updates available?
b. Will the quantity of water in the system affect my recreational pursuits?
c. How do current conditions compare to last year, ten years ago, etc?

**Driver 5**. **Water accounting and assessment**

*Questions:*

a. How much water was supplied to the river system?
b. How much water was extracted from the river system?
c. How did water extraction compare with recent years?
d. How did water availability compare with long-term predictions?

**Driver 6. Special purpose water monitoring**

*Questions:*

a. Meeting client and industry demands for information driven by business or special interest needs.

The questions lead to the identification of gaps in data and systems, that are described in detail in Section C. Section C also contains a detailed analysis of the impact the Modernisation and Extension Program has had in reducing a significant number of these gaps over a four year period of implementation.

In Section D the strategies and actions to address the Gaps are presented, and then collated in ***Project Activity Areas*** where they are ranked in terms of the jurisdictions strategic planning priorities (Table 23).

## 2.9 Answering the questions

There are many monitoring programs in NSW that provide data associated with information drivers and management questions. Some of the larger monitoring programs that have been developed in response to recent management questions are described below.

### 2.9.1 Water monitoring for production and the environment

The operational management of water has been a key information driver for many years (*Driver 2.7.2*). More recently, the environmental monitoring component of this driver has increased in urgency and profile in response to new flow response research that links ecological condition of rivers and wetlands to flow variability. Monitoring data from hydrometric networks now support ecological research as well as the already extensive use of the data for other information needs included water distribution, flood warning etc.

The monitoring data is also used to support NSW water sharing plans that have been developed to establish rules for sharing water between the environmental needs of a river or aquifer and all other water users, including town and rural water, industry and irrigation. The NSW Office of Water monitors the effects of water sharing plans to determine whether they are succeeding in improving the health of our rivers and aquifers. As our understanding increases, we will be able to more effectively share water between the environment and other water users, and better evaluate the performance of water sharing plans. Accurate feedback about the plans impacts will make efficient sharing of water possible.

The Murray Darling Basin Authority, as required by the *Water Act 2007* (Cwlth), has also released a Draft Guide to the Basin Plan in 2010 and a Proposed Plan in 2011. In 2012 they released a document entitled "*The Proposed Basin Plan – a revised draft"* which contains changes arising out of the 20 week consultation process on the previous Proposed Basin Plan.

The Guide and the Proposed Plan are the first two stages in a three-stage process consisting of the Guide, the proposed Basin Plan and the Basin Plan. According to the MDBA (2012) the 2010 Guide to the proposed Basin Plan (the Guide) can be viewed as an issues paper. The Guide summarised available knowledge. The more recent Proposed Plan (Draft Plan ) incorporates improved data, further research and the results of intensive public, stakeholder and government consultation following the publication of the Guide.

After the Draft Plan was released in November 2011, there was a 20 week consultation process. The MDBA considered all feedback and prepared a document that

summarised all submissions received, and how they were addressed. The Authority then prepared a revised draft plan which incorporated feedback from the consultation process. This revised draft Plan is submitted to the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities for approval. The Minister may then approve the plan or request further changes and only when satisfied will present the Plan to the Parliament. Once approved it is intended that the Basin Plan will be implemented over seven years between 2012 and 2019. Different parts of the Plan will be intiated at different times.

Reviews will be carried out in 2015 (of the SDLs) and by 2017 (environmental watering plan, water quality and salinity management plan). These reviews will be coordinated, and could lead to amendments to the Basin Plan by mid 2017.It is anticipated any further development of the plan will rely on NSW monitoring information to inform the final Plan development, implementation and performance assessment.

The NSW Office of Water is currently involved in the following water and environmental monitoring projects:

- Valley Monitoring Progress Reports: the Office of Water is preparing a summary of current monitoring activities within each valley, describing a range of monitoring functions and outcomes to date.
- Surface Water Monitoring Network: continuous monitoring sites at over 900 river, lake and storage gauging stations, collection of water quality sample data from over 350 sites and continuous monitoring of water quality at over 800 sites.
- Regulated rivers: Integrated Monitoring of Environmental Flows program monitors the ecological response to environmental flow rules in the state's major regulated river systems, and the Barwon-Darling River.
- Unregulated rivers: Environmental monitoring of unregulated river systems to assist development and implementation of water sharing plans
- Snowy River: Environmental flows response monitoring program monitors the impacts of the additional flows being provided under the Snowy Initiative
- Shoalhaven River: Monitoring environmental flows for the lower Shoalhaven River to improve river health and to better mimic the natural river flows.
- Greater Sydney Metropolitan Area and Hawkesbury-Nepean River.
- Sustainable Rivers Audit: Coordinated by the Murray-Darling Basin Authority to assess the ecological condition and health of the rivers throughout the Murray-Darling Basin.
- Catchment monitoring: Measuring and reporting on progress towards the Government’s statewide ’river health ’ targets and defining the physical form of our rivers using River Styles®.
- Groundwater monitoring: continuous monitoring at 400 groundwater sites and manually monitoring from a network of more than 3,000 groundwater monitoring bores, where we record aquifer data from the 100,000 bores that have been sunk in NSW.

- Metering: Effective water management requires accurate and reliable information on the amount of water extracted by water users.

Other agencies in NSW are also undertaking a range of environmental monitoring:

- Hunter Water – groundwater Tomago Sands
- NSW DPI– paddock scale studies into salinity, nutrients and fertilisers?
- Forests NSW – impacts of bushfires
- Sydney Catchment Authority – detailed lake nitrification, where WQ samples are taken every two minutes at multiple depths in lakes and storages.
- Sydney Water – sporadic lake WQ monitoring studies.
- The NSW Office of Water has also just released a tool to assess the condition of the rivers for the entire state. A River Condition Index was developed as part of a two year collaborative project led by NOW in conjunction with the National Water Commission and other state natural resource management agencies. The RCI uses the National Framework for the Assessment of River and Wetland Health (FARWH) to produce a river condition captured at a sub-catchment scale. The approach uses five indices including riparian vegetation, geomorphology, hydrology, biota, and catchment disturbance, with work underway to also use water quality. The project also resulted in spatial layers capturing Riverstyles, instream value, and risks to instream value for NSW.

### 2.9.2 Shepherding environmental water

Environmental water holdings by the Commonwealth government are valued at close to $3.2 billion and the distribution and monitoring of their water is important business for the Government. The Commonwealth has requested that some of the water available under its water licences be ‘shepherded’, that is, transferred and protected from extraction in one system for environmental watering downstream in another system. Water shepherding is a new concept in water management for the Murray Darling Basin, and while transfers between the hydrologically connected and regulated Murray, Murrumbidgee and Lower Darling River systems are possible through normal water trading rules in NSW, the Commonwealth is seeking to extend this concept much further and beyond the current rules in NSW water sharing plans. Issues including the monitoring and calculation of potentially environmentally beneficial water ‘losses’ on the floodplain are adding to the complexity of the process, and are currently being resolved.

Following flood flows in the far west in late 2009 and again in early 2010, NSW agreed to trial the shepherding of water available under the Commonwealth's Toorale water licences in the unregulated Warrego river system in the far north west of NSW to the Murray River. This involved the transfer of water through the Menindee Lakes storage into the Lower Darling River and then into the Murray River system – a distance of over 1,300 kilometres and through three different river systems. Such transfers require complex analysis by the NSW Office of Water of the water available and the losses associated with the movement of the water to ensure that the rights of other water users are not impacted.

In July 2010 the NSW Government signed a Memorandum of Understanding with the Commonwealth to finalise the shepherding methodology and accounting and to further implement water shepherding to support Commonwealth environmental watering requirements..

### 2.9.3 Sustaining the Basin

The $12.9 billion *Water for the Future Program* was announced by the Commonwealth Government in 2008 to take action on climate change, use water wisely, secure future water supplies and to support healthy river systems. Under this program the States were requested to submit a State Priority Project submission for funding under the $5.8 billion 'Sustainable Rural Water Use and Infrastructure' component. NSW submitted a suite of possible projects, some of which have relevance to water monitoring. In 2008 the Commonwealth gave in-principle approval to NSW for $1.358 billion in funding, with the following projects linked to monitoring:

- **Regulated River Metering** – up to $90 million for the replacement of 6,000 existing meters that are used to measure the amount of water irrigators take from NSW regulated rivers, with the new high-tech meters to be owned by State Water. New meters will be high accuracy, tamper-proof and low maintenance, reducing in-accurately metered extractions and minimising water theft. This project will be jointly implemented by State Water and the NSW Office of Water. A pilot for this project is currently underway in the Murray River. The pilot will see meters installed on sites in regulated rivers, unregulated rivers and groundwater systems. Water extracted for town water supplies will also be metered by the Project. Metering of basic landholder rights and on-farm dams are not part of this projects. The Pilot will be used to evaluate installation options and techniques prior to roll-out of metering across the Murray Darling Basin in NSW. It is anticipated this project will support information driver 1.6.5 that relates to water accounting.
- **Groundwater and Unregulated River Metering** – up to $131 million for the installation and upgrading of metering for groundwater and unregulated water sources. The project, implemented by the NSW Office of Water, will install or upgrade about 9,500 meters. It will provide more accurate information on water usage and compliance, thereby informing information drivers 1.6.3 and 1.6.5
- **Healthy Floodplains** – up to $50 million for the delivery of a project which will reform the management of water on floodplains through modifications of floodplain structures and control of extractions. This project will be implemented jointly by the NSW Office of Water and the Office of Environment and Heritage and will support information driver 1.6.1. It will provide more accurate information on water usage and compliance, thereby informing information drivers 1.6.3 and 1.6.5. It will also support environmental management decisions and link to driver 1.6.2.

## 2.10 Water Monitoring Standards

The standards to which water monitoring is undertaken is of vital importance to the users of the data. This covers areas such as data measurement, processing, storage and access to data. In particular, the concept of ‘known quality’ underpins the

confidence of the data user in ensuring that the data is fit for their purposes. The purposes for which data is used are wide ranging and include river and flood operation, hydraulic design, resource and environmental assessment and water accounting.

In NSW, water data monitoring programs cover both general assessment programs designed to meet a wide range of data needs plus individual project monitoring to meet specific needs. In both cases, it is essential that the monitoring is undertaken to known and published standards to ensure users have confidence in the data they access and use.

Major data collecting agencies in NSW have implemented certified quality assurance systems to ISO 9001. This includes the NSW Office of Water, Sydney Water Corporation, DECCW / Manly Hydraulics Laboratory and Sydney Catchment Authority (via their water data collection contractors).

The Bureau of Meteorology, under the powers of the *Water Act 2007* (Cwlth), has power to issue water information standards. These are important to its new role as the national water information manager. To achieve the outcome of a common national approach to water monitoring, the Bureau established the Water Information Standards Business Forum (The Forum). This brings together key water industry representatives together with the Bureau to coordinate water information standards development. In May 2012 the Bureau held workshops in each state to outline the role of the Forum and to gain consensus in relation to two important standards.

As part of its M&E Program the Bureau funded three standards projects in 2010 and two in 2011. These are:

- 09-10 NSW 1.06 – Development of Water Information Standards,
- 09-10 NSW 1.17 – Licence and Water Supply Work – Quality Standards, and
- 09-10 Qld 1.3 – Water Quality Metadata and Standards
- 10-11 NSW 1.05 – Align NSW Office of Water Procedures with Water Information Standards
- 10-11 QLD 1.08 – Water Quality Metadata Standards Phase 2

Projects NSW 1.06 and Qld 1.3 were extended in M&E 2010-11. Liaison has taken place between these three project teams and the outcomes reported to the Bureau and the NSW SWIMP Steering Committee. NSW 1.06 involved the following water agencies:

- Bureau of Meteorology
- Office of Environment and Heritage
- Forests NSW within Department of Primary Industries (NSW DPI),
- Manly Hydraulics Laboratory within Department of Services, Technology and Administration
- NSW Office of Water
- Snowy Hydro
- Sydney Catchment Authority

- Sydney Water Corporation

These organisations represent 97 per cent of the water resource data collected in NSW.

The NSW SWIMP Steering Committee has signed off on the adoption of the seven standards developed under the NSW project and these will now be forwarded to the Bureau for consideration for adoption as national standards.

The standards developed are:

- Primary measured data standards
- Site operational standard
- Instrument management standard
- Gauging standard
- Data editing and estimation standard
- Standard for Stream Discharge Relationship Development and Maintenance
- Training standard

With each standard is a training package prepared following the template provided by Government Skills Australia.

While this is not a complete list of the standards that need to be adopted at a national level, it is an important start and complements new standards developed in water accounting, water licensing and water data transmission (WTDF).

For its part, the Bureau is undertaking the design of a framework for reviewing and accepting state standards as national standards under the *Water Act 2007* (Cwlth). Workshops on this topic were held in Melbourne in Decmeber 2010 and again on 24 November 2011.

The NSW project report contains three recommendations:

1. Proposal for review and adoption of these standards nationally
2. Generic process for adoption of standards
3. Proposed amendments to the Water Data Transfer Format quality codes

Development of national standards is an evolving area and in 2012 the Bureau is currently working to align the 7 NSW and 3 Qld standards. It is also developing, with stakeholders, a common glossary which will go into Australian Water Information Directory (AWID).

## 2.11 Metadata

The *Water Regulations 2008* under the Commonwealth *Water Act 2007* currently contain ten categories of water information, which are further divided into subcategories. The Regulations stipulate the data that is to be provded to the Bureau. The provision of metadata is currently found under Category 10 and it prescribes that organisations are required to provide metadata and contextual information about water information at the same time that they provide data for other categories. This information is vital to enable the Bureau to understand water information provided

under categories 1 to 9. However, Category 10 only describes the metatdata and contextual information in a limited fashion, which has led to uncertainty around the specific information required.

An ammendent to the *Water Regulations 2008* is planned for July 2012 to improve certainty about metadata. The ammendment removes category 10 from the Regulation and refers to a new document that the Bureau will maintain online. This document called “Metadata and contextual information requirements” will set out, in much greater detail, the metadata and contextual information required to be given at the same time as the water data for each subcategory. The online document will be incorporated into the Regulations, meaning that it carries the same compliance requirements as the regulations themselves. The ammendent also removes many of the existing references to metadata from the subcategories to simplify and standardise the subcategory text in the Regulations.

The Bureau is currently developing the metadata and contextual information requirements. The Burea will notify organisations when it adds metadata element lists to the online document. Data providers will be required to give the metadata and contextual information set out in the document within six months of the notification.

## 2.12 Metering (Hawkesbury Nepean)

The NSW Office of Water has installed about 800 water meters in order to accurate measure water extraction throughout the Hawkesbury Nepean basin. The project was funded by the Australian Government under the Hawkesbury-Nepean River Recovery Program

Such meters are equipped with telemetry and will assist water sharing, accounting, trading, billing and compliance activities. All meters have been installed to comply with new national meter standards.

## 2.13 Metering (Murray Darling Basin)

The Australian Government through the ‘Water for the Future Program’ has agreed to commit up to $221 million to the NSW Water Metering Scheme to improve the measurement of water extracted from groundwater, regulated and unregulated rivers throughout the Murray Darling Basin.

Ultimately, the project will see the installation of high accuracy, tamper proof and low maintenance meters across the NSW Murray-Darling Basin, that comply with the national meter standards. About half the water that is expected to be saved by the installation of the new meters will be granted to the Australian Government.

As the first stage of the roll-out, a pilot project has commenced which will involve about 800 meters in the upper part of the Murray valley. A similar project will involve replacement of about 800 meters in the regulated section of the Murrumbidgee River. The Murrumbidgee and Murray pilot projects will be complete by end of 2012, while the full Murray Darling Basin will take another 5 years.

State Water Corporation is managing the implementation of the Murray Pilot Project. Comdain Infrastructure Pty Ltd has been contracted to design and manage the process of installing the new meters and telemetry.

## 2.14 National Water Market

The National Water Market System (NWMS) project is a part of the Commonwealth Water for the Future initiative. NWMS will improve the efficiency and responsiveness of Australia's water market through:

- improved water trading experiences because transaction times for trades and other dealings are not limited by water register processes or functions;
- maximising the value of irrigated agriculture through efficient movement of water to its highest valued use;
- easy access to current information about the water market;
- increasing market transparency allowing for more informed water trading decisions;
- jurisdictions having high-performing water registers that accurately record water rights and supports water accounting and resource management.

A key deliverable of the NWMS program is the Common Registry Solution (CRS). The CRS will replace and standardise existing water registers in States and Territories, delivering a new register system, personal water accounting and online logging and tracking of water entitlement trade applications. Data generated will be accurate and consistent and be able to be exchanged between the registers.

The CRS is being developed by teams in the Commonwealth and States and Territories. The project is nearing the end of the requirements phase and is about to enter into system design in conjunction with a Project Implementation Partner, followed by system build and implementation phases.

## 2.15 Creative Commons

It is the policy of the NSW Government that access to public sector information is a democratic right. NSW Government information assets are economically, socially and culturally valuable and they should be made available in a consistent and trustworthy environment.

There is growing support to provide general government information on terms that clearly permit the use and re-use of information. The NSW Government is building an open and transparent approach to information access by applying, where appropriate, the ‘Creative Commons Licensing’ approach that removes barriers to accessing information and broadening its dissemination and use.

It is anticipated that a whole-of-government approach will be used to implement any policy on public sector information that, when it occurs, will include the agencies and organisation that hold NSW water data.

The Bureau of Meteorology and the vast majority of NSW State Agencies have recently accepted the use of Creative Commons, in particular the Creative Commons Attribution

# 3 Section B – Water monitoring and information systems

## 3.1 Introduction

***Section B*** of the SWIMP provides significant detail on the State's data collection networks and data management systems. Descriptions include the monitoring network policies that ensure networks are cost-efficient, effective and appropriate for NSW needs.

The main detail of these systems is contained in an accompanying supplementary report titled *Water monitoring and information systems in NSW*. The supplementary report also contains an '*inventory*' of monitoring network metadata provided by key water monitoring organisations. It describes 97 per cent of the surface water and groundwater data being collected in NSW.

## 3.2 Modernisation and Extension of Hydrologic Monitoring Systems Program

### 3.2.1 Overview

The Bureau's $80M Modernisation and Extension of Hydrological Monitoring Systems Program (M&E) has provided the Australian water resouces industry with an opportunity to make quantum improvements in key areas of water monitoring, especially instrumenation, data acquisition, transmission, data management and quality assurance processes. This significant cash stimulus has allowed NSW State agencies and other water monitoring organisations to upgrade much fo the ageing and outdated instrumentation and software systems.

### 3.2.2 Implementation

As part of the planning process for this investment in NSW, a broad range of 49 gaps in water data monitoring and water information systems were identified. The M&E program was targeted at eliminating or reducing these gaps across the full range of organisations that applied for funding. Section C of this SWIMP provides detail on impact and reduction in these data gaps.

In NSW, there are eight major State agencies that collect manage and share water resources data with other State and Federal agencies. The eight State agencies are complemented with the Bureau of Meteorology NSW and Snowy Hydro Limited. These 10 organisations monitor over 97 per cent of the water data that is collected in NSW. In addition, there are over 60 other organisations (CMAs, local government, irrigation corporations and power utilities) that are also involved in some level of water data monitoring.

To manage the *M&E Program* and related Bureau activities, NSW established two management committees

- the SWIMP Steering Committee — to address strategic water information issues.
- the NSW Technology Reference Group in Water Monitoring (TRG*)* to coordinate technology issues.

With so much 'activity' taking place as a result of Bureau initiatives, a *knowledge management* approach was considered essential to achieve full benefit of the investments being made. As a result, the NSW TRG was formed to provide a focus for technology adoption, provide a forum for communication between organisations, and assist with information sharing in key areas of water resource monitoring. External speakers with expert experience in water monitoring technology are invited to the meetings.

The areas of special interest in NSW include telemetry, instrumentation, Doppler technology, real-time quality assurance processes, data management, sharing and dissemination. A secondary, significant benefit of the M&E program is the improved level of communication and knowledge sharing between water monitoring specialists within these organisations.

### 3.2.3 M&E Program Benefits

An independent review of the Modernisation and Extension Funding Program was contracted by the Bureau in 2010 to determine how well the Program was meeting its objectives and delivering other benefits, and to identify where improvements could be made.

The review found that:

- the program has been effective in improving the efficiency of field operation and the data capture and storage process. The proliferation of telemetry was particularly significant, leading to much less equipment downtime and large efficiency gains.
- the program has been effective in enhancing data accuracy, reliability and management. In this regard, the improvements in data accuracy from investments in Acoustic Doppler Current Profiler (ADCP) were mentioned in many interviews.
- the program has been effective in improving data transfer and data sharing, particularly through WDTF, however some respondents requested stronger feedback loops and data quality metrics from the Bureau.
- there was limited evidence that funding had significantly extended monitoring coverage. Monitoring investment was focused mainly on improving the accuracy and currency of data collection and transfer from existing sites, with agencies being in many cases reluctant to expose themselves to the future depreciation costs of adding new sites.
- the review found strong evidence of improved collaboration among data providers and managers within and across jurisdictions, and strong indications of benefits to the Bureau through enhanced cooperation across the sector. SWICs and SWIMPs were noted as particularly important in this regard.
- the Bureau water information products are in a preliminary stage so it is difficult to quantitatively link the investments to improvements in Bureau outputs. However the review found there to be a reasonable assumption inherent in the program logic that tangible benefits will accrue in the future.

- the review found that the program is well run, that program administration is robust with regard to controls, and that grantees are made well aware of the requirements. Recommendations to implement a stronger monitoring evaluation and reporting framework have been implemented.
- Many respondents suggested that the provision of funding over a longer period than the current annual cycle would lead to better project outcomes.

### 3.2.4 NSW agency benefits

Five of the largest water monitoring organisations were asked to provide their comments on the impact, benefit and future investment objectives for the M&E Program. Their individual reports are contained in Appendix 3. A summary of these reports follows, including a description on how M&E funding contributed to improved monitoring of the recent 2010 - 2012 flooding across NSW.

### 3.2.5 Flood monitoring benefits

The recent heavy rain and flooding across much of NSW during 2010, 2011 and early 2012 has seen an end to a prolonged 9 year drought. With the changed conditions, water information priorities have moved from drought monitoring to measuring flood conditions for many of the NSW river catchments. A few valleys have experienced two major floods. Across NSW some rivers experienced the highest levels since records began, particularly in the tributary streams in the upper catchments. Many of the western flowing rivers will remain in flood for extended periods, particularly at the lower reaches, in wetlands and lakes. The Southern Oscillation Index (SOI), which is read by some as an indicator of rainfall, predicts above average winter rainfall for much of NSW including those catchment that were subject to flooding in 2012. Monitoring the flows and floods will be significant for safety, farm production and environmental values.

During the drought years, NSW agencies (including the NSW Office of Water as the lead water agency) used several Federal Government funding sources to upgrade water monitoring equipment, infrastructure and computer systems. The Bureau's 'Modernisation and Extension Program' provided close to $15M over five years for these activities alone. It was not until the floods arrived that the community became aware of the benefits from these upgrades.

The various system upgrades included:

#### Acoustic Doppler Current Profilers (ADCP)

Over the five rounds of the M&E Program the Bureau funded various acoustic Doppler projects submitted by water agencies in the jurisdictions. In total some $4 Million was provided to fund 30 projects. Closely related to this work is the development of water monitoring standards for the use of this new technology. Three draft standards were compiled through cross jurisdictional collaboration of state and territory representatives that have demonstrated expertise in this field. In addition a NOW project in round 5 reviewed the performance of ADCP in NSW during the flood years 2010 to 2012.

Due to the completion of the M&E projects, the NSW Office of Water Hydrometric field teams were able to deploy acoustic Doppler Current Profilers (ADCP) to measure flooded streams that could not have been achieved with traditional current meter technology. The ADCP provides a more accurate, much faster and safer methodology for undertaking flood measurements. From the flood data collected for the 2010 floods and again in 2012, there is evidence, that at many of the monitoring sites the stage vs discharge relationship has changed. This is critical information for flood prediction and water resources assessment and water accounting.

While the ADCP technology has many benefits, equipping and supporting a large hydrometric team in its use will require increased financial and training resources. The technology is relatively new and these support issues will continue as the technology further develops. NOW Hydrometric staff use this equipment as a matter of routine, with mechanical equipment being used only on special occasions. More than 80 per cent of stream flow measurements are now undertaken using ADCPs.

### Telemetry

The upgrade of the majority of the telemetry components at priority sites is continuing with one hundred sites transferred from PSTN to IP in the last year allowed NSW Office of Water to collect and distribute current (hourly) river level and flow information. While this information is automatically transferred to key flood prediction and dam operation agencies it is made available to any member of the public who has access to an Internet connection.

Many of the NSW dam flood operations procedures for Murray Darling Basin dams were developed after the major floods in the 1970s. The dam operations staff in 2012 still followed the procedures but with access to the latest inflow and downstream conditions at a frequency not contemplated previously. As was the in 2010 it is worthwhile noting that while these staff had access to corporate water databases there was a tendency to use publically available web based information products.

Some issues did arise as a result of the availability of this information to the public. For example, the Office of Water collects and publishes all its data in Eastern Standard Time (EST), this is then converted to Daylight Saving Time (DST) by some agencies using the data. During the summer floods in Southern NSW in 2012 there was some confusion about the data being either EST or DST

### Improved communications and planning

Improvements in communication and information related to updated procedures using mobile phone, GPS tracking and satellite mapping during flood inundation resulted in better management of on-ground gauging staff. Improved rainfall prediction techniques used by the Bureau permitted agencies more time to plan and roster staff to meet peak demand. There is a greater level of reliance on rainfall predictions to plan river monitoring activities.

Monitoring the floods, particularly with the Murrumbidgee, Lachlan and Barwon-Darling valleys flooding at the same time also highlighted where some improvements or continued work are required. These are listed below:

#### Damage

Damage in the 2012 flood was caused to individual monitoring stations caused by flood. The repair effort is underway with sites infrastructure being replaced as the flood waters subside. Again in 2012 as in 2010 the damage to infrastructure has been relatively minor. With IP telemetry, damaged sites can be seen within the hour and plans put in place rectify faults.

#### Staff pressures

There are higher demands on staff in response to increased monitoring during the flooding. Staff have had difficulty in maintaining a balance between routine activities and new tasks such as obtaining flood gaugings, updating rating tables based on flood gaugings, and rectifying flood damage. The 2010 flood event gave staff valuable experience for the 2012 event particularly with the Doppler equipment. There was also increased need for flood monitoring activities measuring flood waters away from the main channels.

#### Communication

A small number of very localised Telstra communication failures were recorded, some to the IP network. PSTN lines were again an issue, with several instances of failures with the few remaining PSTN lines. While the satellite service is proving reliable it will not provide any communication redundancy and the cost remains relatively high

#### Volume of data

With lessons learned form the 2010 flood most organisations coped with data being collected in real time (hourly). Some catchments were trialled on 30 minute data regime. Minor telemetry computer system problems were again noticed and in most cases quickly rectified. However the 2012 flood created unexpected interest by the general public, such that Internet sites were not able to cope with the volume of requests during peak periods.

### 3.2.6 NSW Office of Water

The significant stimulus provided by the M&E program has resulted in a range of benefits to NSW that would not have otherwise been achievable. The major outcomes include:

- major upgrades to a wide range of water monitoring, data management and data dissemination system
- the provision of more timely and better quality information to the NSW Office of Water, its customers, including Murray Darling Basin Authority and State Water Corporation and other stakeholders such as the Bureau of Meteorology and the general public
- major review of data and monitoring activities in NSW

- identification of gaps
- investment strategy plan
- re-establishment of communication between NSW water agencies
- sharing and caring
- development of standards

An important outcome is that water monitoring is now undertaken in a smarter and more cost-effective way. Seventy per cent of surface water sites are being telemetered in near real-time directly to the internet. It is expected that this will expand to 100 per cent of NSW Office of Water continuous surface water monitoring sites within the next two years. The program has significantly accelerated implementation of new technologies, with rapid gains in cost-effective operation.

Key areas of investment have included:

- Modernisation of logging and sensing equipment
- Modernisation of databases and data transfer systems
- Acquisition of acoustic doppler current meters for better measurement of discharge
- Upgrading of telemetry systems to IP communication for more timely data delivery
- Conversion of important historic paper records to digital record making it more accessible
- Replacing outdated structures to address OHS issues
- Connection of monitoring sites to AHD to meet spatial data needs
- Surveillance of bore holes using modern camera equipment for refurbishment.

To address a number of the outstanding gaps in monitoring in the state the Office of Water identified the following areas as crucial for future investment:

- continued improvement of instrumentation and telemetry (including satellite) for timely and efficient data capture
- implementation of a asset management strategy
- streamlining and standardising data capture, data management and data transfer mechanisms between water agencies nationally
- improving data value by spatial referencing of streamlines and monitoring sites,
- recovering investments in monitoring by historic data recovery and data clean up.
- the adoption of uniform National Standards for water monitoring including the associated metadata standards

The harnessing of the investment in the stated areas will result in:

- equipment and systems capable of meeting current and future monitoring needs
- data of known and accepted standards

- improved reporting of water resource assessment and support for environmental sustainability
- improved understanding of water balance and the ability to deliver contemporary water accounting.
- improved communication and knowledge and data transfer between agencies

### 3.2.7 Sydney Water Corporation

Programs implemented by Sydney Water under the Bureau of Meteorology Modernisation and Extension program funding have provided significant benefits to hydrometric monitoring networks and improved water-related data and information delivery. The following summarises the improvements made and some of the benefits realised since implementation of the 2009/10 programs.

#### Upgrade Rainfall and Inland STP data loggers

Modernisation of Sydney Water-operated metropolitan rainfall and inland STP monitors with the replacement of ageing, dial-up data loggers with 125 Halytech Spider™ IP data loggers has resulted in the following improvements:

- A significant reduction in the number of logger failures in the hydrometric networks particularly with the elimination of 'modem – logger lock up' problems formerly associated with older, dial-up loggers with external OEM modem
- With its easily programmable functionality the new logger has provided a simple and effective 'push data' telemetry system with data being sent independently from each individual site via GPRS to an FTP server each day or up to each hour as required
- The GPRS telemetry system provides a data delivery 'guarantee' and has reduced the reliance on specialised, centralised, dial-up polling programs which required additional maintenance and were subject to failure and late data deliveries
- Each site data logger transfers data automatically at pre-programmed times via GPRS and the ethernet to an FTP server from where it is automatically processed to Hydstra or re-directed elsewhere as raw data as required
- Threshold alarms can now be sent from logger to logger via SMS. This has allowed for additional controlling, activation of water samplers and a simple yet effective metropolitan catchment-based high rainfall alarm system
- The overall network reliability has improved (generally 100% recorded)
- The new loggers have enabled simple, automatic data send as well as dial-up access for configuring, remote firmware upgrade or interrogation
- The overall reliability and high-level data capture has resulted in more timely, validated information being provided and in future will be the 'standard' logger used across various Sydney Water hydrometric networks.

#### Differential Global Positioning System (DGPS)

The provision of funds for a DGPS for use by hydrometric and field sampling teams has resulted in the following improvements:

- Easy to use Hemisphere R220™ DGPS with sub-metre capability has provided improved metadata of water quality samples taken at drinking water catchment sites sampled by Sydney Water Field Services team
- Sub-metre accuracy provides a means to locate specific sampling points and an added assurance of repeatability
- Accurate geo-coding of hydrometric sites and in particular sensor location, morphology assets or other features that may describe the information collected from sites.

#### Data Extractions from Source Systems

The Bureau partnership has also enabled upgrading of some source systems and the writing of scheduled data extraction and send processes. Storage, Water Quality and meteorological data are being extracted from a variety of sources, summarised and transmitted to the Bureau on a weekly basis without human intervention.

### 3.2.8 NSW Office of Environment and Heritage

The following summarises the program improvements funded under the Bureau of Meteorology's Modernisation and Extension program, achieved by the Office of Environment and Heritage, with assistance from Manly Hydraulics Laboratory (MHL).

#### Benefits to OEH monitoring program

- Capital upgrades to an ageing network of data loggers and sensors unable to be renewed previously due to State funding constraints.
- Renewal of an ageing telemetry system unable to be renewed previously due to State funding constraints.
- Renewal of an ageing database and content management system unable to be renewed previously due to State funding constraints
- The upgrade of the data network, essential in monitoring long-term changes in flood and tide characteristics as a result of climate change and associated sea level rise.

#### Benefits to NSW

- Co-ordination and rationalisation at a State level of all major monitoring programs via the NSW Technology Reference Group in Water Monitoring
- Working towards the supply of data in specified format.

Considering the benefits achieved so far under the program and the direction water monitoring is taking at a national level, OEH and MHL will be targeting further improvement in the following areas.

#### Future opportunities for OEH

- Telemetry upgrade – complete capital upgrade to IP modems
- Telemetry investigation – ensure redundancy of priority flood warning stations
- Real-time quality assurance – for data provision to Bureau NSW Flood Warning Centre, Bureau AWRIS database and State Emergency Services
- Development of a database and content management system
- Co-ordinate digitising, transfer and the metadata for all the additional stations not required to be sent under the current Regulations (i.e. 50 years of gauging exercises and project water quality and level data)
- Development of a more robust, streamlined OHS compliant gauging station
- GPS survey of the entire network to ensure regionally consistent datums.

#### Future Opportunities for NSW

- Further co-ordination of data delivery systems to streamline and rationalise the NSW monitoring network
- Co-ordination of instrumentation standards across NSW
- Co-ordination of data quality standards across NSW
- Co-ordination of metadata requirements across NSW
- Contribution of quality standards at a national level
- GPS survey of the entire network to ensure regionally consistent datum
- Development of a more robust, streamlined OHS compliant gauging station.

#### Future opportunities for Australia

- Real-time quality assurance – to ensure that the end user (of the data) understands the quality of the dataset prior to use.
- NSW driving reform in data quality and instrumentation standards
- Following implementation of the new MHL database and content management system, MHL systems could be used to help pilot future AWRIS development.

### 3.2.9 NSW Department of Primary Industries (including Forests NSW)

#### Benefits of M&E funding to date

The funding received by NSW DPI has been of enormous benefit. Across NSW DPI, much of its water monitoring equipment was outdated and in urgent need of

replacement. The M&E funding has injected much-needed capital into these projects and undoubtedly increased the reliability of data collected, extended the working life of the stations involved and improved NSW DPI's capability to transfer data to the Bureau as required under the *Water Regulations 2008* (Cwlth).

Projects funded to date have achieved the following:

- Upgraded and replaced data loggers, pressure transducers and optical shaft encoders in the water monitoring network
- Replaced data loggers at six existing Automatic Weather Stations (AWS) and installed new AWSs at two new sites
- Telemetry upgraded at all the above eight sites for improved data delivery to the Bureau
- Upgraded stream gauging, climate and groundwater stations with data loggers, turbidity sensors, EC sensors, pyrometers, RH and temperature sensors, barometric pressure sensors, wind speed and direction sensors, solar radiation sensors and modem for telemetry.

### Future Priorities

Across NSW DPI, the following have been listed as priorities for water monitoring/investment:

- acid sulphate soils in coastal catchments
- understanding the effect of changes to landuse on interception
- flow regimes and impact of landuse on fish populations
- increased adoption of water-efficient practices
- understanding and reducing the impact of mining on aquatic ecosystems
- water management risks that threaten water-dependant ecosystems and aquatic industries
- development of water accounting and reporting standards including MER.

More specifically, Forests NSW has identified the following priorities:

- increased reliability of rainfall networks
- increased reliability of in-situ water quality data
- installation of telemetry.

### Recommendations

Forests NSW recommends:

- upgrades to its pluviometer and storage rain gauge network
- telemetry to provide real-time data from gauging stations (possibly satellite and/or radio-modems in remote sites).

NSW DPI recommends:

- upgrades to its existing field instrumentation network including telemetry to provide real-time data
- upscaling measurements to key areas by adding additional instrumentation.

#### State Wide Issues

NSW DPI believes there are opportunities for better cross-agency collaboration in the field of water monitoring. The technical reference group (TRG) is a good starting point for opening discussions regarding the availability of and need for new or improved technologies to effectively and efficiently meet the various objectives of water monitoring programs. Perhaps the most obvious opportunity is to collaborate on funding applications to increase the possibility of obtaining bulk-discounts with suppliers. Another opportunity exists to develop consistent standards for water monitoring to be applied by all agencies within the jurisdiction.

Current NSW DPI water research activities are examining the effect of changes to landuse on the paddock water balance. This is particularly relevant to the current interest in quantifying interception of water. NSW DPI activities are measuring landuses outside the current focus of interception research and may provide valuable research for evidence based policy.

### 3.2.10 Sydney Catchment Authority

As a consequence of the SCA's projects funded under the M&E Program, the vast majority of water monitoring sites have:

- new, modern data-loggers and modems
- new rain gauges
- upgraded, consistent physical configurations and wiring
- all relevant data recorded in the SCA's asset management database.

#### Specific site improvements

Funding from two rounds of the M&E program has been used to:

- replace 27 outdated Mace HM2000 data loggers at water level sites at SCA storages
- reprogram 77 telemetered water level data loggers so that the data received is of a consistent format
- upgrade 45 rain gauges – at 11 sites, both the rain gauge and data logger were replaced; at 13 the rain gauge only was replaced; and at 20 sites the data logger was replaced.

Important strategic benefits include:

- consistency of equipment and programming has improved the reliability and efficiency of data transfer to existing systems and facilitate conversion to new formats and systems in the future
- enablement of IP capability, with resulting increases in communications reliability, flexibility and cost efficiencies
- simpler, more efficient maintenance and upgrade processes
- more timely and reliable data to both the SCA and the Bureau during major inflow and flood events
- in the long-term, more accurate and complete datasets for water resources assessment and planning including data delivery to the Bureau.

### 3.2.11 State Water Corporation

The funding facilities under the M&E program have resulted in wide ranging improvements to water monitoring, data management and data dissemination systems within State Water Corporation (State Water). The most important outcome is the ability to provide timely and better quality information dissemination to the Bureau through the central database of the Office of Water as well as to provide this water information to State Water's huge customer base.

Under the M&E program State Water has under taken the following projects:

- upgrades to Level Recorder instrumentation of all of 20 major storages
- installation of modern, up-to-date Automatic Weather Stations (AWS) at ten of the major storages. State Water will be submitting a proposal to continue with the modernisation and installation of AWS in the remaining ten major storages in Round 4 of funding
- modernising and developing a data management tool, called Koncentrator, to harmonise discrete surface water datasets from multiple sources within State Water Corporation, facilitating the rationalisation and automation of data distribution systems
- the bathymetric survey of State Water-controlled storages and weir pools, to allow the development of more accurate capacity tables, increasing operational efficiency, particularly in times of low flow conditions. More accurate storage data will enable better water resource management decisions to be made and provide an accurate and robust set of data to the Bureau, complying with *Water Regulations 2008* (Cwlth) and Bureau requirements
- development, testing and implementation of a web-based manual data entry tool that will facilitate data entry on storage levels, releases, diversions, stream levels, etc. from non-automated sites
- installation of pressure measurement systems for storage with hydro-electric power generation capability.

The key objective of these projects was to provide accurate surface water and meteorological data monitored at State Water's major storages and transfer to the Bureau of Meteorology in a timely, formatted and efficient manner. The proposed systems developed under M&E program will provide more accurate, timely and effective information for the management of storages, enhancing management of water resources throughout NSW and providing an automated process to deliver the water data to the Bureau as required under the *Water Act 2007* (Cwlth).

The priorities and key aspects of future investment under M&E program relevant to water delivery and monitoring program of State Water include:

- identify data requirement and automate the systems to transfer data/information to the Bureau
- automation of meteorological monitoring
- upgrade instrumentation of storage and weir level recording equipment
- upgrade the accuracy of storage capacity tables
- software development to automate the transfer of temporary transfer figures to the Bureau
- installation of accurate measuring devices monitoring equipment
- identification of isolated manual data management systems and automation of the same
- automation of data collation and transfer systems to the Bureau
- providing improved water monitoring networks to meet objectives of NWI
- close gaps in current monitoring network
- improved forecasting of water demands and river 'losses' to make river operation more efficient – telemetry or other methods to improve demand capture and compliance monitoring
- flood operation – rainfall runoff predictive capacity, improve timing of storage pre-release against tributary flows
- better event forecasting for more effective environmental release
- review accuracy of current monitoring network by Identify NWI/Bureau compliant standards
- seasonal forecasting – improve management of transfers between storages
- seasonal forecasting better management of environmental allocations
  - airspace operation of storages
  - more flexibility in access for water users
- consistent and efficient handling of information at times of floods and low flow conditions.

The harnessing of the investment in the stated areas will result in improved understanding of water balance and the ability to deliver contemporary water

accounting. Coupled with this will be improved reporting of water resource assessment and support for environmental sustainability.

## 3.3 Hydrological Geospatial Fabric

The Australian Hydrological Geospatial Fabric (Geofabric) is being developed as the geospatial framework to underpin Australian Water Resource Information System (AWRIS). It will hold key spatial data layers within a single, consistent, national geospatial framework for hydrological features. The Geofabric will contain a consistent representation of water features and their connectivity in the Australian water system.

The first implementation of the Geofabric (Phase 1) was delivered to the Bureau in February 2010 and was released in October 2010 with subsequent implementations due to be released annually. Phase 1 of the Geofabric is based on key national datasets including a:

- national hydrography layer (AusHydro1) at 1:250,000 with topological connectivity and directional flow paths
- new set of national catchment boundaries derived from a nine-second Digital Elevation Model (DEM)
- new national DEM at one-second resolution (~30 m) derived from the Shuttle Radar Topographic Mission (SRTM) data.

Phase 2 of the Geofabric aims to evolve the core datasets from national to regional/local scales according to user requirements and priorities.

At present, NSW stakeholders and users do not have easy access to a consistent, seamless state-wide spatial groundwater and surface hydrology database at the appropriate scale that is able to fully support their current or future information needs in relation to:

- planning for future sharing of the resource
- operational management
- compliance
- public interest
- water accounting and assessment
- special-purpose water monitoring.

Current mapping of natural water courses in NSW consists of 1:25,000-scale mapping across the ranges and east coast that has been revised over the last ten years; 1:50,000 across the central division captured up to 30 years ago; and 1:100,000 mapping of the western division captured less than ten years ago. In many areas, irrigation and other development has significantly changed the actual location of water course within the 1:50,000 mapped area. A recent National Data Audit also highlighted inconsistencies and variability in network connectivity, currency and spatial accuracy of the 1:50,000 mapping, which will limit its utility for water resources assessment and accounting purposes at the state and catchment levels. Approximately 45 percent of the 1:50,000 mapping is incomplete.

Over the last five years, LPI and GA have been working closely through the National Topographic Information Coordination Initiative (NTICI). Collectively the agencies have invested more than $2M completely re-mapping and revising the location of man-made water storages (hillside farm dams and irrigation storages) across NSW. This work is now complete within the MDB, and nearing completion on the east coast, but needs to be fully integrated back into the state-wide spatial database.

Current mapping of groundwater systems consists of a spatial layer of Groundwater Management Areas (GMAs). These GMAs are the primary basis of water management as they broadly identify the different groundwater systems in NSW. Projects are currently improving the accuracy of the geospatial location of the groundwater monitoring network and the data quality of the State Groundwater Database System. The completion of these activities will improve our ability to interpret regional groundwater flow, knowledge of hydrogeology and the characteristics of groundwater sources in the State.

Spatial information relating to the surface and groundwater characteristics is required to underpin planning and implementation of sustainable water management strategies, and support specific planning priorities that include:

- the Murray-Darling Basin Plan
- water sharing plans – regulated, unregulated (including estuaries) and groundwater
- major urban metro water supply monitoring systems
- medium urban metro water supply systems
- flood and extreme event warning
- environmental water quality data
- research – surface water, groundwater and water quality
- small non-metro urban monitoring.

The need for ‘spatially-enabled’ water data also cuts across Australian government, the community and industry. Spatial information is a key foundation for planning and managing sustained population growth, demographic and climate change, continued land development balanced with environmental sustainability, and heightened need for emergency management. The needs span government agencies, and require a whole-of-government approach. At the same time, the ability of individuals and organisations to discover, access, process and communicate information is essential.

New gaps in data and systems for the hydrological geospatial fabric are included in Section C.

NOW is also improving the spatial location of water monitoring sites. While new sites are established with quality spatial locations, older and historical sites have varying quality in location. In 2011 NOW updated the spatial location information for all current surface water monitoring sites with adequate spatial location and 80 percent of discontinued sites with adequate spatial location. Any future sites will have adquate spatial location.

## 3.4 NSW inventory and observation networks

The Bureau specified that each jurisdiction outline existing water information-related monitoring systems, database infrastructure and water information transfer processes including:

- sites where data is collected
- type of telemetry equipment (if any) at each site
- frequency of measurement/downloading at each site (time series, daily, etc.)
- parameters collected at each site
- length of data record at each site
- indicative data quality standards
- other non-site-specific monitoring activities (e.g. remote sensing etc.)
- how storage of the information occurs within the jurisdiction
- the data transfer processes in place between agencies.

The named organisations in NSW (those identified by the Bureau as organisations holding water data) were contacted originally in 2009, and again for updates in 2010, and were asked to provide monitoring site details on a supplied template. The responses were collated in two formats, one for major government agencies and another for the other organisations. The inventory of this monitoring site metadata is included in the supplementary report of this report. Table 2 of this report summarises that information and tabulates the total number of monitoring sites for each organisation that responded to the request. In total 35 organisations provided information.

The Bureau also requested that information relating to data categories 5, 6, and 7 be included in this report. There has been a concerted effort to present this in the discussion below. No site location information has been specifically requested for data categories 5, 6 and 7.

Name changes of some government agencies and organisations have occurred since publishing of SWIMP 2011. This version has incorporated the new names.

Section B of this report summarises the information collected as part of this process. A summary of the NSW inventory included in this section contains the following:

- number of monitoring sites for all organisations surveyed
- details of database information systems used
- data currency

In addition, the following sections of this report on water availability are an extract from *Water inventory and observation networks in New South Wales* and are reproduced as an overview of the water resources and water monitoring activities in NSW.

**Table 1: Total water monitoring sites in NSW**

| | Monitoring Sites | | | | |
|---|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** | **Total** |
| **Major Agencies** | | | | | |
| NSW Office of Water | 2325 | 9043 | 1887 | 161 | 13366 |
| SWC* | 350 | 0 | 0 | 25 | 25 |
| SCA | 134 | 0 | 115 | 167 | 416 |
| MHL** | 237 | 0 | 23 | 72 | 287 |
| OEH** | 269 | 12 | 0 | 72 | 0 |
| NSW DPI | 48 | 5 | 41 | 31 | 125 |
| HWC*** | 1 | 197 | 6 | 47 | 251 |
| Bureau of Meteorology NSW | 218 | 0 | 0 | 450 | 668 |
| Sydney Water | 5 | 0 | 179 | 99 | 363 |
| Snowy Hydro | 179 | 0 | 0 | 0 | 179 |
| Total | 3179 | 9257 | 2222 | 1124 | |
| **Other Agencies** | | | | | |
| Armidale-Dumaresq Council**** | 10 | 0 | 17 | 7 | 34 |
| ActewAGL | 14 | 0 | 0 | 0 | 14 |
| Ballina Shire Council | 0 | 0 | 15 | 0 | 15 |
| Bathurst Regional Council | 7 | 0 | 0 | 0 | 7 |
| Bega Valley Shire | 2 | 0 | 0 | 0 | 2 |
| Cabonne Council | 2 | 0 | 0 | 0 | 2 |
| Coffs Harbour | 1 | 0 | 0 | 0 | 1 |
| Essential Energy | 3 | 0 | 3 | 0 | 6 |
| Dubbo City Council | 0 | 1 | 7 | 0 | 8 |
| Eurobodalla Council | 6 | 0 | 0 | 0 | 6 |
| Gosford Wyong Council | 10 | 20 | 0 | 0 | 30 |
| Goulburn Mulwaree Council | 9 | 0 | 0 | 0 | 9 |
| Kempsey Shire Council | 2 | 86 | 51 | 9 | 148 |
| Lismore Council | 12 | 0 | 0 | 15 | 27 |
| Mid-Western | 1 | 0 | 0 | 0 | 1 |
| Port Macquarie | 9 | 0 | 4 | 20 | 33 |
| Queanbeyan City Council | 0 | 0 | 0 | 0 | 0 |
| Shoalhaven | 24 | 0 | 0 | 27 | 51 |
| Tweed | 13 | 0 | 0 | 13 | 26 |
| Wagga Wagga | 0 | 0 | 2 | 0 | 2 |
| Wyong | 8 | 10 | 0 | 8 | 26 |

| | Monitoring Sites | | | | |
|---|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** | **Total** |
| Sydney Metro CMA | 6 | 0 | 0 | 2 | 6 |
| Murrumbidgee Irrigation# | 16 | 900 | 27 | 7 | 950 |
| Murray Irrigation# | 6 | 1449 | 0 | 0 | 1455 |
| Coleambally Irrigation# | 6 | 809 | 56 | 0 | 871 |
| Total | 167 | 3275 | 182 | 108 | |

Notes:

General – many sites are multi-purpose monitoring sites. Thus a site may measure Surface Water, Water Quality and Meteorological parameters at one location. While the primary usage of the site has tried to be identified the total number of sites must be viewed with some caution in absolute terms.
NSW Office of Water sites quoted include 'discontinued sites' and ground water sites read at irregular intervals. For more detail contact John Hayes who is a co-author of this Report.

* SWC requires a number of river sites for their river operations (these sites are funded by irrigators and SWC collects these monies). NSW Office of Water operates these sites and these numbers are included in the NSW Office of Water totals. SWC operates 20 major storages where a range of manual data is collected and some 280 weirs, many of which supply data via SCADA. At some storages, water quality is monitored, but not on a regular basis at this stage. All SWC data is stored on the NSW Office of Water Hydstra system and NSW Office of Water sends this data to the Bureau on SWC's behalf.

** OEH/MHL – all OEH sites are operated by MHL. Their numbers are included in the MHL totals and NSW Office of Water totals, and are not double-counted in the overall totals. MHL also operates sites for a number of councils and SCA. Attempts have been made not to double count these sites. Some sites undertake multiple tasks and are not double counted.

*** HWC – many sites undertake multiple tasks, i.e. groundwater, water quality and meteorology. Some double counting may have occurred.

## 3.5 Data currency

The majority of agencies in NSW operate digital equipment in surface water and meteorological monitoring. A large number of these systems are telemetered.

In water quality and groundwater, the vast majority of measurements are taken manually and it is only recently that the use of digital equipment and telemetry has begun.

The details of the how the data is collected and transmitted is summarised in Table 2 below.

**Table 2: Currency of data collection systems**

| | Equipment and Communication Summary | | | |
|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** |
| **Major Agencies** | | | | |
| **NSW Office of Water*** | Mix of manual 5% and digital 95%, 77% telemetered* | Mix of manual 90% and digital 10%, 10% telemetered | Mix of manual 90% and digital 10%, 7.5% telemetered | Digital 100% |
| **SWC** | Mix of manual and digital, majority telemetered | N/A | Manual 100% | Manual 100%* |
| **SCA** | Mix of manual 5% and digital 95%, 73% telemetered | N/A | Mix of manual 22% and digital 78%, 7% telemetered | Digital 100%, 25% telemetered |
| **MHL** | Digital 100%, all telemetered* | N/A | Digital 100%, all telemetered* | N/A* |
| **OEH*** | N/A | N/A | 100% manual | Mix of manual and digital, majority telemetered |
| **NSW DPI** | Digital 100%, none telemetered | Digital 100%, none telemetered | Mix of manual 20% and digital 80%, none telemetered | Mix of manual 13% and digital 87%, none telemetered |
| **Hunter WC** | Digital 100%, all telemetered* | 100% manual | 100% Manual | Digital 100%, all telemetered * |
| **Bureau of Meteorology** | Mix of manual 12% and digital 88%, all telemetered | N/A | N/A | Digital 100%, all telemetered |
| **Sydney Water** | 100% digital, all telemetered | N/A | Manual 100%, none telemetered | Digital 100%, all telemetered |
| **MDBA** | Mix of manual and digital, all telemetered | N/A | N/A | Mix of manual and digital, all telemetered |
| **Snowy Hydro** | Not Known | Not Known | Not Known | Not Known |
| | | | | |
| **Other Agencies** | | | | |
| **Armidale – Dumaresq Council** | Digital 100%, all telemetered | N/A | 100% manual | Digital 100%, all telemetered |
| **ActewAGL** | Digital 100%, all telemetered | N/A | N/A | N/A |
| **Ballina Shire Council** | N/A | N/A | 100% manual | N/A |
| **Bathurst Regional Council** | Digital 100%, all telemetered | N/A | N/A | N/A |
| **Bega Valley Shire** | Digital 100%, all telemetered | N/A | Digital 100%, all telemetered | Digital 100%, all telemetered |
| **Cabonne Council** | 100% manual | N/A | N/A | N/A |

| | Equipment and Communication Summary | | | |
|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** |
| **Coffs Harbour** | Digital 100%, all telemetered | N/A | N/A | N/A |
| **Essential Energy** | Digital 100%, all telemetered | N/A | 100% manual | N/A |
| **Dubbo City Council** | N/A | 100% manual | 100% manual all telemetered | N/A |
| **Eurobodalla Shire Council** | Not known | Not known | 100% manual | Not known |
| **Gosford Wyong Council** | +Not Known | 100% Manual | N/A | +Digital 100%, 90% telemetered |
| **Goulburn Mulwaree** | Digital 100%, all telemetered | N/A | N/A | N/A |
| **Kempsey Shire Council** | Digital 100%, all telemetered | 74% digital data, no telemetry | 100% manual | Digital 100%, 10% telemetered |
| **Lismore Council** | +Digital 100%, all telemetered | N/A | N/A | +Digital 100%, all telemetered |
| **Port Macquarie Hastings Council** | Digital 100% all telemetered | N/A | N/A | N/A |
| **Queanbeyan City** | N/A | N/A | N/A | N/A |
| **Shoalhaven** | Digital 100% all telemetered | N/A | N/A | Digital 100% all telemetered |
| **Tweed** | 62% manual other not known | N/A | N/A | Not Known |
| **Wagga Wagga City** | N/A | N/A | 100% Manual | N/A |
| **Wyong Council** | Digital 100% all telemetered | 100% manual | N/A | Digital 100% all telemetered |
| **Sydney Metro CMA** | Digital 100% all telemetered | N/A | N/A | Digital 100% all telemetered |
| **Murrumbidgee Irrigation** | Digital 100%, 50% telemetered | 100% manual | 100% manual | Digital 100%, all telemetered |
| **Murray Irrigation** | Digital 100%, 80% telemetered | 100% manual | N/A | N/A |
| **Coleambally Irrigation** | 100% digital | 100% manual | 100% manual | N/A |

Note: * funds applied for from the Bureau for modernisation of equipment.

## 3.6 Water usage monitoring

From the information supplied by various organisations an attempt has been made to extract summary details. This collated information may not be complete but is based on the best available data.

**Table 3 Water Supply and Usage Monitoring**

| | Current Water Supply/Usage Monitoring Sites | | | | |
|---|---|---|---|---|---|
| | **Treatment /Supply** | **SW Extract** | **Bore** | **Storage** | **Total** |
| **Major Agencies** | | | | | |
| NSW Office of Water | | 14,145 | 91,635 | | |
| SWC | 0 | 11,230 | 0 | | 11,230 |
| SCA | 11 | 16 | | 20 | 47 |
| HWC | 0 | 2 | 179 | 3 | 184 |
| Sydney Water | 8 | 21 | 0 | 0 | 29 |
| Total | 1664 | 25,414 | 2222 | 23 | |
| **Other Agencies** | | | | | |
| Armidale-Dumaresq Council | | | | | |
| Bega Valley Shire Council | 10 | 2 | 2 | 5 | 19 |
| Bathurst Regional Council | | | | | |
| Cabonne Council | 0 | 0 | 0 | 2 | 2 |
| Dubbo City Council | 2 | 0 | 7 | 0 | 9 |
| Eurobodalla Council | | | | | |
| Gosford Wyong Council | | | | | |
| Kempsey Shire Council | | | | | |
| Lismore Council | | | | | |
| Mid-Western | 0 | 0 | 0 | 1 | 1 |
| Port Macquarie-Hastings Council | 10 | 7 | 0 | 2 | 19 |
| Murray Irrigation# | | | 1449 | 0 | 1455 |
| Murrumbidgee Irrigation | | | | | |
| Coleambally Irrigation# | | | 809 | 0 | 809 |
| Total | 58 | 7 | 809 | 0 | |

Notes

1: The Inventory document did not lend itself to specifically collating information relating to urban and rural water supply and the monitoring required for its management. The information supplied has been gleaned from the data supplied and cannot be thought to be a comprehensive summary of the situation.

2: It is difficult to separate the general hydrometric assessment roles from the water supply and water use monitoring undertaken at a site. Accordingly, there is level of double counting taking place when comparing this and Table 12.

## 3.7 How much surface water does NSW have?

New South Wales is located between the summer monsoon rainfall system of northern Australia and the winter cold front rainfall system of southern Australia. River flows in NSW show distinct variations in time, with streamflow showing both a seasonal pattern and substantial year-to-year variability in discharge.

The inland Murray and Murrumbidgee Rivers in southern NSW experience most of their runoff in the late winter/spring period, with about 58 per cent of the average annual natural flow in the Murrumbidgee River occurring in the four month period from July to October. The seasonal pattern in the northern inland rivers is less obvious, with 36 per cent of the average annual natural flow in the Gwydir River occurring in the four month period from July to October, and 31 per cent in the three month period from January to March. The annual flow in the southern inland rivers is less variable than in the northern rivers, with the minimum and maximum annual natural flows for the Murrumbidgee being 12 and 392 per cent of the average annual natural flow, while for the Gwydir River the range is five to 480 per cent. The Macquarie River, located in the central inland part of NSW, demonstrates the most variability of the western-flowing rivers with minimum and maximum annual natural flow ratios of three and 780 per cent.

The inland rivers with the lowest average annual flows are those flowing from Queensland and crossing the border west of Mungindi. Therefore, it is not unexpected that the Darling River is subject to extreme variability with minimum and maximum annual natural flow ratios of seven and 300 per cent.

For coastal streams, the catchment size and distance from the coast are the main factors influencing the flows. The large coastal catchments of the Clarence, Hunter and Hawkesbury-Nepean Rivers have proportionally low rates of flow. The exception is the Snowy River, which benefits from snow melt, although a large part of its flow is now diverted inland.

## 3.8 Available resource

The total average annual surface water resource for NSW is 42,000 GL. This information has been determined from a combination of water resource system models and historical flow analysis.

The total annual divertible surface water resource for NSW is based largely on the volumetric water entitlements issued for the large regulated river systems, combined with the rules that have been developed as part of the NSW water sharing plans. The combination of observed streamflows and water sharing plan rules create a Plan limit, which is a long-term average diversion limit. Where close connectivity between surface and groundwater exists, part of the groundwater recharge that replenishes these aquifers comes from surface water as well. The major groundwater systems are also covered by Water Sharing Plans, which also have long-term average diversion limits. These limits are essentially a portion of the average recharge, thus providing a buffer to protect environmental assets as well as aquifer integrity.

Priority for Water Planning in NSW was originally placed on water sources where the major diversions were occurring and where significant environmental assets required protection. However, there is also a considerable level of activity developing water sharing arrangements for a large number of minor unregulated surface water and

aquifer systems. Consequently, NSW has placed a high priority on the management of the unregulated rivers. Management plans for the most highly stressed unregulated rivers have been prepared. Plans for other stressed and high conservation unregulated rivers are being covered by macro water sharing plans, which are nearing completion.

Most regulated streams occur inland and are part of the Murray-Darling Basin. As this basin is subject to a cap on diversions, NSW has assumed that there will be no further infrastructure development in the basin that would increase diversions. In the valleys, where NSW has implemented environmental flow rules, average annual diversions have been designed to be lower than the long-term Murray-Darling Basin Cap values. Hence, the specific river health rules that have been developed in the WSPs have been used by NSW to maintain compliance with the MDB Cap. The current gazetted WSPs are shown in Figure 1.

The Murray Darling Basin Authority is currently developing *The Basin Plan* for long-term sustainable management of the Basin. The plan will be prepared in consultation with Basin states and communities. It will be complemented by water resource plans prepared by Basin states and provided to the Commonwealth Minister for accreditation.

The Basin Plan will also play an important role in identifying responsibilities for managing risks related to reduced water availability and changes in reliability of supply.

Water-sharing arrangements that are provided for in existing water resource plans will remain in place until these plans cease as outlined in the transitional arrangements set out in the Act. Further detail can be found at: http://www.mdba.gov.au/basin_plan.


**Figure 1: NSW Gazetted Water Sharing Plans**

## 3.9 How much groundwater does NSW have?

NSW has enough groundwater to cover the whole of the state to a depth of 11.5 m. Its availability is unevenly spread across the state, with some rocks being impermeable so any bores sunk are 'dry' while other units yield over 30 ML/day to suitably constructed bores. The quality of the groundwater varies greatly ranging from rainfall quality in some coastal areas to over 200,000 mg/L TDS (seven times saltier than sea water).

The dominating influences on the location and magnitude of groundwater resources in NSW are geology, geomorphology and climate. The runoff divide formed by the Great Dividing Range separates the short, steep, eastward-flowing rivers that flow directly into the Pacific Ocean from the western-flowing rivers that have a much longer and more circuitous course to the Southern Ocean as tributaries of the Murray River.

The eastern flowing rivers have had a relatively short period, since the last major sea level changes, in which to develop, with only limited development of alluvial deposits. Where such deposits occur, they commonly grade laterally into unconsolidated estuarine and marine deposits. Consequently, the highly productive aquifer systems often associated with alluvial deposits are generally not available in association with these eastern flowing rivers. Extensive, but shallow, alluvial deposits are associated with the Hunter and Richmond Rivers. The other coastal river systems have only limited groundwater resources associated with their alluvial deposits, but are used extensively as a stock and domestic source of water, especially during droughts.

The most productive aquifer systems in the eastern coastal region are the coastal dune deposits, which have been extensively developed along some parts of the coast during a succession of sea level changes. They provide a water supply source for most urban settlements north from the Shoalhaven River at Nowra. Of particular importance are the Tomago Sand Beds and associated Tomaree and Stockton deposits, which provide an important part of the water supply for Newcastle and surrounding areas.

The western-flowing rivers have a much longer route to the sea, with lower gradients across the western slopes and plains. Alluvial deposits have formed extensively along their valley systems and, in the case of the southern rivers, in delta areas where in past times they debouched into the eastern marginal areas of the lakes and swamps of the Murray Basin. A large proportion of these deposits formed during periods when the climate was very humid, resulting in chemical deposition of the products of erosion from the highlands. Under these conditions, quartz grains remain as an inert residual product, while all other products of decomposition are soluble and removed as part of the salt load of the rivers. The outcome of this process is the accumulation of thick and extensive deposits of clean quartz gravel and sand, and it is these deposits that form the main aquifers in the western-flowing river systems in NSW.

Highly permeable sediments associated with the western-flowing rivers have developed extensive aquifers containing significant volumes of lower salinity (less than 800 mg/L TDS) which yield in excess of 1100 GL in the last water year. These aquifer include the Gwydir Valley (downstream of Moree), Murrumbidgee Valley (upstream of Narrandera downstream from Wagga Wagga), Namoi Valley (generally downstream from east of Gunnedah) and Lachlan Valley (downstream from Hillston and between Cowra and Condobolin), Murray Valley (downstream of Howlong), Macquarie Valley (downstream from Wellington). In all these areas, it is possible to construct bores with very large supplies. Pumping rates of 20 ML/day are not uncommon and water salinity

is as low as 300 mg/L. Less substantial resources are available in all the other westward flowing rivers, to a varying degree.

The alluvial deposits described above are, in terms of their geological character, superficial, i.e. they form a thin veneer on some parts of the landscape, obscuring the underlying basement rocks. These are of varying character and have a very wide range of water storage and transmitting capacity. Sandstone, with residual intergranular porosity, is generally the most highly productive, occurring in a number of large sedimentary basins. From a groundwater sense, the Great Artesian Basin (GAB) is by far the most important. It occupies an area covering 20 per cent of the Australian landmass, extending over four states/territories. Its water resources are discussed elsewhere.

The Oxley Basin contains a sandstone and volcanic rock that locally can generate large supplies of water from bores. The aquifers are extensively covered and obscured by the basalt of the Liverpool Range. Sandstone and coal seams in the Clarence-Morton, Gunnedah and Sydney basins is generally less productive than in the GAB but locally yield in excess of 5 ML/day where fracturing has enhanced the normal porosity. Stock and domestic supplies are commonly available.

Older, fractured crystalline rocks of igneous or metamorphic origin form the landscape in large areas of the State and have been grouped here into the New England, Lachlan Fold Belt and Olary Provinces. These rocks are intrinsically impermeable and only attain a degree of porosity and permeability, which enables them to store and transmit water by secondary processes. Such processes may be tectonic (earth movements), which causes fracturing and jointing and consequently open spaces within the rock mass, or chemical erosion, which may differentially remove some of the rock mass leaving a matrix of residual material with some porosity and permeability. In the more humid areas along the Great Dividing Range, salinity is generally less than 1500–2000 mg/L, with small pumping rates sufficient for stock and domestic use. Towards the west, as the rainfall decreases and the land slopes and elevation that control the hydraulic gradients decrease, the salinity increases gradually. Due to this salinity, the water can only be used for stock watering and limited domestic purposes.

Groundwater monitoring tends to be related to the high use aquifer outlined above both along the coast and inland. In these areas water level information is required to manage aquifer storage and the associated impacts on streamflow and other users as well as aquifer compaction and water quality change.

In most of the other areas, it has been found that due to the large volume of groundwater in storage pumping has little impact on the natural system.

## 3.10 Water monitoring sites in NSW

This section of the report concentrates on the more physical side of water monitoring, i.e. Surface Water Quantity, Groundwater Level, Surface and Groundwater Quality, and Meteorological monitoring. It contains the updated information from the most recent inventory.

Information on data categories 5, 6 and 7 have been added where relevant.

### 3.10.1 Surface water

The first gauging station was established at Windsor NSW in 1799. Since then some 1841 river gauging stations in NSW have been established and operated by the current NSW Office of Water or one of its predecessors. Of this total, 230 of these stations are or were run by other authorities. Of the remainder run by NSW Office of Water, over 1000 remain operational and data is archived from over 750 of these stations (see Table 6).

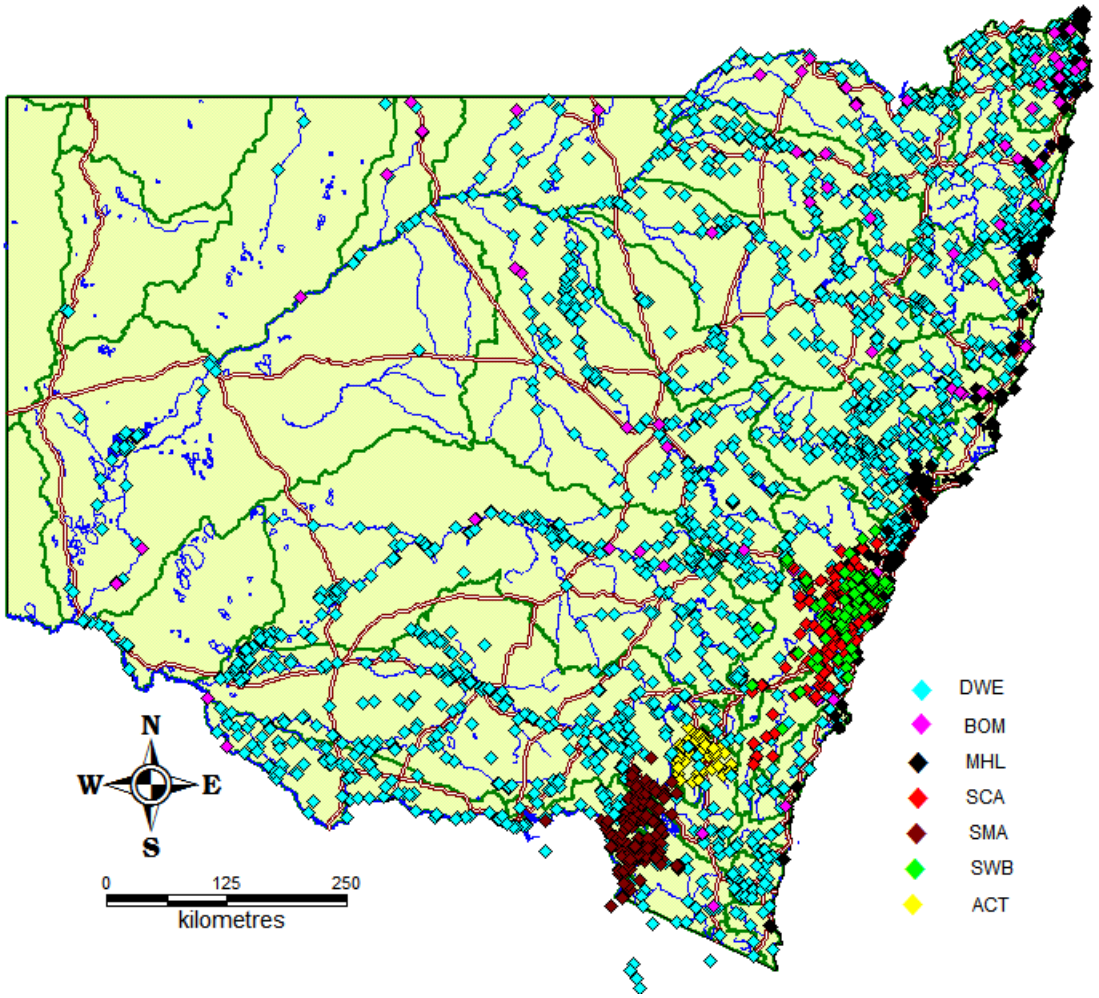


**Figure 2: Surface water monitoring sites in NSW**

Note: The organisation names have changed since this diagram was created, not the location or ownership of the sites. DWE = NSW Office of Water, BUREAU = Bureau of Meteorology, SCA = Sydney Catchment Authority, SWB = Sydney Water Corporation, ACT = ActewAGL

The total NSW surface water network recorded so far in the Inventory totals over 1700 current sites. There are also over 1000 discontinued sites that are not included in the Inventory at this stage. However, it is intended that these will be included if requested.

These gauging stations have been operated on behalf of the state as a whole, for various branches within NSW Office of Water, a variety of state and interstate

authorities and a range of other clients including private firms and councils. However, the bulk of the non-directly client-funded stations have been operated under the State's capital budget.

NSW networks currently consist of some 900 active surface installations where comprehensive water quantity data is captured and another 150 installations where other surface water data is collected. Some 650 of these active installations provide real-time data via a range of telecommunications networks. The surface water archive holds data from 1800 sites, 45 of which date pre-1900. At 200 of these surface water installations, water quality data is/has also been collected for various clients.

The NSW Office of Water network is currently expanding as various state legislative requirements (Water Sharing Plans) and National Water Commission funding drive this expansion. Anecdotal evidence suggests that most other networks appear to be relatively stable. Figure 2 displays the location of the monitoring sites operated by the major agencies.

**Table 4: Age of surface water network on the NSW Office of Water archive**

| Stations | Opened | Closed | Sites Still Open |
|---|---|---|---|
| Opened Before 1900 | 45 | 0 | 45 |
| Between 1900-1920 | 86 | 8 | 123 |
| Between 1920-1940 | 192 | 55 | 260 |
| Between 1940-1960 | 305 | 74 | 491 |
| Between 1960-1970 | 292 | 74 | 709 |
| Between 1970-1980 | 231 | 107 | 833 |
| Between 1980-1990 | 170 | 192 | 811 |
| Between 1990-2000 | 231 | 138 | 904 |
| Between 2000- 2010 | 345 | 150 | 1099 |
| **Total** | **1897** | **798** | |

Source: NSW Office of Water Site Database Queries February 2010.

### 3.10.2 Groundwater in NSW

Groundwater is an important and vital natural resource in NSW. It makes a substantial contribution as a source of water for the maintenance of aquatic environments and is an integral component in the long-term management of water resources at both State and regional levels. It is coming under increasing pressure to meet the needs of agriculture and industry as well as drinking water for many country towns. It also sustains a variety of ecosystems.

In NSW, groundwater plays an important role in town water supply. The city of Newcastle relies on the Tomago Sandbeds Aquifer for up to one-third of its town water, especially when drought or water quality problems affect its surface water supplies. Outside the metropolitan centres, over 130 towns and 220,000 people rely at least in part on groundwater for domestic supplies. However, one-quarter of these supplies is drawn from bores in alluvial aquifers alongside rivers and is likely to also contain surface water.

Many thousands of private properties in rural NSW also rely on groundwater, especially in arid and semi-arid areas such as the GAB, where surface water supply can be scarce and infrequent.

Now that most of NSW river systems are stressed, there is increasing demand for groundwater to meet human needs. As groundwater demand and use increases, so too does the need for groundwater management. Groundwater extraction by humans disrupts the natural water cycle. It lowers and alters the natural variability of groundwater levels, which in turn alters the timing of availability and volume of groundwater to its dependent ecosystems. Groundwater use must be made to be sustainable, for the long-term benefit of all the people, plants and animals that depend on it.

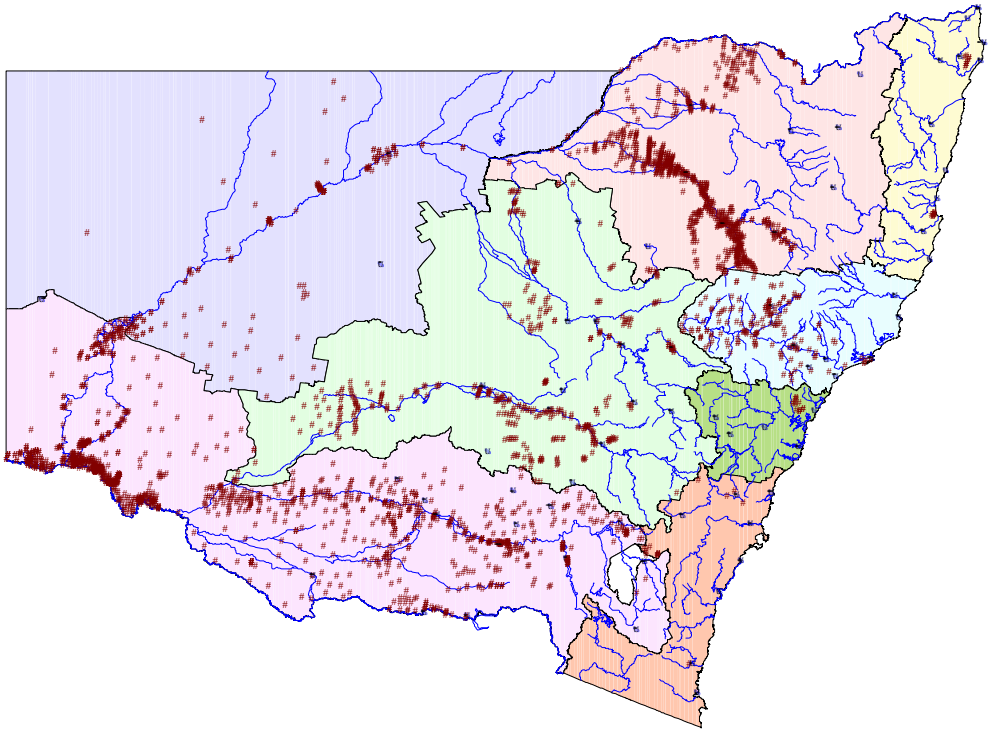

**Figure 3: NSW GW monitoring sites**

Groundwater monitoring is expanding at a rapid pace, especially continuous monitoring of bores. Some 5000 manual-read groundwater installations are currently active. Of these, 250 are operated by NSW Office of Waters hydrographic staff. The water archive holds data for almost 900 installations, where groundwater level data has been measured continuously by logging devices. Of these, over 320 are still operating.

### 3.10.3 Water quality

We can use water without depleting its supply. However, water is a fundamental component of a complex ecosystem. Its maximum sustainable yield depends on how we exploit it within the system. Evidence of over-exploitation and environmental stress is abundant. Pollution from human activities destroys aquatic life and threatens human health. Misuse of the water resource causes widespread degradation of soils, disrupts

the supply of potable water and generates massive economic losses. To be aware of the extent of these problems and to manage them, baseline data is needed.

The business of water quality monitoring is divided into two separate areas:

1. continuous monitoring
2. discrete sampling.

The Continuous Monitoring business processes have been externally quality certified to ISO 9001. Investigations are continuing regarding the practicality of seeking quality certification for manual/discrete sampling.

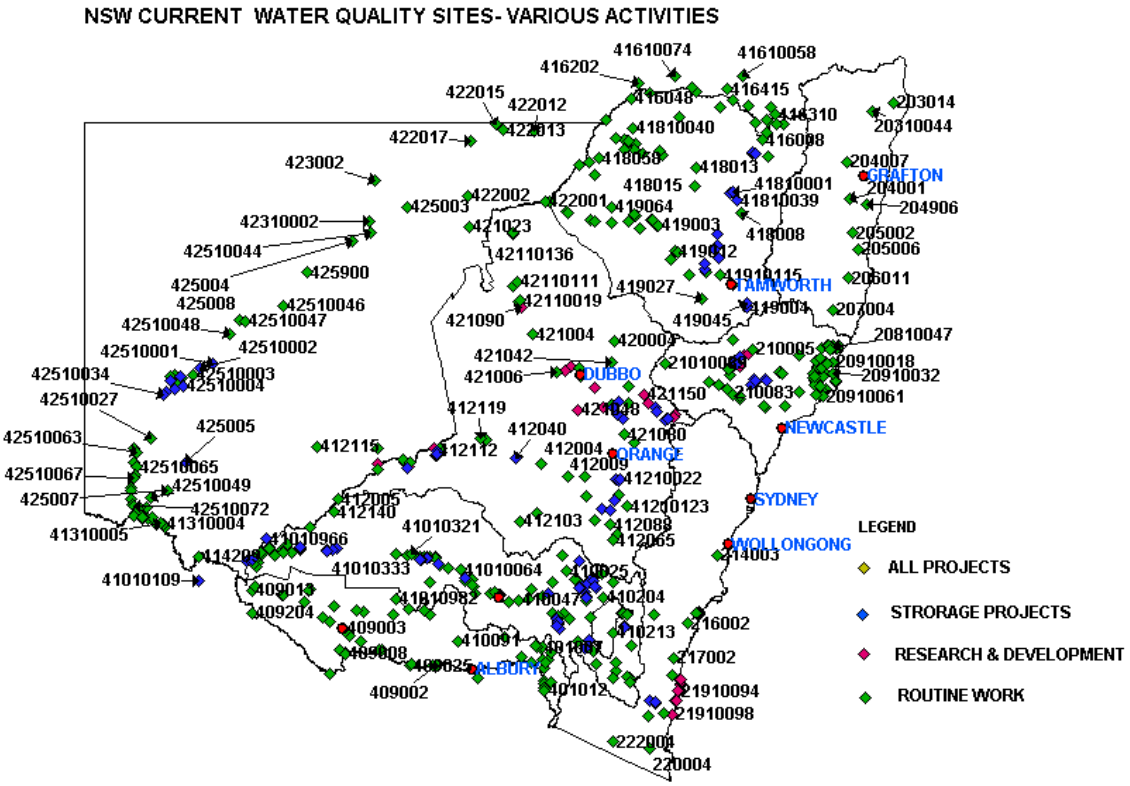


**Figure 4: NSW Water Quality Monitoring Sites**

### 3.10.4 Meteorological

While the Bureau is the primary meteorological data collector in Australia, various state agencies also have meteorological networks.

The state agencies networks were primarily for river and storage operations especially during flood times, so these agencies were earlier adopters of automated technology for rainfall measurement. Many of the sites are in non-standard installations and as such are not used as long-term rainfall data stations by the Bureau, but the information is supplied to the Bureau's flood forecasting sections.

Recently, there has been increased installation of weather stations for research purposes measuring a range of meteorological data, but the number is still low compared to rainfall sites. Figure 5 identifies where meteorological data is collected in NSW.

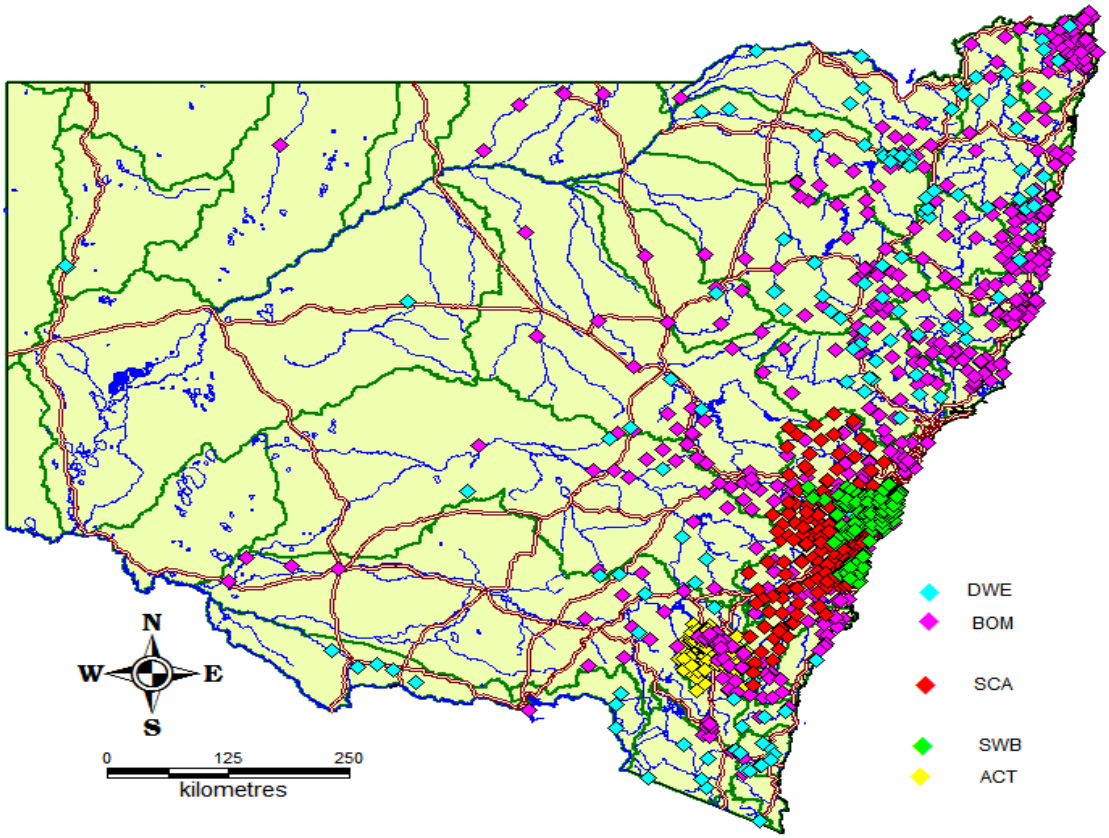


**Figure 5: Meteorological monitoring NSW**

Note: The organisation names have changed since this diagram was created, not the location or ownership of the sites. DWE = NSW Office of Water, BUREAU = Bureau of Meteorology, SCA = Sydney Catchment Authority, SWB = Sydney Water Corporation, ACT = ActewAGL.

## 3.11 Information Systems

The most common system in use for the data of concern to the Bureau is the Kisters product, Hydstra. In smaller organisations, there are a range of in-house systems used primarily for Water Quality and Groundwater data, such as MS Access and Excel. In many councils, various SCADA products are used as a common data collection and short-term data storage system. Table 5 outlines the reported information systems for hydrometric data.

**Table 5: Information Systems Summary**

| | Information Systems | | | |
|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** |
| **Major Agencies** | | | | |
| NSW Office of Water* | Hydstra | In-house Oracle – GDS* | In-house Oracle – Triton* | Hydstra |
| SWC | Hydstra | N/A | In-house Oracle – Triton | Hydstra |
| SCA | Hydstra/SCARMS | N/A | In-house Oracle – WQDB | Hydstra |
| MHL | Wiski** | NA | Wiski | Wiski |
| NSW DPI | Hydstra | In-house – MS Access | In-house – MS Access | Hydstra |
| HWC | EDRS | EDRS | EDRS | EDRS |
| Bureau of Meteorology | Enviromon plus in-house Oracle | N/A | N/A | Enviromon, Time Studio plus in-house Oracle |
| Sydney Water | Hydstra and IICATS | N/A | In-house Oracle – LIMNOS | Hydstra |
| MDBA | Hydstra | N/A | N/A | Hydstra |
| Snowy Hydro | Hydstra | Not Known | Not Known | Hydstra |
| OEH*** | N/A | N/A | In-house Oracle | AcquisNet |
| Snowy Hydro | Hydstra | NA | NA | NA |
| **Other Agencies** | | | | |
| Armidale-Dumaresq Council | MS Excel | N/A | MS Excel and Paper | Elpro |
| ActewAGL | Hydstra | NA | NA | NA |
| Ballina Shire Council | N/A | N/A | MS Excel spreadsheets | N/A |
| Bathurst Regional Council | | NA | NA | NA |
| Bega Valley Council | MS Excel | NA | NA | NA |
| Cabonne Council | Not Known | NA | NA | NA |
| Coffs Harbour Council | Excel | NA | NA | NA |
| Essential Energy | MS Excel | N/A | MS Excel | N/A |
| Dubbo City Council | NA | Not Known | Not Known | NA |
| Eurobodalla Shire Council | Not known | Not Known | Not Known | Not Known |
| Gosford Wyong Council | MS Excel | Not Known | N/A | Not Known |
| Goulburn Mulwaree Council | Hydstra | N/A | N/A | N/A |

| | Information Systems | | | |
|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** |
| Kempsey Shire Council | MS Excel | MS Excel | MS Excel | Not Known |
| Lismore Council | Not Known | N/A | N/A | Not Known |
| Mid-Western | | NA | NA | NA |
| Port Macquarie Council | Not Known | NA | Not Known | Not Known |
| Queanbeyan City Council | NA | NA | NA | NA |
| Shoalhaven Council | Not Known | NA | NA | Not Known |
| Tweed Council | Not Known | NA | NA | Not Known |
| Wagga Wagga Council | NA | NA | MS Excel | NA |
| Wyong Council | Enviromon | WSC Telemetry System | N/A | Enviromon |
| Sydney Metro CMA | Enviromon | NA | NA | Enviromon |
| Murrumbidgee Irrigation **** | Hydstra? | Not Known | Not Known | Not Known |
| Murray Irrigation | Rubicon | GIS Compatible | N/A | N/A |
| Coleambally Irrigation | MS Excel | Not Known | Not Known | MS Access |

Note

* In-house Oracle system. Bureau funds have been granted to implement new commercial database system replacement for WQ and GW databases. Kisters Pty Ltd won the tender to supply these systems.

** In-house VAX LEOST system replaced by Bureau funded Kisters' Wiski system recently.

*** Previously a multitude of small systems, Bureau provided funding for development of a new in-house Oracle-based database system.

**** Information as supplied.

N/A – not applicable, i.e. no data stored.

Not Known – no information supplied.

## 3.12 Details of water licensing in NSW

The NSW Office of Water is responsible for managing access to water and ensuring water is shared between the environment, towns and cities, and farmers and industry as well as for Aboriginal cultural activities.

A range of different licence types are used by the department to allocate and monitor water usage in the state. The 'supplementary report' contains a detailed description of the following elements:

### 3.12.1 Basic rights

Three basic rights to access water are available to rural landholders in NSW. Licences are not required for water taken under basic rights:

1. domestic and stock water
2. native title water
3. harvesting runoff – farm dams.

### 3.12.2 Water licences

A water licence or other approval from the NSW Office of Water is generally required to extract water from rivers or aquifers to use for commercial purposes.

NSW currently operates under two pieces of legislation relevant to water licences and water trading (the buying and selling of water licences or annual allocation water):

The *Water Management Act 2000* governs the issue of new water licences and the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced.

The NSW *Water Act 1912* governs the issue of water licences in other areas.

Water access licences under the *Water Management Act 2000* differ from licences under the *Water Act 1912*. These licences:

- provide a clearly-defined share of the available water in a particular water source that can be sustainably extracted
- provide a clearly-defined entitlement that is separate from land ownership
- separates the entitlement to access water from the approvals associated with supply works and the use of water
- in the case of 'continuing' water access licences (licences granted in perpetuity), allow for the licence and water allocation available under that licence to be bought and sold fully or in parts and for the licences to be subdivided, consolidated and changed (e.g. for category, zone, water source)
- are listed on a public Water Access Licence Register.

Note that licences issued for specific purposes such as domestic, stock or Aboriginal cultural are not transferable.

Once a water sharing plan commences, all existing NSW *Water Act* licences are converted to water access licences and approvals under the *Water Management Act*.

Generally, new water access licences for commercial purposes (irrigation, industry, and mining) with a share of the available water are no longer being granted. If you need to obtain a permanent share of water you will have to purchase an existing licence on the water market (see the information on dealings and trade).

However in most water sources it is still possible to apply for:

1. specific purpose licences (such as domestic and stock, Aboriginal cultural, or local water utility access licences)
2. zero share licences that allows you to have a water account and to buy allocation water on an annual basis or share component from another licence holder.

#### Water access licence trading

There are three agencies involved in water dealings:

- NSW Office of Water
- Land and Property Information (LPI) – a division of the NSW Dept. of Finance and Services
- State Water Corporation (State Water).

There are two types of water access licence dealings:

- general water dealings
- water allocation assignment dealings.

#### General water dealings

General water dealings under the *Water Management Act 2000* include the trading of water access licences as well as any change to water access licences on the Water Access Licence (WAL) Register.

#### Water allocation assignment dealings

A water allocation is a volume of water (in megalitres) credited to a water access licence water allocation account. All or part of the water allocation can be traded.

### 3.12.3 Interstate transfers

For inter-state transfers into NSW, the user will need to hold a current NSW water supply work approval or combined work and use approval.

For transfer out of NSW, the user must hold a NSW water access licence or an agreement to exercise a NSW water access licence.

### 3.12.4 Approvals

There are three main categories of approvals that can be granted:

- water supply works approvals
- water use approvals
- activity approvals.

Under the *Water Management Act 2000* (WMA), water access licences entitle a licence holder to a share of the water in a water source that can be sustainably extracted. These licences are held and traded independently from land and are issued separately to approvals.

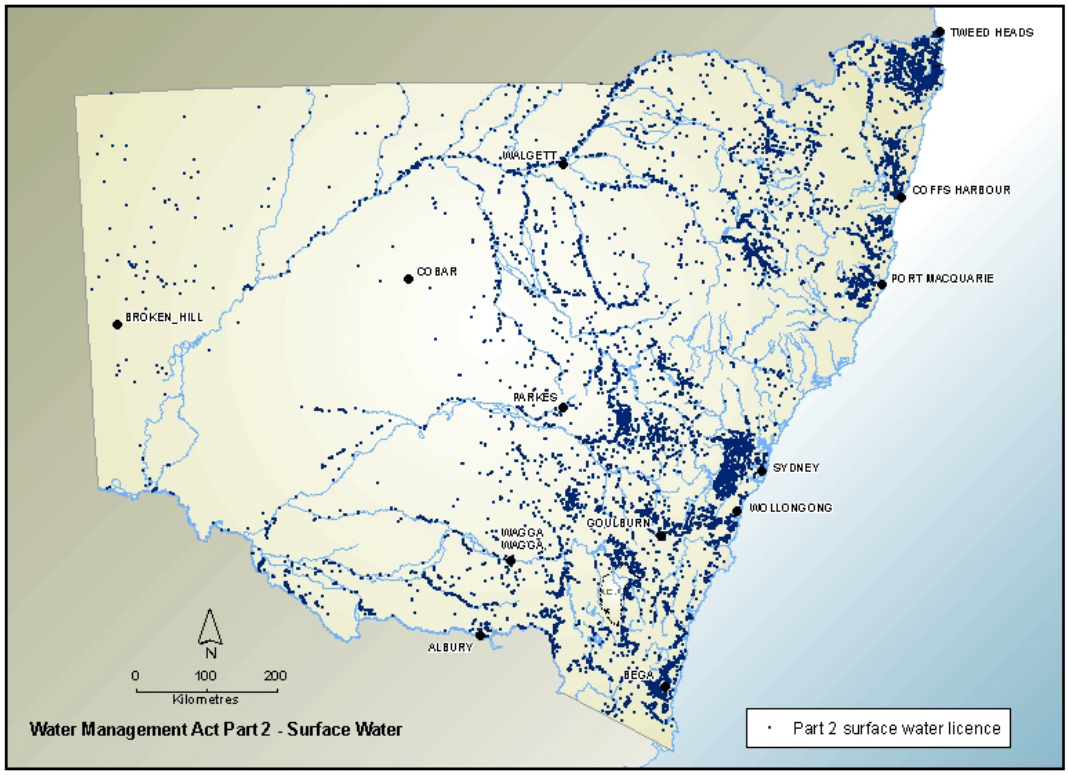


**Figure 6:** ***Water Management Act 2000*** **Surface Water Licences**

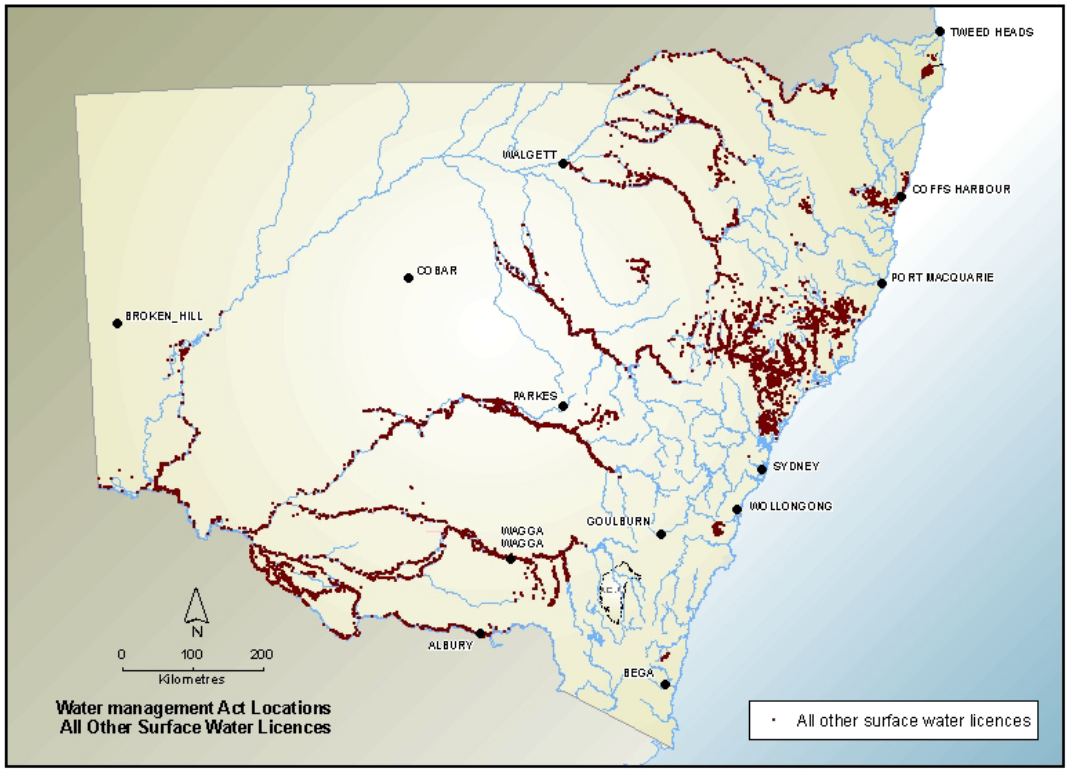


**Figure 7:** ***Water Management Act 2000*** **Other Water Licences**

### 3.12.5 Aquifer interference

Groundwater is a complex and often very fragile resource that plays an important role in natural ecosystems. Groundwater sources (aquifers) are often connected to surface water flows and it is important that they are managed sustainably and that their quality is protected.

Landholders considering accessing groundwater in New South Wales must obtain the relevant approval or licence from the NSW Office of Water before any drilling or bore construction takes place.

If you are in an area covered by a water sharing plan for a groundwater source, then the *Water Management Act 2000* requires you to obtain:

- water supply works approval to construct a bore, well or spear point
- water access licence to access the water.

In all other areas, that is, those still covered by the *Water Act 1912*, you must obtain a Groundwater licence.

Regulations and licences also apply to bore drillers. Drillers must be licensed in the state or territory in which they intend to operate. The Office has a drilling service which specialises in the larger and more difficult projects requiring a high degree of expertise and access to specialised equipment.

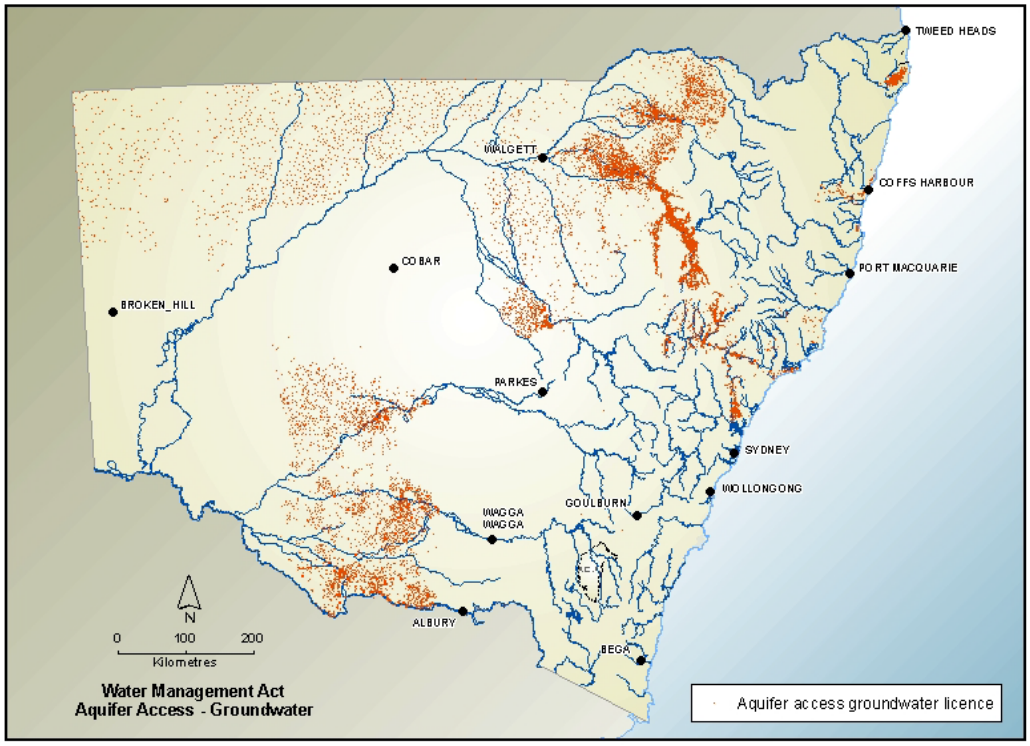


**Figure 8:** ***Water Management Act 2000*** **Aquifer Access Licences**

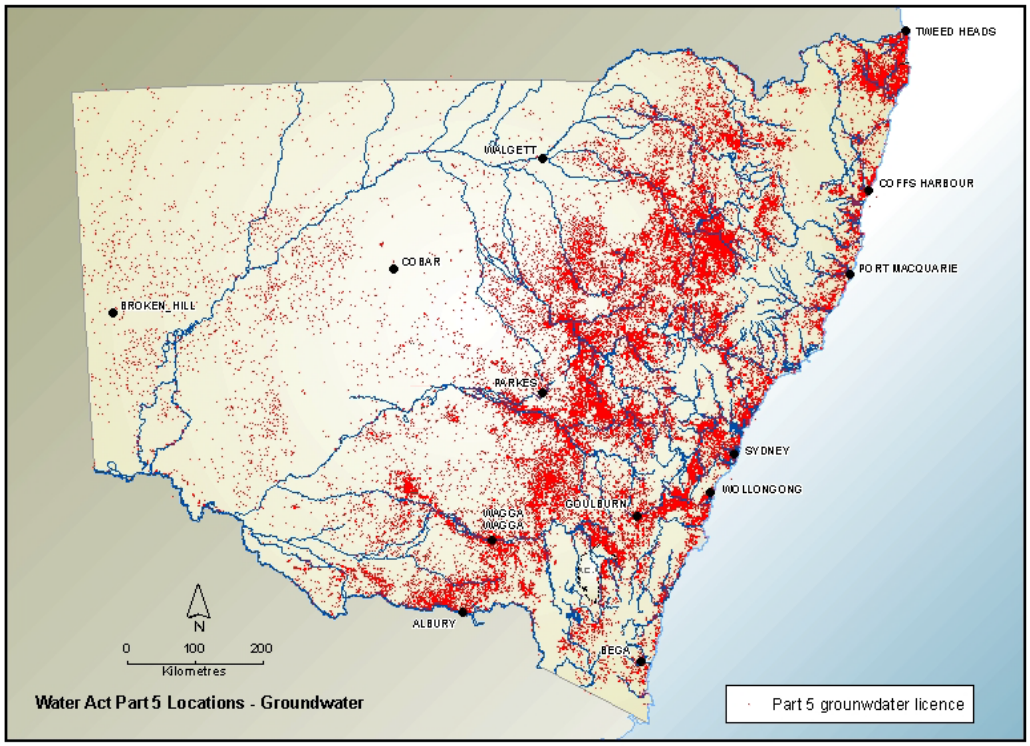


**Figure 9:** ***Water Act 1912*** **Groundwater Licences**

### 3.12.6 Corporate licences

The management of corporate licences was established in 1998 in response to the NSW Government's water reforms. Corporate licences are those licences identified by the NSW Office of Water as being held by entities that are significant users of water and require specific attention. These entities are generally Government Trading Enterprises, or enterprises authorised to engage in trade that are owned, sanctioned or otherwise supported by the government. Many of the corporate licensees are state-owned corporations.

The Office plays a key role in managing the corporate licences of:

- four power utility companies – Delta Electricity, Eraring Energy, Macquarie Generation and Snowy Hydro Ltd
- three water supply utilities – Sydney Water Corporation, Sydney Catchment Authority and Hunter Water Corporation
- five irrigation corporations
- one river operator – State Water.

The Office also coordinates scientific input into conditioning and reviewing licences as well as providing direct support to water sharing plan teams.

### 3.12.7 Major utilities

Water licences and approvals of a major utility entitle it to take and use water from authorised water sources in accordance with a comprehensive set of conditions. These conditions cover works authorisations, environmental flow releases and other operating requirements, monitoring, reporting and scientific studies.

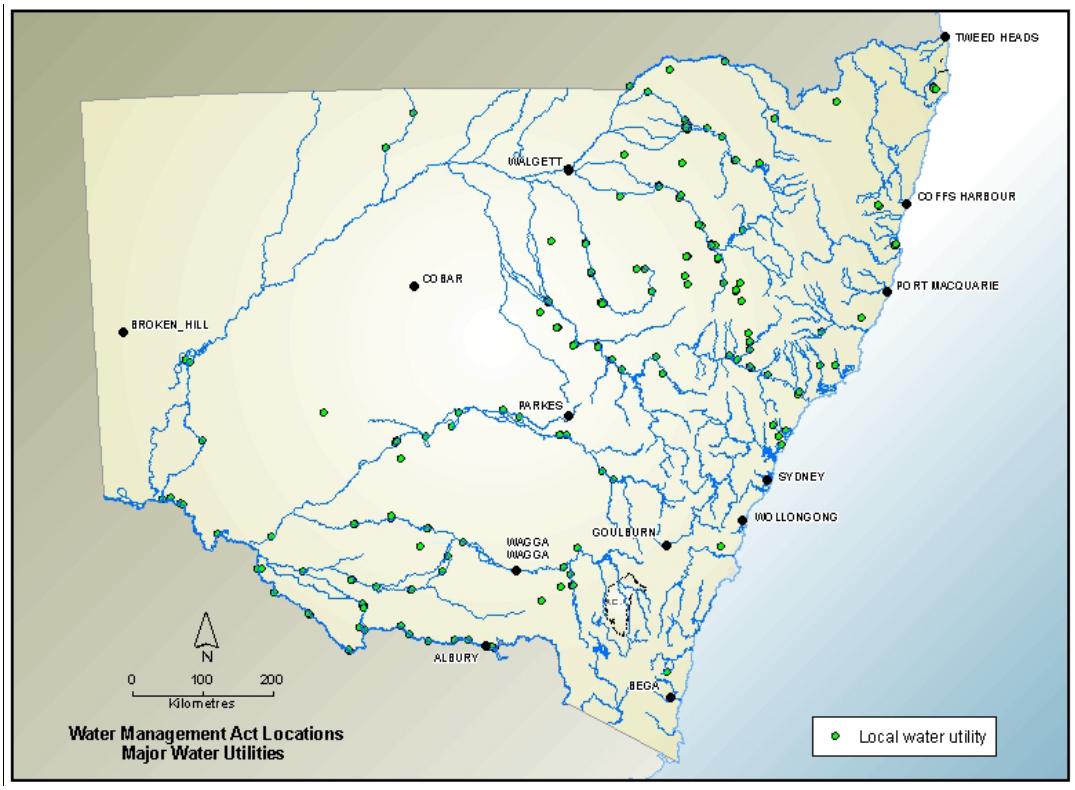


**Figure 10:** ***Water Management Act 2000*** **Major Utility Licences**

These licences and approvals can be amended by the department either during a major statutory review or as issues arise. In NSW, the following utilities have been granted licences and/or approvals.

Delta Electricity

Eraring Energy

Hunter Water Corporation

Macquarie Generation

State Water

Sydney Catchment Authority

Sydney Water Corporation

Snowy Hydro

### 3.12.8 Irrigation corporations

Reform of management of government-owned irrigation systems in NSW was enabled by the *Irrigation Corporations Act 1994* (IC1994), which had the intended effect of:

- (initially) establishing State-owned corporations to manage existing Ministerial owned and operated irrigation schemes
- (subsequently) enabling those and other irrigation scheme areas to be owned and managed by private corporations on behalf of shareholders, being the existing water entitlement holders.

Between February 1995 and March 2001, the government controlled schemes were consolidated, by proclamation, into five state-owned Corporations. The corporations were then privatised and through this process ownership and management of the irrigation corporations became the responsibility of the shareholders.

The five Irrigation Corporations created under the IC1994, were:

- Coleambally Irrigation Ltd (now known as Coleambally Irrigation Cooperative Ltd)
- Jemalong Irrigation Ltd
- Murray Irrigation Ltd
- Murrumbidgee Irrigation
- Western Murray Irrigation Ltd.

The five Irrigation Corporations have now been listed as ‘Irrigation Corporations’ under Schedule 1 of the *Water Management Act 2000*.

# 4 Section C – Analysis of gaps in data and systems

***Section C*** is a critical assessment of the water monitoring networks and water information systems outlined in Section B. It identifies whether they provide the required water information to address the six key water information drivers that focus on water planning, management and operations. The monitoring networks and data management systems have also been examined in terms of data delivery to the Bureau of Meteorology's *Improving Water Information Program.*

The assessment has been undertaken as a **data gap review** by comparing what is available to what is needed. The context for this comparison is *Section A: Water Information Drivers*. These drivers characterise the challenges and issues facing water managers and planners in NSW. Iterative communication with agency practitioners in the areas of surface water, groundwater, water quality, modelling, water accounting and water operations was used to determine what data was available relative to the key information drivers, and where there were notable gaps.

The format for Section C has been to:

- derive the data gaps through interview and a targeted workshop
- provide ***descriptions*** of each of the ***49 data gaps*** – Table 6
- link the ***gaps*** to the ***information drivers*** (as described in Section A) – presented in Tables 8-13 (section C).

The section also includes a gap resolution assessment to determine how the projects funded in all five rounds of the M&E funding contributed to closing gaps. This continues on from the discussion in Section B that looked at the benefits of M&E funding generally.

The NSW Office of Water, as the lead agency in NSW, in consultation with other key organisations, will develop a final list of *prioritised actions* that are considered important to maintain or improve on the water monitoring programs and systems that have been upgraded as a result of the M&E funding program from 2009-2012.. (Section D).

## 4.1 NSW Water Monitoring Reviews.

The Bureau has requested that the gaps analysis include consideration of previous reviews and reports. The integration is difficult because the focus of the assessment is not always on the same management scale. For example, many of the previous reviews focus at a policy level and identified gaps in programs as opposed to specific gaps in data. Many recommendations therefore focus on policy level gaps and emphasise types of data that are currently lacking rather than noting any gaps in existing data or systems. For example, a common gap noted in previous reviews was a lack of a surface water and groundwater hydraulic conductivity data collection program. However, where possible, all relevant gaps identified by previous reviews were considered for the gaps analysis in section C of the SWIMP. Details on those reviews are at Appendix 2.

## 4.2 Gaps in data and systems

There are a total of 49 gaps in data and systems that have been identified by the SWIC and NSW Office of Water, and reviewed by the NSW SWIMP Steering Committee. Membership of this committee was derived from the key eight water data collection agencies plus the Bureau of Meteorology and Snowy Hydro Limited. The gaps were developed in consultation with other organisations and government departments that either collect, manage or use water data in NSW. The gaps relate to water management information requirements across the State. In this report, the gaps have been described in Table 6 and linked to Water Information Drivers in Table 7 to Table 12. The gaps are also listed in Tables 15-20 relative to the themes in the NSW Strategic Investment Plan 2012-2017 (see Section D), which are consistent with the Themes provided by the Bureau over the 5 year program. The themes are presented below.

Theme one: Data Collection and Telemetry

Theme two: Collating and Reporting Water Information (includes National Water Account)

Theme three: Improving the Australian Hydrologic Geospatial Fabric surface water foundation dataset

Theme four: Improving the Australian Hydrologic Geospatial Fabric groundwater foundation dataset

Theme five: Development and Application of Data Standards for the collection, management and transfer of data (WDTF)

Theme six: Data provision and WDTF (includes dataset upgrades)

The Gaps analysis is inclusive and representative of NSW as a whole. In 2010 letters were sent to all named persons in NSW who had not previously been contacted by the SWICs. The letter was an invitation to read the current SWIMP and then develop an Organisational SWIMP that would highlight their monitoring activities and nominate any new gaps in data and systems. All organisational SWIMPS submitted to NOW are in appendix one, with those having updated the content identified by the version date.

These 49 Gaps in Data and Systems will influence the ability of NSW to respond in a timely, efficient and accurate manner to some of the challenges in managing the water resources of NSW. The challenges were outlined in Section A and include:

- environmental sustainability
- extreme drought and extreme events
- intense competition for water
- productive use of water
- finite water resources.

Section A also outlines the key information drivers that developed from these challenges. The information drivers establish a management context to which all the data can be applied. The data that is collected, stored and analysed, and the

equipment and systems set up around this data collection therefore work towards supporting the following information needs:

- planning for future sharing of the resource
- operational management
- compliance
- public interest
- water accounting and assessment
- special-purpose water monitoring.

**Table 6: Gaps in data and systems**

| | |
|---|---|
| **GAP 1:** | **In some catchments the surface water network coverage is not fully meeting water information requirements (see information drivers, section A)** |
| **Description** | |
| Strategic network coverage of NSW streams will support adequate detail in development of water planning models and contribute to river operations, flood operations and environmental monitoring. Currently rainfall runoff modelling is used to provide indicative coverage for some unregulated streams. This is not adequate for catchments where water extraction competition is significant or important environmental assets exist.<br>A regular network review in NSW helps determine the distribution of the gauges. Results from a consultants report that outlines coverage gaps for the operational management of regulated rivers and streams is also currently available for review, and results will be integrated into this report at a later date.<br>Other data gap processes have been undertaken in NSW including the ongoing internal network reviews, national projects including some comments in the CSIRO Sustainable Yields Report, and the National Land and Water Audit. All of these reports are outlined in the Appendix and will be integrated into later versions of the SWIMP. | |
| **GAP 2:** | **Streamflow data not meeting all accuracy requirements** |
| **Description** | |
| The accuracy of flow information particularly in low flows is critical. For example, pumping restrictions are now in place in Water Sharing Plan areas. These plans rely on robust flow data. | |
| **GAP 3:** | **Lack of adequate asset management and replacement for surface water monitoring network** |
| **Description** | |
| There is no funded long-term asset management system being implemented. Planned asset management is more efficient in terms of cost and time saving than ongoing response to individual issues. | |
| **GAP 4:** | **Data capture and transfer not meeting time requirements** |
| **Description** | |
| The currency of the data from the surface water network is not meeting management needs to an adequate standard including floods, river operations, drought management, and compliance. | |
| **GAP 5:** | **Inadequate water mass balance information** |
| **Description** | |
| Data gaps for the adequate representation of water balance in planning and operational models include:<br>· 'Total Valley Outflow' measurement is limited due to a lack of measurement of tributary inflows or streamflow rating accuracy (particularly floodplain flows) (this information can also be important for environmental management)<br>· effluent creek data is often not available due to a lack of gauging on these small systems. Due to water savings initiatives (e.g. proposed piping of the stock and domestic flows of these creeks), this lack of data is becoming more significant | |

- we have inaccurate data for area cropped and type of crop. This limits representation of on-farm interception, irrigation water requirements and vertical fluxes for groundwater system model inputs. There are also limits to modelling irrigator behaviour based on economic and water drivers
- rainfall/evaporation data is not accurate enough – currently using SILO to get estimated values
- the quantification of the amount of water being exchanged and losses incurred (e.g. groundwater/surface water interaction is only in early days of measurement)
- this gap is described in multiple dimensions to obtain a holistic view of modelling gaps. Addressing all aspects of this gap is beyond the scope for the SWIMP, but some issues, including total valley outflow, effluent creeks, and surface water/groundwater interaction, are within the scope of this Plan.

**GAP 6: Inadequate spatial location of surface water monitoring sites**

**Description**

Many sites have poor or missing details about location and elevation. With recent developments in surveying equipment, the accurate location of sites is now possible.

**GAP 7: Surface water sites no longer meet OHS and accuracy requirements**

**Description**

Much of the surface water monitoring network was established in the 1960s–1970s. A significant number of these sites are nearing the end of their life and need to be replaced. Some of these sites have confined spaces and elevated structures making them more costly to maintain and are also at heightened OHS risk.

**GAP 8: Height/flow calibrations not meeting accuracy requirements**

**Description**

Traditionally, flow data has been derived from height/flow calibrations (rating tables). For some sites, this is not the ideal method to derive flow. New technologies (Doppler) are now available to increase the accuracy of flow information. Flows in the lower range are becoming more important. Improving the low flow control at sites and using Doppler technologies will redress low flow inaccuracies over time.

**GAP 9: Water storage and surface water data not in electronic format**

**Description**

The spatial and temporal detail of data is available for assessment, but not in electronic format. For some agencies, as little as 3% of new information (electronic) is added to the water database annually, while significantly more old information (from paper records) is not added. Many of the datasets used for water management and planning are still held in paper format. This is the prime record (heights and flows) at sites used for long-term modelling and many other uses. Perhaps more importantly, the metadata associated with this data is located in many places (including the personal knowledge of key individuals) and is increasingly at risk of being permanently lost.

**GAP 10: Insufficient quality attributes for data stored in Groundwater Database (GDS)**

Note: See gap six and18 for similar gaps in other water disciplines.

**Description**

There are data quality issues with the information stored in the GDS for water levels and bore construction. The issues include:

- water level data incorrectly recorded against a bore at a nested site
- anonymous water level reads where the reading is below the screen interval, the bore was dry, or it was free-flowing
- ensuring that the appropriate strata graphic unit is assigned to drillers' logs
- the improvement of data quality, which will improve numeric models, assessment of trades, and analysis of the relationship between aquifer systems and surface water sources.

**GAP 11: Insufficient groundwater data in electronic format (data at risk)**

**Description**

The spatial and temporal detail of data is available for assessment, but not in electronic format. For some agencies as little as three per cent of new information (electronic) is added to the groundwater database annually, while significantly, older information (from paper records) is not added. Many of the datasets used for groundwater management and planning are still held in paper format. This is the prime record at

sites used for long-term modelling and many other uses. Perhaps more importantly, the metadata associated with this data is located in many places (including the personal knowledge of key individuals) and is increasingly at risk of being permanently lost.

**GAP 12: Lack of adequate asset management and replacement for groundwater bores**

**Description**

In some cases, data from the groundwater network does not meet needs. There are a range of site-related physical factors that impact on data accuracy. They include:

- silting of the bores, which blocks the screened interval and prevents the bores reflecting the groundwater level in the aquifer
- general deterioration and corrosion of steel casings in older bores
- age of loggers and sensors used in the groundwater level, pressure and electrical conductivity monitoring.

**GAP 13: In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A)**

**Description**

The expansion of the network would enable appropriate level of data for numerical model development of the interaction between surface water and groundwater systems and whole of groundwater unit management to better meet the information drivers.

Examples are: for assessment of the water sharing plan, long-term average extraction limits and monitoring of MDB groundwater and surface water CAPs. The assessment of permanent and temporary trades in areas where there is insufficient network coverage to be able to make a confident assessment of the impact on water markets.

**GAP 14: In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see information drivers, section A)**

**Description**

Groundwater use has the potential to induce leakage from adjacent saline aquifers causing a decline in higher quality groundwater aquifers. In coastal areas, groundwater use has the potential to impact on the groundwater/sea water interface. Over extraction has the potential to increase groundwater salinity through increasing sea water intrusion.

In coastal areas, the influence of climate change will result in sea level rise, causing inundation of coastal estuaries and lakes and changes in the groundwater/sea water interface. This has the potential to impact on GDEs and the availability of water for users.

**GAP 15: Lack of information about GDEs for their sustainable management**

**Description**

There is a growing understanding of the need to have monitoring around GDEs for the protection of environmental assets and monitoring of groundwater levels and quality in the area of GDEs to assess the influence of climate change, climate variability and competition for water between users and the environment. Knowledge of these impacts is required to ensure that the appropriate risks assessments are undertaken to protect GDEs and for water sharing plan development and monitoring.

**GAP 16: Inadequate spatial mapping of groundwater network**

**Description**

The spatial component of the data is not up-to-date. The surveying of the x, y and z coordinates of the State monitoring network require verification when:

- the coordinates have not been checked since the work was installed. In some circumstances, this is 40 to 50 years
- the coordinates have been identified as being suspect
- the monitoring site is missing an elevation measurement in AHD
- monitoring sites that have not been surveyed since installation.

**GAP 17a: Inadequate water quality monitoring network for flow/water quality associations**

**Description**

Flow and water quality relationships are poorly understood. Information on these relationships is required to inform future water sharing planning and to better share the resource between extractive industries and environmental needs.

Low flow pool water quality monitoring is necessary for ecological flow response, which is significant for pools following cease to flow events or during very low flows. This can impact on stream biota as micro-habitats are lost, water quality deteriorates and competition for resources between biota increases. Cease to Pump (CtP) or pool protection provisions can be used to protect environmental water in unregulated water sources.

Ecological Response Monitoring is necessary for the review and assessment of the success or impact of water sharing plans and other water management activities. Some monitoring is being undertaken in NSW, but temporal and spatial coverage is not adequate. Major data gaps include:

- gaps in the number of permanent vegetation transects to assess response to flow
- detailed survey sites at key flow points such as riffles and benches, and the development of hydraulic models
- long-term macroinvertebrate monitoring sites across priority water sharing plans to assess taxa sensitive to change in flow and allow evaluation of plans
- flow and water quality response of key fish taxa in priority water sharing plans.

In order to understand water quality and flow relationships, a better understanding of the factors contributing to changes in water quality is required. Such factors can include sediment and nutrient run-off from the catchment as well as changes to river stability as a result of fluvial processes. Without an understanding of the causal factors leading to water quality change, it is difficult to attribute cause and effect, or tease out the influence of externalities when evaluating water sharing plans. Additionally, major changes to stream geomorphology (such as streambed lowering) can significantly alter stream character and hence flow behaviour (e.g. stream incision can influence the frequency of recurrence of overbank flows). Major data gaps include:

- up-to-date landuse mapping and, in some cases, development of nutrient export models
- development of permanent monitoring cross-sections within-stream channels to assess stream stability and its long-term trajectory, channel flow relationships, and instream sediment and nutrient sources
- state coverage of fluvial geomorphic type, condition and recovery potential, including reference reaches
- extent and condition of riparian vegetation (influences water quality via filter role and bank stability).

**GAP 17b: Inadequate water quality monitoring network for surface water physical/chemical parameters**

**Description**

There are several water quality gaps related to operational water management:

Salinity – Inadequate coverage and quality of stream salinity data to enable flow surrogates for generation of salt loads in salt transport modelling.

Salinity – EC probes and salinity models required in estuary areas so that flow/water extraction/EC relationships can be developed for the development and evaluation of water sharing plans.

There is limited information on streams to determine salt loads (see Gap 20). Currently, broad estimates are used. Longitudinal profile measurements and data to determine if there are groundwater/surface water interactions affecting the loads are also lacking.

Temperature – There is limited information around storages in relation to cold water pollution impacts and evaluation of the performance of dam management change (including structural works and operating protocols).

**GAP 17c: Inadequate water quality monitoring network for groundwater/surface water interaction**

**Description**

Stream temperature can provide an excellent dataset for the study of surface groundwater interactions. When water levels in piezometers and the stream stage are measured concurrently, the combined data

will enable assessment of water fluxes between the stream and the subsurface and quantification of streambed hydraulic properties. In conjunction with water level elevation measurements, temperature data collected in shallow piezometers and deep bores can be used to estimate the rate of streambed seepage, hydraulic conductivity and conductance of the geologic materials that surround them.

There is also little understanding of the relationships between water quality/chemistry and stygofauna/general GDE health and requirements.

**GAP 18: Inadequate spatial mapping of water quality network**

**Description**

There are other water quality gaps related to the spatial information on the stream network:

- Stream order mapping for NSW is incomplete. Spatial information is lacking particularly for stream orders 1 and 2.
- Spatial information on weirs is lacking.
- Accurate (1:25,000 or better) information is required for the State's regulated rivers.
- Many sites are poorly located in location and elevation. With recent developments in mapping tools, relocation and referencing of sites is now possible. There is equipment to accurately connect sites to a reorganised level datum.

**GAP 19: Insufficient water quality data in electronic format (data at risk)**

**Description**

Water quality data is available for assessment, but not in electronic format. Many of the datasets used for water quality and planning are still held in paper format. Perhaps more importantly, the metadata associated with this data is located in many places (including the personal knowledge of key individuals) and is increasingly at risk of being permanently lost.

**GAP 20: Inadequate number of water quality sensors in the surface water network**

**Description**

There is a need to benchmark models to approximate quality and quantity levels to model associations between flows and EC values. However, there is currently limited information on streams to determine salt loads, and broad estimates are used with little understanding of whether groundwater/surface water interactions are affecting the loads.

**GAP 21: Insufficient coordination for SWIMP activities at jurisdictional/lead agency level**

**Description**

Water data is collected, stored and used by a range of government agencies across NSW. It is efficient to have coordinated data access to support informed water management decisions. The Bureau currently supports a data coordinator in each state or territory in Australia. This role will be left vacant upon completion of the Commonwealth funding program that supports this position.

**Gap 22: Inadequate blue-green algae monitoring**

**Description**

Major blooms of blue-green algae occur from time to time in the MDB. The NSW Blue Green Algae Program is not using up-to-date methods and processes. It responds to ad hoc field sampling. New technologies (e.g. Flouroprobes) need to be tested, with monitoring established in priority locations.

Some modelling has been undertaken in NSW to assess the relationship between flow and algal blooms. The information collected through these programs can be used to assess the types of flows required to prevent blooms from forming, or to dissipate existing blooms. Such a model has been developed for some sections of the Darling River and its capabilities should be extended throughout the Basin.

**GAP 23: Insufficient monitoring for a range of water quality programs**

**Description**

Water quality programs running in NSW do not cover all water management issues and in addition to extending the current programs, there is a need to collect more water quality information to meet management needs. There is currently no State-wide coordinated monitoring of pesticides or other environmental contaminants. There is also a need for more monitoring of sulphuric conditions as they can impact on wetland management.

**GAP 24: Lack of access to integrated datasets on the web**

**Description**

The data is not consistent with reporting expectations with regard to temporal and spatial, accuracy and reliability, including systems backup.

**GAP 25: Licensing database system unable to export data in WDTF format**

**Description**

The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 26: Surface water database system unable to export data in WDTF format**

**Description**

The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required, particularly from large agencies that transfer data between local systems and from clients.

**GAP 27: Inability to collate and delivery water accounting data efficiently**

**Description**

Current systems do not have the capacity for the extraction and provision of data to meet the reporting needs of the National Water Account or the delivery of Bureau data as specified under the regulations in the format detailed in WDTF specifications.

**GAP 28: Groundwater database unable to export data in WDTF format**

**Description**

The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 29: Groundwater Water Licensing and Usage Database system unable to export data in WDTF**

**Description**

The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 30: Water quality database unable to export data in WDTF format**

**Description**

The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 31: Insufficient redundancy in telemetry systems**

**Description**

A significant proportion of water data is now collected and published in near real-time to meet operational needs (such as flood warning). The dependence on having reliable data is such that redundancy of some or all components of water information systems is being considered. Most agencies do not have fully integrated redundancy of systems and infrastructure. The major components include power, communication, logger and computer hardware, telemetry software, FTP and web publishing.

**GAP 32: Inadequate water data QA system**

**Description**

There is no common data quality attributes system within the jurisdiction to send data to the Bureau.

**GAP 33: Insufficient collection of meteorological data in electronic format**

**Description**

The analogue system needs to be upgraded to digital to enable data to be collected in a timelier manner and in electronic format.

**GAP 34: Insufficient number of hydro-meteorological stations at critical sites, e.g. storages**

**Description**

The ability to manage storages is limited by the insufficient number of meteorological stations.

**GAP 35: Insufficient knowledge of capacity of river storages**

**Description**

Bathymetric survey information for storages is essential for managing storage capacity, water accounting, routing water events downstream, and modelling.

**GAP 36: Core database unable to meet current and future data management and delivery needs**

**Description**

Access to data is needed in the correct format for WDTF, modelling, reporting and compliance.

**GAP 37: Data capture for metering not meeting time requirements**

**Description**

The currency of the metering data is not meeting management needs to an adequate standard including compliance, river operations and drought management.

**GAP 38: Inadequate spatial mapping of groundwater and surface water access licences**

**Description**

The spatial component of the data is inadequate. Some licences are linked to rivers, while others are linked to properties.

**GAP 39: Inconsistent licensing quality attributes for up to 25% of non high yielding bores**

**Description**

The information linked to 25% of the 24,000 non-high yielding bore licences is inadequate. The data was uploaded from excel spreadsheets and the information is not consistent, and often not relevant.

**GAP 40: Inability to collate water transfer licensing data efficiently.**

**Description**

Current systems do not have the capacity for the extraction, collation and provision of data to meet the reporting needs of the Bureau data as specified under the regulations in the format detailed in WDTF specifications.

**GAP 41: Insufficient metering data available for unregulated rivers.**

**Description**

There is limited water extraction data for unregulated rivers which can lower the potential for the planning and management of unregulated rivers.

**GAP 42: Water extraction data is not being provided in a timely enough manner.**

**Description**

Water extraction data for groundwater and surface water is not available in sufficient time to adequately support water management planning.

**GAP 43: Inability to transfer category 7 data in WDTF format**

**Description**

The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required, particularly from large agencies that transfer data between local systems and from clients.

**GAP 44: Inefficiencies from inconsistent data storage of category 7 data**

**Description**

The data is stored by the data collectors in a range of programs and systems.

**GAP 45: Inaccuracy of category 7 system data, and lack of quality assurance**

**Description**

Data sent to the data broker is not of a standardised quality.

**GAP 46: Lack of mapping of surface water features and their connectivity and characteristics**

**Description:**

Data currently does not connect water features with other vital natural and man made features important for water management planning.

**GAP 47: Lack of fast and easy and affordable access to spatial data**

**Description**:

Data needs to be available to assist with resource planning.

**GAP 48: Insufficient hydrogeological classification of groundwater sources**

**Description:**

Spatial mapping of groundwater sources is not adequate to support planning needs across a range of scales.

**GAP 49: Lack of appropriate metadata**

As part of 2012 ammendents to the *Water Act 2007* (Cwlth), the Bureau will publish the "Metadata and contextual information requirements" Following the proposed ammendents the water regulations data providers will be expected to provide this data if it is in their possession

Identifying how the 49 Gaps in data and systems fit with the information drivers can assist with not only prioritising the resolution of the gaps, but also determine which of the information drivers may not have enough data to support the development of solutions for key water management questions and issues. Table 7 to Table 12 below link the 49 data gaps to the six information drivers.

**Table 7: Water information – Driver one**

| | |
|---|---|
| **1. Planning for future sharing of the resource** | |
| · Sustainability for water users and the environment | |
| · Drought management | |
| · Competition for water | |
| · Climate variability and climate change | |
| · Medium and long-term forecasting. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 3 | Lack of adequate asset management and replacement for surface water. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 5 | Inadequate water mass balance information. |
| Gap 6 | Inadequate spatial location of surface water monitoring sites. |
| Gap 7 | Surface water sites no longer meet OHS and accuracy requirements. |
| Gap 8 | Height/flow calibrations not meeting accuracy requirements. |
| Gap 9 | Water storage and surface water data not in electronic format. |
| Gap 21 | Insufficient coordination for SWIMP activities at jurisdictional/lead agency level. |
| Gap 33 | Insufficient collection of meteorological data in electronic format. |
| Gap 35 | Insufficient knowledge of capacity of river storages. |
| Gap 37 | Data capture for metering not meeting time requirements. |
| Gap 41 | Insufficient metering data available for unregulated rivers. |
| Gap 42 | Water extraction data is not being provided in a timely manner. |
| Gap 44 | Inefficiencies from inconsistent data storage of category 7 data. |
| Gap 46 | Mapping of surface water features and their connectivity and characteristics. |
| Gap 47 | Fast and easy and affordable access to spatial data. |
| **Groundwater – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 12 | Lack of adequate asset management and replacement for groundwater bores. |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 14 | In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 15 | Lack of information about Groundwater Dependent Ecosystems (GDEs) for their sustainable management. |
| Gap 16 | Inadequate spatial mapping of groundwater network. |
| Gap 39 | Inconsistent licensing quality attributes for up to 25% of non-yielding bores. |
| Gap 48 | Hydrogeological classification of groundwater sources. |
| **Water quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations. |
| Gap 18 | Inadequate spatial mapping of water quality network. |
| Gap 19 | Insufficient water quality data in electronic format (data at risk). |

**Table 8: Water information – Driver two**

| | |
|---|---|
| **2. Operational management** | |
| · River operations. | |
| · Delivery, short-term forecast, plan operation, including wetland watering, environmental contingencies, algae impacts, and access to river flows for industry. | |
| · Flood operations. | |
| · Flood forecasting, emergency planning. | |
| · Environmental monitoring. | |
| · Flow variability, flow targeting, water quality. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 20 | Inadequate number of water quality sensors in the surface water network. |
| Gap 34 | Insufficient number of hydro-meteorological stations at critical sites, e.g. storages. |
| Gap 37 | Data capture for metering not meeting time requirements. |
| Gap 41 | Insufficient metering data available for unregulated rivers. |
| Gap 42 | Water extraction data is not being provided in a timely manner. |
| Gap 46 | Mapping of surface water features and their connectivity and characteristics. |
| Gap 47 | Fast and easy and affordable access to spatial data. |
| **Groundwater – Gaps in data and systems** | |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 12 | Lack of adequate asset management and replacement for groundwater bores. |
| **Water quality – Gaps in data and systems** | |
| Gap 17b | Inadequate water quality monitoring network for surface water physical/chemical parameters. |
| Gap 17c | Inadequate water quality monitoring network for groundwater/surface water interaction. |
| Gap 19 | Insufficient water quality data in electronic format (data at risk). |
| Gap 22 | Inadequate blue-green algae monitoring. |
| Gap 23 | Insufficient monitoring for a range of water quality programs. |

**Table 9: Water information – Driver three**

| | |
|---|---|
| **3. Compliance** | |
| · Auditing of compliance (MDB Cap and water sharing plans). | |
| · Access rules (cease to pump, etc.) particularly for unregulated systems. | |
| · Groundwater use – pumping drawdown, interference, trading. | |
| · Drought sharing. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 3 | Lack of adequate asset management and replacement for surface water. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 37 | Data capture for metering not meeting time requirements. |
| Gap 38 | Inadequate spatial mapping of groundwater and surface water access licences. |
| Gap 41 | Insufficient metering data available for unregulated rivers. |
| Gap 42 | Water extraction data is not being provided in a timely manner. |
| **Groundwater – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 12 | Lack of adequate asset management and replacement for groundwater bores. |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A). |
| GAP 14 | In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 15 | Lack of information about Groundwater Dependent Ecosystems (GDEs) for their sustainable management. |
| Gap 16 | Inadequate spatial mapping of groundwater network. |
| Gap 38 | Inadequate spatial mapping of groundwater and surface water access licences. |
| **Water quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations. |

**Table 10: Water information – Driver four**

| | |
|---|---|
| **4. Public information** | |
| · Reporting/internet – key stakeholders.<br>e.g. river heights and flows, water quality, current storage levels, reliable and near real-time. | |
| · Recreation<br>e.g. water levels, predicted conditions. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 6 | Inadequate spatial location of surface water monitoring sites. |
| Gap 9 | Water storage and surface water data not in electronic format. |
| Gap 24 | Lack of access to integrated datasets on the web. |
| Gap 46 | Mapping of surface water features and their connectivity and characteristics. |
| Gap 45 | Inaccuracy of category 7 system data, and lack of quality assurance |
| Gap 44 | Inefficiencies from inconsistent data storage of category 7 data. |
| Gap 47 | Fast and easy and affordable access to spatial data. |
| Gap 49 | Lack of appropriate metadata. |
| **Groundwater – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A. |
| Gap 48 | Hydrogeological classification of groundwater sources. |
| **Water quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations. |
| Gap 18 | Inadequate spatial mapping of water quality network. |
| Gap 19 | Insufficient water quality data in electronic format (data at risk). |

**Table 11: Water information – Driver five**

| | |
|---|---|
| **5. Water accounting and water resource assessment (reporting)** | |
| · Institutional Government requirements. | |
| · NSW is a signatory to National Water Initiative (including recent COAG updates), inter-state agreements (Murray-Darling Basin Agreement, NSW QLD Border Rivers Agreement). | |
| · Legislation (water sharing plans, *Water Act 2007* (Cwlth)). | |
| · Public disclosure of water management information. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 3 | Lack of adequate asset management and replacement for surface water. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 5 | Inadequate water mass balance information. |
| Gap 25 | Licensing database system unable to export data in WDTF format. |
| Gap 26 | Surface water database system unable to export data in WDTF format. |
| Gap 27 | Inability to collate and delivery water accounting data efficiently. |
| Gap 30 | Water quality database unable to export data in WDTF format. |
| Gap 32 | Inadequate water data QA system. |
| Gap 36 | Core database unable to meet current and future data management and delivery needs. |
| Gap 40 | Inability to collate water transfer licensing data efficiently. |
| Gap 43 | Inability to transfer category 7 data in WDTF format. |
| Gap 44 | Inefficiencies from inconsistent data storage of category 7 data. |
| Gap 45 | Inaccuracy of category 7 system data, and lack of quality assurance |
| Gap 46 | Mapping of surface water features and their connectivity and characteristics. |
| Gap 47 | Fast and easy and affordable access to spatial data. |
| **Groundwater – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A). |
| GAP 25 | Export licensing database system unable to export data in WDTF format. |
| Gap 28 | Groundwater database unable to export data in WDTF format. |
| Gap 29 | Groundwater Water Licensing and Usage Database system unable to export data in WDTF. |
| **Water Quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations. |

**Table 12: Water information – Driver six**

| | |
|---|---|
| **6. Special-purpose monitoring** | |
| · NSW Office of Water is funded for water monitoring across NSW to support particular water management activities of other agencies, organisations and industry. | |
| **Surface water – Gaps in data and systems** | |
| Gap 26 | Surface water database system unable to export data in WDTF format. |
| Gap 31 | Lack of telemetry system full redundancy. |

## 4.3 Gap assessment

For the 2012 SWIMP the Bureau of Meteorology requires a Gaps Analysis. The analysis is based upon a common reporting approach developed by the Bureau for adoption by each State/Territory SWIC demonstrating how Modernisation and Extension of Hydrologic Systems Program (M&E) projects have helped address gaps in data, networks and systems as identified in State/Territory SWIMPs.

The approach required by the Bureau has been developed from what was presented in the NSW 2010 and 2011 SWIMP documents, and has the following objectives:

- Link M&E funded projects undertaken in Rounds 1 -5with ***themes*** as defined in the Round 4 funding guidelines (*see them listed below*) and ***gaps*** as defined in the 2010 SWIMP (*gaps 1-49 in current NSW SWIMP section C*).
- Report on the extent to which gaps have been addressed ***for individual organisations*** through completion (or anticipated completion) of specific M&E projects.

It is anticipated that this common reporting approach delivers strategic benefit to both the Bureau and to the States and Territories, including NSW. The reports will:

- allow each State/Territory to take stock of data, network and system gaps and review the extent to which they have been addressed through M&E investment
- provide a structured, quantifiable way of highlighting areas where further investment is required to address indentified gaps. This will assist individual organisations and the State/Territory when presenting the case for future funding programs, including the NSW Strategic Investment Plan (2012-2017) that is summarised in Section D
- provide the Bureau with another means of demonstrating the value of the M&E program, consistent across jurisdictions. The Bureau will have the opportunity to aggregate State/Territory reports into a single national report, providing a powerful visualisation of the achievements of M&E and the scale of investment still outstanding.

### 4.3.1 Gaps Analysis approach

The assessment of the 120 individually funded applications associated with 97 separate projects was undertaken to determine how close the completed project was to closing a data gap. There are more funded applications than projects because several projects were funded over more than one funding year. The level of assessment was coarse, with the gap either closed, or addressed at 75%, 50% or less than 50%. The score generally reflects the extent of the gap, with those gaps still outstanding likely requiring more work. Appendix 4 lists each of these 120 NSW projects, their stated purpose, outcomes, and gap resolution. The list was circulated to project proponents for their determination of the level of gap resolution.

From this list it is obvious how the funding has contributed to the improvement of water monitoring in NSW, and specifically how it has improved the capacity of NSW to manage to the water drivers outlined in section A of the SWIMP.

The assumptions made for the assessment are listed below:

- the assessment to determine if the gap is resolved focuses at the organisational scale, not a state-wide perspective
- the determination of the level of gap resolution is based on the scope of the problem, not the scope of the project. For example, a project may be complete and focus on ten bores. If there are 100 bores to be addressed the gap is not resolved, but the project has been completed
- gap resolution is based on all projects being complete. There is no consideration given to late projects, the resolution assumes it is finished
- no consideration is given to the cost benefit associated with the closure of each gap, nor does it consider the relative significance of the first ¾ of the gap closure relative to the final 25%
- only one gap per project is integrated into the assessment, despite many projects addressing more than one gap.

After the individual gaps analysis was completed, all projects were identified as being linked to a gap (as per gaps in the 2010 SWIMP) and a theme (as per the 2010-11 M&E program themes listed below). This grouping enabled comparison across gaps for NSW, and across themes for all States and Territories. During the relevant funding rounds, there were 49 Gaps in data and system described for NSW. Each of the gaps did not hold equal priority, nor did each gap require a similar amount of work for their resolution. The themes used are:

Theme 1: Improving the accuracy of existing water storage measurement, stream flow, groundwater, meteorological, and water quality networks.

Theme 2: Installation of telemetry.

Theme 3: Extending the coverage of the monitoring network to address critical information gaps.

Theme 4: Improving water data (and metadata) management procedures.

Theme 5: Recovery or rescue of water information, including metadata.

Theme 6: Improving the Australian Hydrologic Geospatial Fabric's (AHGF) national surface water foundation data set.

Theme 7: Improving the Australian Hydrologic Geospatial Fabric's (AHGF) national foundation groundwater data set.

Theme 8: Participating in the cooperative planning and production of the National Water Account (NWA).

Theme 9: Engagement of Strategic Water Information Coordinators.

Theme 10: Development and application of best practice guides or standards for the collection, monitoring, measurement and storage of water information and or metadata.

## 4.4 Gap assessment results

### 4.4.1 Individual gaps

In NSW 120 projects have been funded in five rounds of the M&E program at an expenditure of $21 Million (not including in-kind contributions). Projects that carry over a few years are only accounted for as one project but include multi year funding. Each of the projects are linked to a gap and Figure 11 shows that the greatest expenditure was on Gap 2 (approx. $4,979,980),Gap 4 (approx. $2,343,900) and Gap 36 (approx $1,466,370). Gap 2 focuses on improving data accuracy for surface water data, while Gap 4 addresses the upgrade of loggers and modems to improve data transfer capabilities. Gap 36 focuses on the ability to transfer data to the Bureau.

The gaps with the highest number of projects and expenditure against them have been a priority for the Bureau at the initiation of their Improving Water Information Program. The issues in these gaps address the key components of the base upon which AWRIS can be built. The well funded gaps address the accuracy and currency of the data, and the ability of each organisation to provide it to the Bureau in WDTF. NSW has benefited significantly from this focus of the funding and many stations have been upgraded and the data (including historic data) is generally more accessible.

Figure 11 below also indicates that 15 of the 49 gaps have not been funded as the main gap addressed by a project (30% of the gaps). Several of the funded projects contributed to the resolution of more than one gap but the additional gaps were not considered as the analysis focused only on the main gap. Generally most of the non funded gaps addressed issues associated with expanding the coverage of the monitoring programs, GDE assessment, as well gaps asociated with significantly upgrading the water quality monitoring. None of these issues were priorities for funding by the Bureau. Other non-funded gaps have been addressed by separate Commonwealth funding programs. An example of this would be gap 37 that addresses issues with metering and this gap was funded under the Sustaining the Basin Program (see section A). It is important to acknowledge that gaps were funded to address Bureau priorities.

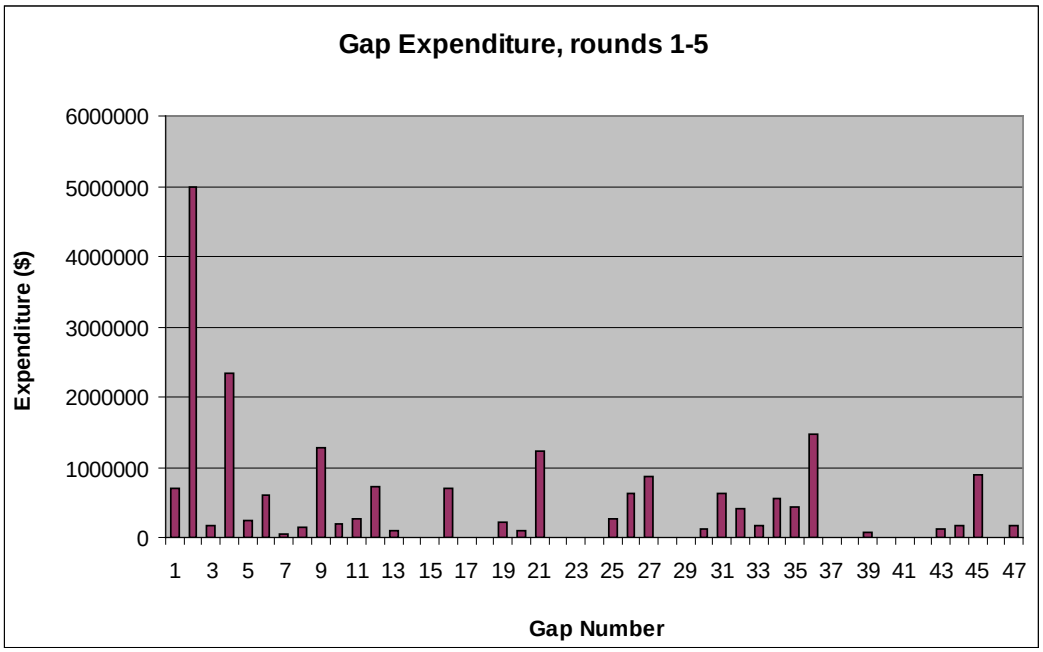


**Figure 11: Expenditure by Gap, rounds 1-5**

### 4.4.2 Themes

All of the gaps relate to funding themes identified by the Bureau and the gaps analysis focused on the ten themes associated with the round 4 funding program. Figure 11 shows that for NSW, the the M&E funding were directed predominantly at Theme 1 that aimed to improve data accuracy. Themes 2 and 4 were also relatively well funded and focused on installation of telemetry to improve data currency as well as supporting data and metadata management procedures which will ultimately improve the efficiency and ease of data transfer. As indicated above, all of these themes address the basic building blocks for AWRIS and it was expected that they would be the priority for the Bureau.

### 4.4.3 Analysis for comparison across States and Territories

This section of the Gaps Analysis addresses the significant achievements that have been made in NSW as a result of the M&E funding program. This information is presented in a format that will be applied consistently across all States and Territories, allowing the Bureau the opportunity to aggregate State/Territory reports into a single national report.

Table 13 and Table 14 report on the extent to which gaps have been addressed for individual organisations through completion (or anticipated completion) of specific M&E projects. The tables also provide a structured, quantifiable way of highlighting areas where further investment is required to address indentified gaps.

The first table indicates that the NSW Office of Water, the lead water monitoring organisation in NSW, ran the largest number of Bureau funded projects. Approximately 50% of the NSW Office of Water projects have closed the gap, with 50% of the projects requiring more work. As several of the larger NSW Office of Water projects focused only on the priority locations/issues, some of the outstanding work to close a gap is not considered a priority at this time. Priorities for NOW are summarised in the NSW Strategic Investment Plan for Water Monitoring 2012-2017 and discussed in section D of this report. State Water also had a substantial number of projects funded under the M&E program and they supported a range of activities relating to improving data quality, water storage data and data transfer.

As State Water and NSW Office of Water are responsible for a large proportion of water management and water delivery in NSW, it is understandable why they would receive a large component of the funding. Some of the smaller organisations and local councils received funding for smaller projects, generally focussing on improving data accuracy and data delivery to the Bureau. For NSW DPI the money supported local catchment monitoring and the development of technology.

Tables below summarise for each theme and each gap how many projects have been funded, how many were submitted and the associated gap closures. Again, projects that cover multiple years are only counted once.

The table illustrates a number of observations that are summarised below.

- Highest number of projects submitted.

  Gaps 2, 36 and 3 all received at least 15 applications, while gaps 1,4, and 26 received at least 10 applications. This is a higher proportion of applications relative to the other gaps. The gaps relate to data accuracy, lack of asset management, data capture, flood warning / meteorological data and an inability to transfer data to the Bureau in WDTF.

- Highest number of unfunded projects.

  Gap 3 had 13 unfunded projects, Gap 2 had 10 and gap 36 had 9. These gaps focus asset management, data accuracy and support for data transfer. The outstanding issues relating to Gaps 3 and 2 will be addressed in the conclusion. In 2012 NOW held M&E funded workshops to support smaller organisations with WDTF so many of the outstanding projects/issues associated with Gap 36 were addressed at the workshops.

- Gap closure of Gaps 2 and 4.

  These two gaps received the highest proportion of funding in the M&E program. After this final round more than 50% of the gaps are resolved, with all the gaps at least 50% resolved. As these gaps focus on core activities for water monitoring agencies, it was not expected that all gaps would be closed and there would be ongoing work requirements.

- Gaps with most projects closed.

  Gap 36, which assisted with data transfer to the Bureau had the most gap closures for the organisations.

- Gaps with most project unresolved.

  Gap 2 which dealt with data accuracy had the greatest amount of outstanding work still to be done to close the gap for the organisations.

- Gap with greatest number of M&E applications:

  An assessment across Themes indicates that the greatest diversity of applicants was associated with Gap 36 showing that several named persons in the Regulations required financial assistance to support data transfer activities to the Bureau. The majority of these projects were completed within the year.

### 4.4.4 Discussion

The objective of the $80 million Monitoring and Evaluation Program was to assist water information collectors to modernise and extend their water monitoring systems. The program funded projects associated with improving the accuracy and transfer of real-time data to the internet. The gaps analysis outlined in section 4.4.3 indicates that the funded projects in NSW supported this objective, with Themes 1 and 4 being the two highest funded Themes. They addressed data accuracy and data transfer to the Bureau.

All the themes are discussed below, with some consideration of future funding requirements that could be addressed through the NSW Strategic Investment Plan in Water Monitoring (2012-2017) that will be summarised in section D. The Themes are presented in an order that reflects generally on the amount of funding they received in Rounds 1-5.

#### Theme 1: Data accuracy – $5,833,980 total M&E funding

The gaps analysis assessment of Theme 1 (and particularly gap 2 that focuses on data accuracy), indicated that a considerable amount of work has been done. Of the 19 funded projects 8 still have not closed the gap for their organisation, but 7 of these are at least 50% closed. However, as data accuracy is a core business need and work item for most monitoring agencies, it is realistic to expect ongoing work in this area. New digital equipment purchased and installed at the beginning of the M&E program has a 5-10 year life span, and it is necessary to plan for replacement of this equipment. In addition, projects may be completed but due to the size of the networks the project completion will not close the gap.

Under Gap 2 the Bureau has funded the purchase and installation of new equipment that has been useful for monitoring the large floods in 2011 and 2012. This is discussed in more detail in section 2.2 with this section focussing on gap closure for the network. M&E funds have been used to purchase and install acoustic Doppler instruments for NSW Office of Water (including critical sites in and out of Menindee Lakes), update equipment for Sydney Catchment Authority, OEH, and Sydney Water Corporation, and upgrade key sites in the Murrumbidgee Irrigation Area as well as investigate the value of remote controlled boats that are integrated with ADCP meters to permit safer gauging of rivers. Other associated work has also occurred, including a project by NSW Office of Water to develop a means of tracking gauge zero changes through the development of a time based rating system. Future funding will be required to resolve key aspects of data delivery..

### Theme 4: Data transfer – $3,398,920 total M&E funding

All data transfer projects have been successfully closed by the majority of all organisations that were funded under the M&E program. NSW Office of Water, the NSW main agency for water monitoring took a lead role in developing WDTF for Hydstra and Excel and has tools available for most data collectors to use. In 2012 NOW held workshops to assist organisations in using these tools. A review is currently being undertaken by the Bureau and the NSW Office of Water to determine if the tools have resolved all data delivery problems.

The next phase of data transfer focuses on metadata. As described in 2.10 in July 2012 all metadata requirements will be removed from Category 10, and instead the Regulations will refer to a new document that the Bureau will maintain online. This document, called, “Metadata and contextual information requirements” will set out, in much greater detail, the metatdata and contextual information required to be given at the same time as the water data for each category. The online document will be incorporated into the Regualation, meaning that it carries the same compliance requirements as the Regulations themselves. Funding will likely be necessary to support the NSW water monitoring agencies with the management, currency and acquisition of metadata and its delivery to the Bureau using WDTF.

### Theme 2: Data currency – $2,762,900 total M&E funding

Data currency was a strong focus for the Bureau, and in NSW the M&E funding in combination with State funding has placed NSW in a good position for the next 5 years. Theme 2 addressed data currency (with Gaps 4, 12 and 33) and was relatively well funded compared to other themes (see figure 12) showing that organisations took advantage of improvements in IP technology to upgrade equipment. The NSW Office of Water, for example, can provide flood data on the hour, and on special occasions more regularly than that. Upgrades to the various database systems will be required if the frequency is to be increased to 1 minute time steps.

There were a significant number (29) of applications submitted under this theme. Many of the projects submitted were focusing on the ALERT flood warning system that was being funded under an alternate funding source.

### Themes 6 and 7: Geofabric – $1,498,000 and $1,050,000 total M&E funding

Themes 6, and 7 are a relatively recent inclusion in the M&E funding program, contributing to the development of the Australian Hydrologic Geospatial Fabric (Geofabric). It is likely more work will be required. Table 14 shows that the current projects are still underway and have not closed the gap. It is likely that due to the volume of work required in NSW that when the projects are successfully completed the relevant gap will remain unresolved.

NSW aims to relase their Geofabric V3 in November 2012 which is for the Namoi and the Murrumbidgee catchments. The Bureau is hoping to release a V3 map of Australia in 2013 with a significant amount of work required to be completed in NSW.

### Theme 3: Network expansion – $1,452,700 total M&E funding

Water monitoring organisations in NSW focused on improving existing networks rather than extending them, but in a few cases there was an identified and prioritised need. Table 14 shows that 15 projects were submitted in this theme over the 5 rounds, with 8 being funded. State Water received the majority of the funding to add meteorological stations at storages and NSW DPI was able to use available funding to research advances in meteorological data collection. Other funding went to MIA and some Councils where the Bureau felt there was justification to add to existing networks. Any further network expansion in NSW will likely be funded through specific programs such as the Water Shepparding program currently funded by the Commonwealth Government to assist with the management environmental water delivery.

### Theme 5: Data rescue – $1,758,500 total M&E funding

Data rescue was a well funded priority for both NSW and the Bureau. All but two projects submitted were funded with significant volumes of historic surface water, ground water and water quality data all converted into electronic form. Data rescue projects reflected organisational prioritisation to the most valuable datasets, and subsets of that data. Gaps that are outstanding reflect data that is still in paper form, and likely not a priority to convert at this time.

The NSW Office of Water was the major recipient of Theme 5 funding and has converted 6,000 station years of surface water data and 5,000 station years of groundwater data. This represents around 40% of all category 1 and 2 that is not in electronic format. Murrumbidgee Irrigation and Essential Energy also converted raw data to electronic data and closed the gap for their organisations. There remains 4 projects with aproximately 25% of the data still to recover, but this data may not be a priority for these organsiations.

### Theme 8: National Water Account – $1,619,550 total M&E funding

The National Water Account requires the integration of a wide range of water monitoring data, including storage information. In NSW collecting the information has been a priority for NSW Office of Water, State Water Corporation and Sydney Water Corporation, with State Water having completed a large project on storage capacity. In Round 5 a NOW project to automate data delivery from LAS (Licencing Administration System) was funded to improve on the current time consuming manual intervention to deliver the data

### Theme 9: SWIC – $1,222,500 total M&E funding

The funding of the NSW Strategic Water Information Coordinator has been successful in coordinating SWIMP activities at a jurisdictional level. Recommendations have been made by the SWIC to maintain a NSW technical committee to that will sustain the current high level of coordiation between water monitoring organisations in NSW.
Summary

### Theme 10: Data standards – $409,000 total M&E funding

NSW has taken a lead role in the development of Data Standards, which is acknowledged as the next critical step after data compilation. After data has been gathered issues associated with data quality, data standards and meta-data can arise. Changes to the Regulations reflect this expectation with new requirements for metadata. It is anticipated that with the development of metadata standards the need to resend part or all of NSW data might be necessary which would likely require additional funding to ensure an efficient transfer of data.

### Outcomes

The M&E funding has contributed to significant gains for NSW, with many gaps in data systems closed, or at least 50% closed.

Key strategic outcomes from the gaps analysis are numbered below.

1. It is anticipated that with the development of metadata standards the need to resend part or all of NSW data might arise. This may require external funding to ensure an efficient transfer of data.
2. Data accuracy is a core business need for most monitoring agencies. New digital equipment purchased and installed at the beginning of the M&E program has a 5–10 year life span, and the replacement of this equipment should be part of a planned Asset Management System.
3. The development of the Geofabric is relatively recent inclusion to the M&E funding program and it is likely more work will be required in NSW under the geospatial themes.
4. The National Water Account is still developing and it is anticipated that there may be funding required to continue this project for NSW.
5. The current high level of coordination between water monitoring organisations in NSW is beneficial for efficient management of data transfer to the Bureau, and strategic management of the activity. It is recommended that NSW maintain a inter-agency / organisational water monitoring committee.
6. Non-priority issues for the M&E program including water quality, biological data and GDE's have not had similar improvements over the last five years relative to the surface and groundwater monitoring programs.

The M&E funding has been directed towards projects that focus on both State and Bureau needs. It is important to acknowledge that there are outstanding issues specific to NSW. There are gaps relating to monitoring for the implementation and performance assessment of Water Sharing Plans, biological data, licensing and modelling. Asset management is also a significant issue for NSW. A recent IPART determination scaled back a NSW Office of Water proposed asset life of 5 years to 10 years, which may have implications on the operational aspect of some of the IP network, particularly as outdated technology is often not supported. It is expected a NSW hydrometric network review will be completed in June 2012 that will highlight and prioritise key sites in the Murray Darling Basin and issues that will be a focus for NSW water resources planning.

## 4.5 Conclusion

The M&E funding for NSW has achieved substantial gains for all funded organisations. Every organisation that received funding has closed at least one gap in data or systems as a consequence of the M&E program. The significant gains are detailed in Section B and strategic outcomes are listed in section 3.4.

Evaluation of new technologies funded under M&E has clearly demonstrated their worth in improving the efficiency of data collection and storage. Further investment in these technologies is now required to achieve full benefit from their implementation.

To conclude the Gaps Analysis the NSW Office of Water, has integrated the results from the gaps analysis with other information from the M&E program and all NSW water monitoring organisations to develop a NSW Strategic Investment Plan in Water Monitoring (2012-2017).

Signifiantly, the Gaps Analysis identifies what has been achieved and what still remains to be undertaken. Other information used to develop the Investment Plan included:

- all projects where the gaps have not been closed by M&E funding
- all gaps not addressed by M&E funding
- all unfunded M&E projects.
- all outstanding gaps from 14 participating water monitoring organisation in NSW.
- all work required to maintain the current high standard of water monitoring in NSW that has been supported by $21 Million dollars from the M&E program.

An integration of the information above resulted in a prioritised list of outstanding work. When estimates of cost are linked to the work the result is a ‘NSW Strategic Investment Plan in Water Monitoring’ that provides a costed work program for next 3 to 5 years

**Table 13: NSW M&E Projects: organisation and gap closure**

| Organisation name | Number of gaps, 100% addressed | | | | | | | | | | | Number of gaps, 75% addressed | | | | | | | Number of gaps, 50% addressed | | | | | | | | | Number of gaps <50% addressed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | # | 21 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 | 3 | 4 | 5 |
| NSW Office of Water | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Office of Environment &Heritage | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Department of Industry and Investment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| State Water Corporation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sydney Water Corporation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sydney Catchment Authority | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cabonne Shire Council | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Essential Energy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clarence Valley Council | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HWC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Murrumbidgee Irrigation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mid Western Regional | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Port Macquarie Council | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shoalhaven Council | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sydney Metro CMA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tweed Shire | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wyong Council | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Table 14: NSW Gaps - total number of projects and gap closure**

| GAP | | Total Number of funded projects | Total number of projects submitted | Number of M&E funded projects | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Number of projects which fully addressed gap i.e. 100% closed | | | | | | | | | | Number of projects which **part** addressed gap 75% closed | | | | | | Number of projects which **part** addressed gap 50% closed | | | | | | Number of projects which **part** addressed gap <50% closed | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| **Theme 1. Improving the accuracy of existing water storage measurement, stream flow, groundwater, meteorological, and water quality networks** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Streamflow data not meeting all accuracy requirements | 13 | 23 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Lack of adequate asset management and replacement for surface water | 2 | 15 | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Surface water sites no longer meet OHS and accuracy requirements | 1 | 6 | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Height and flow calibrations not meeting accuracy requirements | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | Lack of asset management and replacement for groundwater bores | 1 | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 33 | Insufficient collection of meteorological data in electronic format. | 1 | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 2: Installation of telemetry to improve currency of measurement networks** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Data capture and transfer not meeting time requirements | 10 | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| 33 | Insufficient collection of meteorological data in electronic format | 2 | 6 | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | Lack of asset management and replacement for groundwater bores | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| GAP | | Total Number of funded projects | Total number of projects submitted | Number of M&E funded projects | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Number of projects which fully addressed gap i.e. 100% closed | | | | | | | | | | Number of projects which **part** addressed gap 75% closed | | | | | | Number of projects which **part** addressed gap 50% closed | | | | | | Number of projects which **part** addressed gap <50% closed | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| **Theme 3: Improving the coverage of monitoring networks** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | In some catchments the surface water network coverage is not fully meeting water information requirements | 4 | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | Inadequate number of water quality sensors in the surface water network | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 34 | Insufficient number of hydro-meteorological stations at critical sites e.g. storages | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 4: Improving data management, processing and transfer** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | Licensing database system unable to export data in WDTF format | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 26 | Surface Water Database system unable to export in WDTF | 9 | 15 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 36 | Core Database unable to meet current and future data management and delivery needs | 11 | 20 | | | | | | | | | | 11 | | | | | | | | | | | | | | | |
| 30 | Water quality database system unable to export in WDTF | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31 | Insufficient redundancy in telemetry systems | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | |

| | GAP | Total Number of funded projects | Total number of projects submitted | Number of M&E funded projects | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Number of projects which fully addressed gap i.e. 100% closed | | | | | | | | | | Number of projects which **part** addressed gap 75% closed | | | | | | Number of projects which **part** addressed gap 50% closed | | | | | | Number of projects which **part** addressed gap <50% closed | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| 44 | Inefficiencies from inconsistent data storage of category 7 data | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45 | Inaccuracy of system data, lack of quality ssurance | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 5: Rescue of strategic data** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Water storage and surface water data not in electronic form | 5 | 7 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | Insufficient groundwater data in electronic format (data at risk) | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 | Insufficient water quality data in electronic format, data at risk | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 6: Improving the Australian hydrologic geospatial fabric's national surface water foundation dataset** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Inadequate spatial location surface water monitoring sites | 3 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | Inadequate spatial mapping of water quality network. | 1 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 46 | Mapping of surface water features and their connectivity and characteristics | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 7: Improving the Australian hydrologic geospatial fabric's national groundwater foundation dataset** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |

| GAP | | Total Number of funded projects | Total number of projects submitted | Number of M&E funded projects | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Number of projects which fully addressed gap i.e. 100% closed | | | | | | | | | | Number of projects which **part** addressed gap 75% closed | | | | | | Number of projects which **part** addressed gap 50% closed | | | | | | Number of projects which **part** addressed gap <50% closed | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| 16 | Inadequate spatial mapping of the groundwater network | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 48 | Hydrogeological classification of groundwater sources | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 8: Improving the national water account** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Inadequate water mass balance information | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 27 | Inability to collate and deliver water accounting data efficiently | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35 | Insufficient knowledge of capacity of river storages | 1 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 40 | Inability to collate water transfer licensing data efficiently | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 9: Strategic Water Information Coordinators** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | Insufficient coordination for SWIMP activities at jurisdictional /lead agency level | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Theme 10: Improving data standards** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 32 | Inadequate water data QA system | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |

# 5 Section D – Priorities

NSW has undertaken a detailed review of its water information and monitoring needs from the perspective of current water management priorities and issues. As part of this SWIMP, these outcomes have been aligned with the requirement of the Bureau's *Improving Water Information Program*. The outcomes are described in this section (Section D) of the report, which brings together the work of the previous three Sections and leads to a list of prioritised actions for which Bureau backing is sought.

## 5.1 Summary of sections A, B and C

### 5.1.1 Section A

Identifies the important *water information drivers* for NSW. These underpin the strategic and operational issues and challenges facing water managers in this State.

### 5.1.2 Section B

Provides summary detail on the State's data collection networks and data management systems. In the supplementary report 'Water Inventory and observation networks in New South Wales' descriptions are included of the monitoring network policies that ensure the networks are cost-efficient, effective and appropriate for NSW needs.

A review of the Bureau's $80M M&E program is included in this section. It shows the impact of the first four rounds of the program on closing the gaps in data and systems for NSW.

### 5.1.3 Section C

Includes a data gaps analysis of strategically important water monitoring activities. It links the data gaps with the State's information drivers and proposed actions to address the gaps. It summarises the benefits that have been achieved over five years of the M&E program in closing gaps in the state's water monitoring and data management systems.

## 5.2 Section D approach

The data gaps developed in Section C were assessed, and strategies and actions developed that could contribute to resolving the gaps. This information is presented in Tables 15 to 20. This information was developed by representatives of the eight key agencies for detailed review and consideration at a NSW SWIMP Steering Committee workshop.

Representatives of these agencies developed draft project summaries for for the NSW Strategic Investment Plan in Water Monitoring (2012-2017), with indicative costs for their projects. This information was merged with the detail developed in Tables 15 to 20 and:

- the projects were aligned with appropriate data gaps and theStrategic Investment Plan for Water Monitoring (Investment Plan) 6 themes,

- the projects were placed into one of two categories for funding, namely:
  - Category 1 projects – data collection systems that were upgraded under M&E program that NSW organisations are obliged to operate and maintain, and
  - Category 2 projects – new projects of high priority that were not funded or were partially funded under M&E but are considered essential for effective water resource management.
- the results were placed into Table 21

The outcome is an approximate indication of the project activities and indicative costs for the fourteen organisations that contributed to the NSW Strategic Investment Plan. In summary the key recommendation of this Plan is that a 'NSW Asset Management Plan for Water Resources Monitoring to 2017' be prepared. Options as to whether this should be undertaken on a state basis or individual agency will require management discussion and decision. A budget of approximately $10M over the next five years will be required to maintain the monitoring systems at their present performance level, with some projects yet to be finally costed. This applies to those organisations that have contributed to this Strategic Investment Plan. A budget of approximately $13.4M over the next five years would complete all the category 2 projects.

### 5.2.1 Key strategies and actions per gap, associated with Bureau themes

Between 2009 and 2012 the Bureau identified a number of different themes for funding to improve data collection, storage and delivery across Australia. For the NSW Strategic Investment Plan the themes were collated and integrated to develop six themes that NSW needs to focus funding on for the next five years to maintain the current high standard of water monitoring. The themes are listed below, with tables 15-20 linking the 49 gaps in data and systems (see section C) to these themes.

**Theme one**: Data Collection and Telemetry

**Theme two:** Collating and Reporting Water Information (includes National Water Account)

**Theme three:** Improving the Australian Hydrologic Geospatial Fabric surface water foundation dataset

**Theme four**: Improving the Australian Hydrologic Geospatial Fabric groundwater foundation dataset

**Theme five:** Development and Application of Data Standards for the collection, management and transfer of data (WDTF)

**Theme six:** Data provision and WDTF (includes dataset upgrades)

**Table 15: Data collection and telemetry – Theme 1**

| Data gap accuracy | Strategies and actions |
|---|---|
| **Gap 2: Streamflow data not meeting all accuracy requirements** | **Strategy:** Address data accuracy in priority locations.<br>**Action:** Develop prioritisation process to identify and target locations of greatest need for increased gauging frequency or other methods.<br>**Action:** Lobby clients to obtain resources to meet standards. |
| | **Strategy:** Acoustic Doppler installations. Continuous measurement of velocity in-streams adds another dimension to the measurement of streamflow in increasing the accuracy of flow distribution in-streams.<br>**Action:** Install ADCP at priority assessed end-of-system backwater-affected sites. After initial calibration, these devices will free up resources to undertaken more height/flow calibrations. |
| | **Strategy:** Improve stability of low flow controls. Invest in the stabilization of low flow section of critical sites in support of more accurate low flow assessment, reducing the need for height flow calibrations when the weir controls the total flow (needs to be aligned with NSW Fisheries weirs policy).<br>**Action:** Undertake priority assessment and execute site upgrades for priority stations as part of an overall asset upgrade process. |
| | **Strategy:** Update processes to reflect changed accuracy requirements.<br>**Action:** Implement (guided by the Bureau) national standards for data collection.<br>**Action:** Improve and standardise QA and QC processes, practices and systems within and across agencies to drive consistency of data provision. |
| | **Strategy:** Evaluate appropriate streamflow calibration frequency that is based on network prioritisation analysis to determine the stage discharge relationship.<br>Need to work with the Bureau to develop a national targeted approach that allows for some variability based upon location.<br>**Action:** Strategic increase in human resources. |
| **Gap 3: Lack of adequate asset management and replacement for surface water** | **Strategy:** Improve financial and asset management models and systems as the long-term asset depreciation management is currently reliant on capital enhancement bids. Develop and implement plans to manage the replacement of assets at the end of their life, acquire and carry finances over the life of assets.<br>**Action:** Develop an asset upgrade and replacement plan, obtain client support and implement. |
| **Gap 7: Surface water sites no longer meet OHS and accuracy requirements** | **Strategy:** Prioritise upgrade of key site infrastructure and accuracy objectives.<br>**Action:** NSW Office of Water upgrades in 2009/10 include shelter refurbishment, removal of elevated structures on a priority basis and strategic installation of EC probes. |
| **Gap 8: Height and flow Calibrations not meeting accuracy requirements** | **Strategy:** Institute alternate/new technology solutions to resolve site-specific limitations in measurement – including low flow criteria.<br>**Action:** Install and calibrate in-situ Dopplers in priority locations.<br>**Action:** Undertake site works in priority locations to assess/improve low flow accuracy. |

| Data Gap currency | Strategies and actions |
|---|---|
| **Gap 4: Data capture and transfer not meeting time requirements** | **Strategy:** Improve capture and reliability of real-time data for transfer to the Bureau and other reporting obligations.<br>**Action:** Progressively upgrade logger and modems to new generation technology.<br>**Action:** Upgrade software systems to manage real-time data transfers.<br>Note: Gap 31 Redundancy. |
| **Gap 12: Lack of adequate asset management and replacement for groundwater bores** | **Strategy:** Improve utility of GDS for planning the maintenance and upgrade of monitoring bores, evaluate requirements for bore maintenance.<br>**Action:** Implement a State-wide bore maintenance program and data logger upgrade schedule.<br>**Action:** Undertake site maintenance of the casing head protector, review of casing head survey data, site surrounds from influence of adjacent landuse and flood events for priority bore locations as identified in groundwater network review.<br>**Action:** Progressively upgrade logger and modems to provide real-time data transfer capability. |
| **Gap 33: Insufficient collection of meteorological data in electronic format** | **Strategy:** Improve capture and reliability of real-time data for transfer to the Bureau and other reporting obligations.<br>**Action:** Progressively upgrade logger and modems to new generation technology. |
| **Data gap (coverage)** | |
| **Gap 1: In some catchments, the surface water network coverage is not fully meeting water information requirements (see Information drivers – Section A)** | **Strategy:** Continued implementation of projects to address emerging monitoring priority areas and regular reassessment of the surface water network. The priority focus of the NSW Office of Water Hydrometric Network Expansion Project is on unregulated rivers covered by water sharing plans.<br>**Action:** Completion of hydrometric network expansion. |
| **Gap 5: Inadequate water mass balance information** | **Strategy:** Identify key information elements to improve system water balances for planning models and water accounting/assessment reporting through implementation of water accounting standards and pilot projects supporting development of NWAC. Match information needs with priority questions to be addressed for contemporary water management issues.<br>**Action:** Refer to Theme 1 and 2. These actions support an improvement to assessment of system water balances.<br>**Action:** Increase network coverage of ungauged tributaries into gauged rivers.<br>**Action:** Increase, e.g. 'paired sites' monitoring of groundwater/surface water interactions for HNE project. This has commenced within NSW Office of Water (HNE, and Gaining/Losing Streams Project). |
| **Gap 20: Inadequate number of water quality sensors in the surface water network** | **Strategy:** Install new salinity probes to improve coverage and quality of stream salinity measurement.<br>**Action:** Probes installed to meet specific needs of salt transport models and salinity target monitoring as per Murray-Darling Basin Plan, water quality and salinity plans. |
| | **Strategy:** Develop specific run of river salinity surveys to improve knowledge of point source and diffuse salt load distributions.<br>**Action:** Develop recommendations for refinement of salinity probe network. |

| Data gap (coverage) | |
|---|---|
| **Gap 13: In some catchments, the groundwater network coverage is not fully meeting water information requirements (see Information drivers – Section A)** | **Strategy:** Maximise capture, coverage and utility of groundwater network information by prioritised expansion of the current monitoring network.<br>**Action:** Review groundwater bore coverage and prioritise locations that contribute to the assessment of sustainability of groundwater management units in water sharing plan areas and groundwater management units where plans are being developed.<br>**Action:** In the review of the network, prioritise coverage in areas monitoring the impact of climate variability in high connected systems, and also areas where watertable aquifers are influenced by seasonal variations.<br>**Action:** Rollout of additional monitoring through programs such as NSW Office of Water's WMMIS and GIMP programs. |
| **Gap 14: In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see Information drivers – Section A)** | **Strategy:** Priority expansion of the current monitoring network to meet monitoring needs.<br>**Action:** Seek and obtain funding for, and install a network of bores to provide the information required. |
| **Gap 15: Lack of information about GDEs for their sustainable management** | **Strategy:** Targeted monitoring of groundwater quality and levels in the area of GDEs to identify the influence of groundwater use, the influence of duration, magnitude and frequency of surface water flows events on groundwater quality and groundwater levels in the area of GDEs.<br>**Action:** Bore location paired with surface water gauges at priority GDEs. |
| **Gap 17 A, B:**<br>**Inadequate water quality monitoring network for:**<br>· **Gap 17a: flow/water quality associations**<br>· **Gap 17b: surface water physical/chemical parameters**<br>· **Gap 17c: groundwater/ surface water interaction** | **Strategy:** Assess the adequacy of commence to pump levels through assessment of water quality.<br>**Action:** Changes to water quality at nil or very low flows and the influence of climate change on the frequency and duration of these events.<br>**Action:** Changes to wetted perimeter and loss of riffle micro-habitat under various low flow, cease to pump (CtP) scenarios, including the need for riffles surveys to develop low flow response models.<br>**Action:** Development of low flow response models.<br>**Action:** Information on micro-habitat preferences of aquatic biota and the sensitivity of these to increased frequency and duration of no, or very low flow events.<br>**Action:** Develop methods and locations for a water quality program focused on adequacy of commence to pump levels. |
| | **Strategy:** Prioritise locations and assets for ecological response monitoring of water sharing plans and other water management activities.<br>**Action:** Implement ecological response monitoring at specific sites across NSW. |
| | **Strategy:** Ongoing data collection on physical characteristics of rivers to contribute to improved understanding of the relationship between geomorphologic features and fluvial processes, and their possible contribution to river stability and water quality.<br>**Action:** Research to develop key relationships that could assist with improved water quality management. |

| Data gap (coverage) | |
|---|---|
| | **Strategy:** Extend water quality programs, and align results to regional guidelines.<br>**Action:** Increase coverage of water quality monitoring across NSW.<br>**Action:** Assess and calibrate results to regional condition. |
| | **Strategy:** Expand spatial extent of the water quality monitoring network to meet prioritised river operational needs.<br>**Action:** Integrate water quality data needs into network review process to allow for prioritised growth and spatial expansion of the network. |
| | **Strategy:** To assess surface water and groundwater connectivity, in-stream and off-channel piezometers should be established or expanded in strategic locations. Off-channel piezometers can be located at strategic locations and should be equipped with electrical conductivity (EC) loggers. EC variations in groundwater together with stream EC can be used as a natural tracer.<br>**Action:** Prioritise locations and then install paired piezometers to gain a better understanding of surface water/groundwater interactions. |
| **Gap 22: Inadequate blue-green algae monitoring** | **Strategy:** Use a combined approach of improved monitoring and modelling to improve blue-green algae monitoring in NSW.<br>**Action:** Test new sampling technologies in priority locations across NSW.<br>**Action:** Extend the capacity of the current blue-green algae model. |
| **Gap 23: Insufficient monitoring for a range of water quality programs** | **Strategy:** Strategic coordination and expansion of water quality programs coordinated with water management needs. All data to be incorporated into one database.<br>**Action:** Implement priority programs, matched with management needs.<br>See database gap (Gap 19). |
| **Gap 34: Insufficient number of hydro-meteorological stations at critical sites, e.g. storages** | **Strategy:** Improved meteorological data to support modelling and water accounting.<br>**Action:** Prioritise locations at key storages and install meteorological stations. |

**Table 16: Collating and reporting water information –Theme 2**

| Data Gap | Strategies and action |
|---|---|
| **Gap 5: Mass balance** | **Strategy:** Identify key information elements to improve system water balances for planning models and water accounting/assessment reporting through implementation of water accounting standards and pilot projects supporting development of NWAC. Match information needs with priority questions to be addressed for contemporary water management issues.<br>**Action:** Refer to Theme 1 and 2. These actions support an improvement to assessment of system water balances.<br>**Action:** Increase network coverage of ungauged tributaries into gauged rivers.<br>**Action:** Increase 'paired sites' monitoring of groundwater/surface water interactions for HNE project. This has begun within NSW Office of Water (HNE, and Gaining/Losing Streams Project). |
| **Gap 21: Insufficient coordination for SWIMP activities at jurisdictional /lead agency level** | **Strategy:** Provide adequate funding for SWIMP activities<br>**Action:** Identify necessary resources and seek funding<br>**Action:** Seek major agency supoprt for SWIMP and SWIC functions. |
| **Gap 27: Inability to collate and deliver water accounting data efficiently** | **Strategy:** Provide systems that enable water accounting data to be extracted in required formats.<br>**Action:** Develop systems that enable water accounting data to be extracted in required formats. |
| **Gap 35: Insufficient knowledge of capacity of river storages** | **Strategy:** Bathymetric survey of key storages.<br>**Action:** Prioritise storages and undertake survey. |
| **Gap 37: Data capture for metering not meeting time requirements** | **Strategy:** Improve capture and reliability of real-time data for transfer to the Bureau and other reporting obligations.<br>**Action:** Upgrade software systems to manage real-time data transfers from new metering projects. |
| **Gap 39: Inconsistent licensing quality attributes for up to 25% of non high yielding bores** | **Strategy:** Undertake an audit to establish consistent information requirements and format.<br>**Action:** Progressively apply the new requirements to all bore licences. |
| **Gap 40: Inability to collate water transfer licensing data efficiently:** | **Strategy:** Provide systems that enable water licensing data to be extracted in required formats.<br>**Action:** Develop systems that enable water licensing data to be extracted in required formats. |
| **Gap 41: Insufficient metering data available for unregulated rivers** | **Strategy:** Monitoring of water extraction in unregulated rivers with new technology.<br>**Action:** Include unregulated rivers in the NSW Metering Scheme being funded under the Commonwealth Program 'Sustain the Basin'. |

| Data Gap | Strategies and action |
|---|---|
| **Gap 42: Water Extraction Data is not being provided in a timely manner** | **Strategy:** Standard metering technology will be telemetered.<br>**Action:** Implement the NSW Metering Scheme program being funded under the Commonwealth Program 'Sustain the Basin'. $221M will become available to NSW under this program.<br>**Action:** Develop a data system to manage metering data. |

**Table 17: Improving the Australian Hydrologic Geospatial Fabric surface water foundatation dataset – Theme 3**

| Data gap (surface water) | Strategies and action |
|---|---|
| **Gap 46: Mapping of surface water features and their connectivity and characteristics** | **Strategy**: Development of a seamless state-wide surface hydrology database that is able to support local, catchment, state and national data and information requirements now and into the future.<br>**Action**: Integrate and convert existing state topographic mapping into seamless state-wide surface hydrology database depicting natural and man-made features with flow direction, network topology and naming.<br>**Action**: Integrate the State data into the Bureau's national scale foundation Geofabric data to allow the national dataset to be replaced with a single-point-of-truth state dataset.<br>**Action**: Address data quality and currency issues with existing regional scale data to ensure users have access to consistent, current representations of features across NSW.<br>**Action**: Commence the development of 'next generation' data that meets local, regional and national needs over key catchment areas on a priority basis including the integration of urban water data. |
| **Gap 47: Fast and easy and affordable access to spatial data** | **Strategy**: Development of coordination, management, maintenance and governance arrangements which ensure ongoing access to existing and new data across government and industry.<br>**Action**: Development of a spatial data infrastructure strategy specifically targeted at water information. The strategy should address coordination across all levels of government and industry data management and maintenance, standards data exchange policies ICT and applications development.<br>**Action**: Whole-of-government approach across all levels of government in line with the NSW Common Spatial Information Initiative. |
| **Gap 6: Inadequate spatial location of surface water monitoring sites** | **Strategy:** Improve geo-referencing of surface water network across NSW to enhance geospatial fabric functionality.<br>**Action:** Progressively locate sites spatially and also connect to AHD. |
| **Gap 18: Inadequate spatial mapping of water quality network** | **Strategy:** Improve geo-referencing of water quality network across NSW to enhance geospatial fabric functionality.<br>**Action:** Locate sites, measured to AHD. |
| **Gap 38: Inadequate spatial mapping of groundwater and surface water access licences** | **Strategy:** Improve geo-referencing of licensed works across NSW to enhance geospatial fabric functionality.<br>**Action:** Progressively locate sites spatially and also connect to AHD. |

**Table 18: Improving the Australian Hydrologic Geospatial Fabric groundwater foundation dataset – Theme 4**

| Data gap (groundwater) | Strategies and action |
|---|---|
| **Gap 47: Fast and easy and affordable access to spatial data** | **Strategy**: Development of coordination, management, maintenance and governance arrangements which ensure ongoing access to existing and new data across government and industry.<br>**Action**: Development of a spatial data infrastructure strategy specifically targeted at water information. The strategy should address coordination across all levels of government and industry data management and maintenance, standards data exchange policies ICT and applications development.<br>**Action**: Whole-of-government approach across all levels of government in line with the NSW Common Spatial Information Initiative. |
| **Gap 48: Hydrogeological classification of groundwater sources** | **Strategy:** Development of hydrogeological classification of the State's groundwater sources to support local, catchment, state and national data and information requirements now and into the future.<br>**Action:** Develop hydrogeological unit classifications for the State's groundwater monitoring network that is able to support local, catchment, state and national data and information requirements now and into the future.<br>**Action:** Integrate the State data into the Bureau's national scale foundation Geofabric data to allow the national dataset to be replaced with a single point-of-truth NSW dataset.<br>**Action**: Address data quality and currency issues with existing regional scale data to ensure users have access to consistent, current representations of features across NSW.<br>**Action**: Commence the development of 'next generation' data that meets local, regional and national needs over key-groundwater sources on a priority basis. |
| **Gap 16: Inadequate spatial mapping of groundwater network** | **Strategy:** Improve geo-referencing of groundwater network across NSW to enhance geospatial fabric functionality.<br>**Action:** Locate sites, measured to AHD. |
| **Gap 18: Inadequate spatial mapping of water quality network** | **Strategy:** Improve geo-referencing of water quality network across NSW to enhance geospatial fabric functionality.<br>**Action:** Locate sites, measured to AHD. |
| **Gap 38: Inadequate spatial mapping of groundwater and surface water access licences** | **Strategy:** Improve geo-referencing of licensed works across NSW to enhance geospatial fabric functionality.<br>**Action:** Progressively locate sites spatially and also connect to AHD. |

**Table 19: Development and Application of Data Standards for the collection, management and transfer of data (WDTF) – Theme 5**

| Data gap | Strategies and action |
|---|---|
| **Gap 10: Insufficient quality attributes for data stored in Groundwater Database (GDS)** | **Strategy:** Review and identify key issues with the current database. Prioritise the issues (e.g., archive data, GDS management, procedures review and update, quality assurance, training program, compatibility between recordings and systems) and develop a system to resolve them in a timeframe compatible with the Bureau regulations.<br>**Action:** Scope and design GDS data enhancement project.<br>**Action:** Develop project plan – resources, cost, timeline in Bureau funding application format. |
| **Gap 32: Inadequate water data QA system** | **Strategy:** Develop quality assurance system for the jurisdiction.<br>**Action:** Prioritise the data, and implement the system.<br>**Action:** Develop an automated quality coding of real-time data within and across agencies. |
| **Gap 45: Inaccuracy of system data, and lack of quality assurance** | **Strategy:** After data is compiled, run accuracy assessments.<br>**Action:** Develop (Extract, Transform, Load) ETL process. |

**Table 20: Data provision and WDTF (including dataset upgrades) – Theme 6**

| Data gap | Strategies and actions |
|---|---|
| **Gap 25: Surface Water Licensing and Usage Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to water licensing database to improve WDTF export functionality. |
| **Gap 26: Surface Water Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to surface water database to improve WDTF export functionality. |
| **Gap 28: Groundwater Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to groundwater database to improve WDTF export functionality.<br>**Action:** Assess requirements in overall database terms. Maybe appropriate to replace current systems. |
| **Gap 24: Lack of access to integrated datasets on the web** | **Strategy:** Integration of DECCW's and NSW Office of Water's networks to improve delivery to the community. Aim towards delivering all data from a catchment seamlessly to all clients.<br>**Action:** Currently the estuarine network is available through Manly Vale and the rest is through NSW Office of Water. There is an opportunity to integrate these with metropolitan networks for flood management initially, and then for other uses. |
| **Gap 29: Groundwater Licensing and Usage Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to water licensing database to improve WDTF export functionality. |
| **Gap 30: Water quality database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to water quality database to improve WDTF export functionality. |
| **Gap 31: Insufficient redundancy in telemetry systems** | **Strategy:** Improve reliability of remote data capture by adoption of reliable systems and technologies. Obtain guarantees of service provision from external service providers, build redundancy between agencies.<br>**Action:** Process evaluation and identification of risks.<br>**Action:** Assessment of options and development of back-up system(s) for critical components. |

| Data gap | Strategies and actions |
|---|---|
| **Gap 36: Core database unable to meet current and future data management and delivery needs** | **Strategy:** Evaluate system needs, and determine if best approach is to upgrade or replace.<br>**Action:** Evaluate systems, purchase and install where required. |
| **Gap 43: Inability to transfer category 7 data in WDTF format.** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau.<br>**Action:** Undertake modifications to database to improve WDTF export functionality. |
| **Gap 44: Inefficiencies from inconsistent data storage of category 7 data** | **Strategy:** Centralised data collector to compile data.<br>Action. NSW Office of Water become data broker and develop web based system to collate disparate data. |
| **Gap 9: Water storage and surface water data not in electronic format** | **Strategy:** Assess data entry priorities based on the latest information and progressively make data and metadata available electronically to the national water database (with guidance from the Bureau).<br>**Action:** Entry of metadata into electronic format.<br>**Action:** Conversion of unprocessed prime data to digital format. |
| **Gap 11: Insufficient groundwater data in electronic format (data at risk)** | **Strategy:** Assess data entry priorities based on the latest information and progressively make data and metadata available electronically to the national water database (with guidance from the Bureau).<br>**Action:** Entry of metadata into electronic format.<br>**Action:** Conversion of unprocessed prime data to digital format. |
| **Gap 19: Insufficient water quality data in electronic format (data at risk)** | **Strategy:** Assess data entry priorities based on the latest information and progressively make data and metadata available electronically to the national water database (with guidance from the Bureau).<br>**Action:** Entry of metadata into electronic format.<br>**Action:** Conversion of unprocessed prime data to digital format. |
| **Gap 49: Lack of appropriate metadata** | **Strategy:** Discussions with the Bureau<br>**Action:** Data providers will provide metadata to the Bureau in the required format that is in their possession. |

**Table 21: Summary of projects by Theme for NSW Strategic Investment Plan (2012-2017)**

| Theme | Total projects | Indicative cost ($) |
|---|---|---|
| **Theme 1:** Data Collection and Telemetry | | 19,339,000 |
| **Theme 2**: Collating and Reporting Water Information (includes National Water Account) | | 1,440,000 |
| **Theme 3**: Improving the Australian Hydrologic Geospatial Fabric surface water foundation dataset | | 70,000 |
| **Theme 4:** Improving the Australian Hydrologic Geospatial Fabric ground water foundation dataset | | 400,000 |
| **Theme 5**: Development and Application of Data Standards for the collection, management and transfer of data (WDTF) | | 120,000 |
| **Theme 6:** Data Provision and WDTF | | 1,620,000 |
| | **23** | **7,526,000** |

## 5.3 Priorities

The project activities in Table 22 were ranked against priority water management strategies.

**Table 22: Priorities of project groupings**

| Project activity | Ranking | Water management strategies |
|---|---|---|
| Data delivery to the Bureau – WDTF, database system upgrades, QA, data rescue and clean up | High | Murray-Darling Basin Planning<br>Water sharing plans, e.g. regulated, groundwater, and unregulated including estuaries<br>Major urban water supply system monitoring<br>Flood warning and river operations |
| | Medium | Larger non-metropolitan urban water supply systems<br>Environmental – water quality data<br>Research data systems |
| | Low | Small non-urban water supply systems |
| Water monitoring – infrastructure – instruments for existing network upgrades – new network installations (including research) | High | Murray-Darling Basin<br>Water sharing plans, e.g. regulated, groundwater, and unregulated including estuaries<br>Major urban water supply system monitoring |
| | Medium | Larger non-metropolitan urban monitoring<br>Environmental – water quality data and GDEs |
| | Low | Small non-metro monitoring<br>Flood warning monitoring funded from other areas |
| Surveys – AHD and Bathymetric surveys of river storages, geospatial projects | High | Murray-Darling Basin storages<br>Water sharing plans, e.g. regulated, groundwater, and unregulated including estuaries |

## 5.4 Future investment

The M&E program has been very beneficial for NSW, and this has been particularly apparent for monitoring the recent flood events (see section 2.2.5). However, while it is important to review the success of a program, it is also essential to consider how the successes can contribute to future benefits. In NSW opportunities for future planning can be gained by using information gathered for the gaps analysis (section C) as well as further information developed for the M&E funding program. This has been used to develop a NSW Strategic Investment Plan in Water Monitoring (2012-2017).

Some projects submitted under the M&E program did not receive funding. While the funding of these projects was not a high priority for the M&E program, they still remain as priority for the organisations. In addition 15 of the 49 Gaps in data and systems noted for NSW have not been funded at all

Therefore, as indicated at the end of Section C of the SWIMP (Section 4.5), the NSW Office of Water has integrated the results from the gaps analysis with other information from the M&E program to develop a NSW Office of Water Investment Plan in Water Monitoring. The Plan has identified what has been undertaken, and what work has yet to be done. The information used included:

- All NSW projects where the gaps have not been closed by M&E funding
- All NSW gaps not addressed by M&E funding
- All unfunded NSW projects
- NSW Office of Water Strategic Investment Plan for Water Monitoring 2012-2017
- Projects and priorities provided by NSW Organisations in response a request from the NSW Office of Water in 2011 /2012
- Information provided in Organisational SWIMPS (Appendix 1).

A strategic integration by NSW Office of Water of this information will result in a prioritised list of outstanding work. When estimates of cost are linked to the outstanding work, the result is an ‘Investment Plan in Water Monitoring’ that provides a costed work program for next 5 years (2012-2017).

To ensure it was inclusive NOW contacted all organisations in NSW that provide data to the Bureau, and/or received M&E funding. They were requested to provide estimates of funding was requirements to maintain the infrastructure and processes that were updated using M&E funding, as well as priorties for new projects. All of this information was integrated to develop one plan for NSW, available in 2012.

## 5.5 Conclusion

Around 50 percent of the Murray-Darling Basin lies within NSW. Significant improvements have been made to water monitoring systems over the past five years to improve knowledge on spatial and temporal variation to the resource in both the Basin and coastal catchments. Concern about the prospects of climate change has further sharpened the focus to improve quantification, understanding and management of a finite resource. Major urban centres across Australia have been affected by a decade

of drought, with major government investments in new water sources and urban water demands placing increasing pressure on aquatic ecosystems.

These high profile issues mirror the key water management challenges facing NSW. More specific priority issues for the SWIMP 2012 are outlined below, and reflect changing priorities due to the advances in the monitoring network from previous rounds of M&E funding.

- The start of 2011 and 2012 saw a number of significant rainfall events across inland Australia, creating rural flooding and suppressing drought conditions in a number of regions. The severity of the conditions highlighted the focus on quantifying river flows resulting from these floods for water planning in the Murray Darling Basin. NSW has assessed potential for improved flow measurement in a number of remote areas to more accurately forecast inflow volumes to the Menindee Lakes system. In addition, timelier delivery of storage levels and volumes for the Lakes themselves has been achieved through telemetered water storage instrumentation funded under the M&E program. Minor to major flooding has also occurred along the majority of coastal NSW in 2011 and 2012.
- Flooding in parts of NSW reinforces the importance of high quality stream gauging practice. This can suffer during long periods of drought, resulting in reduced opportunity for professional training and testing of new systems and approaches. However, this should also attest to the importance of work practice and methods standardisation to reduce the reliance on the knowledge embedded in an ageing workforce. Hence, a new series of learning will emerge from application of a range of previous M&E program investments, which must be captured for the future. These include the Acoustic Doppler profilers, the new IP loggers and other instrumentation, and improvements in databases and systems to capture, interrogate and transfer data to the Bureau, with improved quality and reliability.
- Other investments that are markedly improving the utility of historic and ongoing data will need to continue due to the sheer volume of this work. These include AHD connection and geospatial locating for groundwater monitoring bores, rehabilitation of key existing bores and electronic recovery of priority paper-based historic data. Significant progress was made in this area during the five year M&E Program.
- Now that momentum has been established across the range of data categories, investments in metadata to render data flowing into AWRIS useable are necessary to build on M&E successes to date. As we move into data categories that are more interpretive and complex, the necessity to underpin this data with metadata cannot be understated. While quantifying the water resource has been a major focus nationally in M&E investments to date, leveraging important water quality data will entail a major emphasis on metadata and systems to capture historical datasets and ensure greater accessibility and usability.
- While there has been great progress in developing systems, methods and standards to support production of the National Water Account, there is still a body of work to follow up on the methods pilot and to improve the science, efficiency and form of the first and subsequent National Water Accounts.

- Along with significant investments in data quality and reliability, the M&E funding has contributed to managing the existing asset base and protecting the human capital through OHS measures in cableway modernisation, gauging station compliance and the Doppler technology.
- Following the national spatial data audit undertaken for the Bureau by Geoscience Australia, a coherent set of priorities are beginning to emerge across the jurisdictions to support development of the Geofabric. These are supported by investments in georeferencing and groundwater databases already underway. While the Geofabric is a 10-year initiative, there is a need to develop a consistent spatial capacity to underpin M&E investments.

While there is a significant level of water monitoring activity across the nation, the investments that NSW seeks from future funding will provide for maximum utility from the water data collected by ensuring:

- we achieve efficient and reliable capture both in data retrieval and data quality, with appropriate frequency and timeliness through projects for instrumentation (e.g. loggers, sensors, telemetry), an improved quality assurance system and database management
- we can provide high quality data and information to the Bureau via efficient standardised and automated system functionality through projects on WDTF capability, and reduced delays in data provision and transmission
- we improve the value of the data that we capture, manage and deliver by spatial and vertical referencing through projects on AHD referencing, and improved groundwater database functionality to leverage all of the physical attributes available to groundwater data
- we recover the significant investments in water data made over long periods of history and improve its usefulness through better descriptive detail and context in electronic form, and projects on data recovery, metadata, and data clean-up
- we harness investments in data capture, coverage and reliability along with improved understanding and conceptualisation of water balance, for contemporary water accounting and water resource assessment reporting.

Given the scale and importance of this data, NSW water agencies are developing a five year investment strategy to fund this ongoing work – 'NSW Strategic Investment Plan for Water Monitoring - 2012 to 20127. The Investment Plan concludes that the $21 million dollar cash stimulus provided to NSW from the Bureau of Meteorology has allowed State agencies and other water monitoring organisations to upgrade their systems in a relatively short period of time.

Under the funding deeds signed between the NSW organisations and the Bureau, is agreement that the organisations that received funding would continue to operate and maintain the upgraded systems into the future. From this agreement the key recommendations from the Investment Plan are that the NSW Office of Water, in conjunction with other water organisations in the state, prepares a:

- *NSW Asset Management Plan for Water Monitoring to 2017* (category 1 projects) and a
- *NSW Modernisation and Extension Program – Phase 2* (category 2 projects)

This Investment Report has:

- estimated a five year cost of maintaining water monitoring systems in NSW at just over $11.4 million (for organisations that have contributed to this report),
- collated detail on a wide range of projects (prioritised into two categories) that would provide a clear starting point for the preparation of the Asset Management Plan and the NSW M&E Program Phase 2.

Various funding options will need to be considered in developing the Asset Management Plan and the NSW M&E 2 Program. These could include normal consolidated revenue funding for maintenance including technology upgrades, ‘capital grants’ from Treasury for new projects and possible ongoing cost sharing with the Bureau of Meteorology for improvements to data delivery systems.

The next step in this process is for approval to be given to the preparation of the Asset Management Plan and this form the basis for funding submission for the ongoing maintenance and upgrade to the states major water resource monitoring networks.

**Table 23: Projects for the NSW Strategic Investment Plan in Water Monitoring (2012-2017)**

| Project name | Category | Executive Sponsor | Cost ($) Aprox. |
|---|---|---|---|
| **ORGANISATION** NSW OFFICE OF WATER | | | |
| Asset Management Plans (including monitoring and data management) for:<br>a) surface water<br>b) ground water<br>c)water quality | **ONE** | Manager, Water Monitoring | 450,000 |
| Asset management – purchase replacement / upgrade equipment<br>a. Surface water – includes acoustic Doppler<br>b. Ground water – includes telemetry<br>c. Water quality<br>*(* see appendix one for further detail)* | **ONE** | Manager, Water Monitoring | 7,500,000 |
| NSW State-wide IP wireless network | **ONE** | Manager, Water Monitoring | 125,000 |
| EC Probes for groundwater monitoring | **ONE** | Manager, Groundwater Management | 300,000 |
| Development and Implementation of Webcam | **ONE** | Manager, Water Monitoring | 100,000 |
| Meta data – Water Dataset alignment with proposed metadata standard | **ONE** | Manager, Water Monitoring | 20,000 |
| Independent verification of Doppler data | **ONE** | Manager, Water Monitoring | 50,000 |
| **TOTAL FOR CATEGORY ONE (maintenance and upgrades)** | | | **8,545,000** |
| Disaster Recovery and Field System Redundancy Planning | **TWO** | Manager, Water Monitoring | 150,000 |
| Remote Control Vessels | **TWO** | Manager, Water Monitoring | 360,000 |
| Low and High Flow rating accuracy | **TWO** | Manager, Water Monitoring | 150,000 |
| Evaluation of commercially available electrical conductivity sensors | **TWO** | Director, Environmental Evaluation and performance | 193,000 |
| Groundwater telemetry expansion | **TWO** | Manager, Groundwater Management | 600,000 |
| Adopting technological advancement of in-situ real time water quality monitoring | **TWO** | Director, Environmental Evaluation and performance | 870,000 |
| Groundwater telemetry expansion | **TWO** | Manager, Groundwater Management | 600,000 |

| Project name | Category | Executive Sponsor | Cost ($) Aprox. |
|---|---|---|---|
| In-situ Doppler velocity | **TWO** | Manager, Water Monitoring | 980,000 |
| Unregulated Flow Class Announcements | **TWO** | Director, Water Systems | 100,000 |
| Historic data recovery – water use licensing | **TWO** | Manager, Surface Water Management | 140,000 |
| Review and develop standard procedures for converting height data to real time flow data (operational rating table development) | **TWO** | Manager, Water Monitoring | 150,000 |
| Inadequate spatial mapping of groundwater and surface access licences | **TWO** | Manager, Groundwater Management | 70,000 |
| NSW Statewide Hydrological Geospatial Fabric (NHGF) project - Namoi Catchments | **TWO** | Team Leader, Spatial Service and Information | 400,000 |
| Biological database – KIWQM extension and data population | **TWO** | Director, Environmental Evaluation and performance | 615,000 |
| Workforce Planning: Formal training in Hydrographic Practice (Diploma level) for NOW staff | **TWO** | Manager, Water Monitoring | 800,000 |
| Data quality framework for Australian water datasets | **TWO** | Manager, Water Monitoring | 50,000 |
| Environmental water holder needs – water shepherding | **TWO** | Project manager, Water Sheperding | Unknown |
| Lack of information about GDE | **TWO** | Manager, Groundwater Management | 200,000 |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **6,428,000** |
| **ORGANISATION** | **NSW OFFICE OF ENVIRONMENT AND HERITAGE (Contractor: MANLY HYDRAULICS LABORATORY)** | | |
| Asset Management Plan (Coastal Network) | **ONE** | Manager, Coast and Flood Policy. | 200,000 |
| Improved Flood Warning | **ONE** | Manager, Coast and Flood Policy. | 400,000 |
| Improved flood flow measurement | **ONE** | Manager, Coast and Flood Policy. | 300,000 |
| Improve data accuracy | **ONE** | Manager, Coast and Flood Policy. | 240,000 |
| **TOTAL FOR CATEGORY ONE (maintenance and upgrades)** | | | **1,140,000** |
| Digitisation of historical data and metadata | **TWO** | Manager, Coast and Flood Policy. | 350,000 |
| Develop future gauging station | **TWO** | Manager, Coast and Flood Policy. | 100,000 |
| Real time quality codes | **TWO** | Manager, Coast and Flood Policy. | 250,000 |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **700,000** |

| Project name | Category | Executive Sponsor | Cost ($) Aprox. |
|---|---|---|---|
| | | | |
| **ORGANISATION** **STATE WATER** | | | |
| Upgrade instrumentation of weir level recording equipment, with improved accuracy in storage capacity tables | **TWO** | General manager, water delivery | 200,000 |
| Software development to automate the transfer of TT figures to the Bureau | **TWO** | General manager, water delivery | 50,000 |
| Installation of accurate measuring devices monitoring equipment, and confirm accuracy with NWI/Bureau standards | **TWO** | General manager, water delivery | 600,000 |
| Identification and automation of isolated manual data management systems | **TWO** | General manager, water delivery | 50,000 |
| Close gaps in current monitoring network | **TWO** | General manager, water delivery | 1,200,000 |
| Improved forecasting of water demands and river 'losses' | **TWO** | General manager, water delivery | 250,000 |
| Flood operation – rainfall runoff predictive capacity, improve timing of storage pre-release against tributary flows | **TWO** | General manager, water delivery | 400,000 |
| Seasonal forecasting – improve management of transfers between storages | **TWO** | General manager, water delivery | 350,000 |
| Seasonal forecasting - better management of environmental allocations | **TWO** | General manager, water delivery | 300,000 |
| Consistent and efficient handling of information at times of floods and low flow conditions | **TWO** | General manager, water delivery | 100,000 |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **$3,500,000** |
| **ORGANISATION** **NSW DEPARTMENT OF PRIMARY INDUSTRIES (AGRICULTURE)** | | | |
| Increasing the accuracy of streamflow measurement | **ONE** | Research Leader, Water in DPI | 160,000 |
| Developing and implementing an asset management plan for replacement of surface and ground water measurement equipment | **ONE** | Research Leader, Water in DPI | 500,000 |
| Improving surface water sites to meet OHS and accuracy requirements | **ONE** | Research Leader, Water in DPI | 100,000 |
| Improving water mass balance information | **ONE** | Research Leader, Water in DPI | 500,000 |
| | | | |

| Project name | Category | Executive Sponsor | Cost ($) Aprox. |
|---|---|---|---|
| **TOTAL FOR CATEGORY ONE (maintenance and upgrades)** | | | **$1,660,000** |
| Improving the groundwater water quality network coverage to meet water information requirements | **TWO** | Manager, Water in DPI | 150,000 |
| Improving water quality monitoring network for groundwater/surface water interaction | **TWO** | Manager, Water in DPI | 200,000 |
| Increasing water quality sensors in the surface water network | **TWO** | Manager, Water in DPI | 200,000 |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **$550,000** |
| **ORGANISATION** **MURRUMBIDGEE IRRIGATION** | | | |
| Flow measurement and remote communication upgrade of River Drain and End Of System sites. | **ONE** | Murrumbidgee Irrigation | 25,000 |
| Application to send data from SCADA Historian to the Bureau in WDTF | **ONE** | Murrumbidgee Irrigation | 50,000 |
| **TOTAL FOR CATEGORY ONE (maintenance and upgrades)** | | | **75,000** |
| Upgrade of key water distribution and escape monitoring sites | **TWO** | Murrumbidgee Irrigation | 325,000 |
| Upgrade of key water distribution and escape monitoring sites | **TWO** | Murrumbidgee Irrigation | 715,000 |
| Upgrade of key water distribution and escape monitoring sites | **TWO** | Murrumbidgee Irrigation | 255,000 |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **1,295,000** |
| **ORGANISATION** **GOSFORD / WYONG COUNCIL** | | | |
| Telemetry for Groundwater Monitoring Bores | **TWO** | Gosford and Wyong Councils | 256,000 |
| Mangrove Creek stream gauge and telemetry | **TWO** | Gosford and Wyong Councils | 25,000 |
| Installation of rain gauges | **TWO** | Gosford and Wyong Councils | 50,000 |
| Establish weather stations | **TWO** | Gosford and Wyong Councils | 100,000 |
| Water Data Transfer Format (WDTF) Schema Upgrade | **TWO** | Gosford and Wyong Councils | 125,000 |
| Continuous water quality monitoring at Wyong River and Ourimbah Creek Pump Stations" | **TWO** | Gosford and Wyong Councils | 100,000 |

| Project name | Category | Executive Sponsor | Cost ($) Aprox. |
|---|---|---|---|
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **656,000** |
| **ORGANISATION HUNTER WATER CORPORATION** | | | |
| Improved metering of recycled water use | **TWO** | Hunter Water Corporation | **50,000** |
| Installation of telemetered groundwater level monitoring instruments at strategic locations at Tomago and Anna Bay | **TWO** | Hunter Water Corporation | **120,000** |
| Bathymetric Survey of Chichester Dam | **TWO** | Hunter Water Corporation | **100,000** |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **270.000** |
| **ORGANISATION LISMORE CITY COUNCIL** | | | |
| Upgrade telemetry and rain gauges | **TWO** | Lismore City Council | Unknown |
| **ORGANISATION ROUS WATER** | | | |
| SCADA and Historical Database Upgrade | **TWO** | Rous Water | 225,000 |
| Emigrant Creek Dam Inflow Monitoring | **TWO** | Rous water | 150,000 |
| **TOTAL FOR CATEGORY TWO (new projects)** | | | **375,000** |
| **ORGANISATION MIDWESTERN COUNCIL** | | | |
| Telemetry upgrade and monitoring program expansion. | **TWO** | Midwestern Council | Unknown |
| Improving data management | TWO | Midwestern Council | Unknown |
| **ORGANISATION NORTHERN RIVERS CMA** | | | |
| Implementation of Ecohealth Program | **TWO** | Northern Rivers CMA | 150,000 |
| Telemetry purchase for Ecohealth Program | **TWO** | Northern Rivers CMA | 200,000 |

| Project name | Category | Executive Sponsor | Cost ($) Aprox. |
|---|---|---|---|
| TOTAL FOR CATEGORY TWO (new projects) | | | 350,000 |

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## 6.1 Current Acts and Regulations cited

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# Appendix 1 – Organisational SWIMPs

The NSW Strategic Water Information Monitoring Plan (SWIMP) is a requirement under the $80 Million Modernisation and Extension of Water Monitoring Systems Programme (M&E) administered by the Bureau of Meteorology.

To ensure the SWIMP is inclusive of all the water collection agencies in NSW, each individual organisation providing water data to the Bureau was contacted in 2009 and again in 2010 with the opportunity to produce an Organisational SWIMP. An Organisational SWIMP focuses on organisational specific water data programs, priorities, and future activities.

The information provided by the organisations is extremely valuable when identifying and setting priorities for not just the M&E funding but also for other Statewide strategic documents. All submitted Organisational-SWIMPs can be found in this appendix, with those that were re-submitted for this version of the SWIMP identified as being updated.

- Appendix 1(a) Bureau of Meteorology NSW – Flood forecasting
- Appendix 1(b) NSW Office of Environment and Heritage
  *formerly Department of Climate Change and Water (DECCW)*
- Appendix 1(c) NSW Department of Primary Industries
  *formerly Department of Industry and Investment (I&I)*
- Appendix 1(d) Sydney Catchment Authority
- Appendix 1(e) State Water Corporation
- Appendix 1(f) Sydney Water Corporation
- Appendix 1(g) Hunter Water Corporation
- Appendix 1(h) Bega Valley Shire Council
- Appendix 1(i) Wyong Shire Council
- Appendix 1(j) Shoalhaven City Council
- Appendix 1(k) Murrumbidgee Irrigation
- Appendix 1(l) Cabonne Shire Council
- Appendix 1(m) Port Macquarie Hastings Council
- Appendix 1(n) Murray Catchment Management Authority
- Appendix 1(o) MidCoast Water
- Appendix 1(p) Clarence Valley Council

Other NSW agencies named in various appendices were replaced by new organisations since the organisational SWIMP was first prepared:

- Roads and Traffic Authority (RTA) is now NSW Roads and Maritime Services
- Department of Services, Technology and Administration is now Department of Finance and Services

# Appendix 1(a) – Bureau of Meteorology NSW – Flood forecasting

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

Water information required is real-time rainfall, river and tidal data which underpin the Bureau's flood forecasting service to 175 specific locations across NSW as well as other warning services. This information is currently published by the Bureau on www.bom.gov.au/hydro/flood/nsw/. Key stakeholders and clients of this data include:

- Bureau's NSW Flood Warning Centre (NSW FWC)
- Bureau's Regional Weather Forecasting Centre – severe thunderstorm and severe weather warning services utilise rainfall data. Marine and tsunami warnings rely on MHL tide data
- NSW SES
- government agencies, e.g. local councils, RTA, DECCW
- recreational users, e.g. canoeists, school groups, campers
- landholders for property access, lifting of pumps, access to water
- boat operators, oyster farmers
- media
- consultants
- general public interest.

This list of stakeholders is based on experience and email feedback and is by no means exhaustive.

Key drivers for improvement include:

- demand for data to be up-to-date. Real-time data is of more interest and value than historical data. The Bureau prefers event reporting data i.e. available data is updated with each increment of rain or a change in river level. If this is not possible, then to have data updated at least at one hour intervals for the catchments that are presently polled with telephone telemetry. Public feedback also indicates they would like data to be updated at least at hourly intervals across most areas of NSW in areas where the current routine polling practice is for only once a day readings
- reliability of data in terms of accuracy and availability. Inaccurate data is the major source of potential flood forecasting error if the problem is not discovered and is used in modelling. The Bureau relies on water agency data (NSW Office of Water, MHL, SCA and ACT Ecowise) to be sent by FTP which requires robust systems at each end
- better network coverage is required in some areas of the state to facilitate more detailed modelling for warning services.

## Section B

Data collection systems:

a) EnviroMon – collects ALERT radio telemetry data – 40 EnviroMon base stations across NSW
b) FTP – inter agency data transfer mainly from telephone polled sites
c) Timestudio – collects data from the Bureau's telephone telemetry rain stations.

**Table 24: NSW Flood Warning Network**

| SYSTEM/Agency | Rain | River |
|---|---|---|
| ENVIROMON ALERT DATA – Bureau and councils | 317 | 198 |
| FTP – Sydney Catchment Authority | 34 | 16 |
| FTP – ACT Government | 28 | 30 |
| FTP – Hunter Integrated Telemetry System | 12 | 58 |
| FTP – Manly Hydraulics Lab | 61 | 150 |
| FTP – NSW Office of Water | 85 | 395 |
| TIMESTUDIO – Bureau | 113 | |
| **Totals** | **650** | **847** |

Additional rainfall data is collected in real-time from 113 Bureau owned automatic weather stations. The distribution of all these rain and river stations can be viewed on www.bom.gov.au/hydro/flood/nsw.

## Section C

### Data issues and opportunities

a) There is the need to improve the timeliness of data, particularly during floods, so we can provide the public and SES real-time data. This availability can be improved through upgraded communications such as Next G and ERTS (radio).
b) Vulnerability of agencies that provide FTP data feeds with respect to disaster recovery, backup sites and support for 24/7/365 systems.

### Data gaps

The main larger scale areas where improved network coverage is required for flood warning purposes includes the following:

a) Castlereagh Valley
b) Bogan Valley
c) Lower Gwydir

## Section D

### Priorities

a) improved timeliness of data – funding for upgraded communications

b) improved security of agency sites that provide FTP data feeds – funding for backup sites and other strategies that improve data security

c) data gaps – funding for additional gauges.

# Appendix 1(b) – Office of Environment and Heritage

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

The Department of Environment, Climate Change and Water (DECCW) is the lead NSW Government agency with responsibility for protecting and caring for our environment, managing water resources and developing and coordinating programs to address the impacts of climate change in NSW. The NSW Office of Water is part of DECCW and is responsible for strategic management of the State's surface water and groundwater resources.

### NSW Coastal Data Network

DECCW works closely with local councils, Catchment Management Authorities and communities across the state to ensure the long-term protection, conservation and restoration of coastal, estuarine and floodplain environments by reducing the risks posed by coastal hazards such as extreme tides, sea level rise and floods.

The Urban and Coastal Water Strategy Section of DECCW is responsible for the management of the NSW Coastal Environmental Data Network. The provision of coastal/flood data collection services covering eastern NSW is currently defined in an annual contract between DECCW and the Department of Services, Technology and Administration, Manly Hydraulics Laboratory. For historical reasons, environmental data collection west of the Great Dividing Range is undertaken by the NSW Office of Water by the hydrometric unit whilst east of the divide, in the coastal zone, this function is a DECCW responsibility via an annual performance-based contract.

The data collected is primarily used by DECCW to underpin the delivery of the floodplain management, coastal management and estuary management programs. The data program informs the development of management actions which aim to minimise risk to life and property due to natural hazards (storm and flood) in the coastal zone of NSW. The real-time data is used extensively by the Bureau of Meteorology, SES and local councils to generate emergency warnings and delivery of services during extreme events.

The historical archives of data are used in natural disaster mitigation investigations and environmental studies which together feed in to the development of land use planning instruments. Data is specifically used to inform coastal, estuary and floodplain management plans. The data network is also used to monitor long-term changes in flooding, wave and tidal characteristics as a result of climate change and associated sea level rise.

The NSW Coastal Environmental Data Network is used for a wide range of purposes. These include:

- predicting tides and storm surges
- monitoring sea level rise
- monitoring of wave heights

- monitoring of river heights
- flood warnings and flood studies
- coastal hazard definition and erosion studies
- estuarine hydrodynamic and water quality modelling
- state of the environment reporting
- monitoring long-term trends (including climate change) in flooding, wave and tidal characteristics
- determination of Mean High Water Mark used in property definition.

The current network provides data capture, installation, operation and maintenance of 222 River and Estuary Water Level Recorders, 72 rain gauges, 17 ocean tide gauges, four offshore tide and storm surge and seven deepwater waverider buoys. The current performance of the water level network is achieving 99 per cent data recovery. Information is freely made available on the internet with the database currently servicing over 1,200,000 requests annually.

DECCW and MHL are listed in the *Water Regulations 2008* (Cwlth) (under the *Water Act 2007* (Cwlth)) as a water data supplier under Category B and Category H (Flood Warning). MHL currently supplies the Bureau with an extensive amount of near real-time flood warning, severe weather warning and storm surge data in the specified format. Coastal data is also accessible via the Australian Oceans Data Network.

## Section B

### Investment in water information assets

#### NSW Coastal Data Network

Details on the individual stations that make up the DECCW coastal water level network are included in the inventory in the Section B supplementary report. Over the past four funding rounds, DECCW has been successful in securing Bureau M&E funding to upgrade the data loggers and telemetry systems for the entire water level network. M&E funding has also been provided to upgrade the ageing data management systems at MHL, which has resulted in improved data security and reliability in water data management within DECCW/MHL and the processes for the transfer of data to the Bureau in WDTF format. DECCW has recently commissioned a review of existing assets that make up the water monitoring network, to enable preparation of an asset management strategy to ensure future capital improvement costs are identified and planned for.

## Section C

### NSW Coastal Data Network

DECCW has recently completed a comprehensive review of the entire Flood, Estuary, Ocean Tide and Storm Surge programs which form part of the overall NSW Coastal Environmental Data Network. The review has resulted in a number of changes to the

overall network, which are currently being implemented by MHL. The work includes a limited number of new high priority stations, relocation of stations to provide superior information and the decommissioning of redundant sites. The review included consultation with the main stakeholders in data use regarding the proposed changes to the network. As part of the review process, there was no overall increase in the size of the network due to budgetary constraints.

The current network covering the coastal zone of NSW has been developed and refined over the past 30 years, and now represents the minimum data needs for floodplain, estuary and coastal management decision making and emergency response during extreme events (flood and storm).

## Section D

### NSW Coastal Data Network

The overall strategic objectives for the monitoring system are based upon the current drivers and current investment. Also the network vision is flexible enough to cater for the future, expected demands. Outlined below are the targeted objectives:

- exceed 99 per cent data recovery for events and long-term datasets.
- provide all data in real-time
- provide all data in a secure and accessible format
- quality code all data
- provide a monitoring system that:
  - is compliant and compatible with best practice with State and Commonwealth Water Authorities
  - is robust, responsive but flexible
  - is low powered
  - minimises OHS risks
  - optimises resource allocation via low maintenance
  - is discretely designed with minimal environmental impact
  - has sound data security, storage and access.

To achieve the strategic jurisdiction vision, the areas for highest priority investment are:

- complete the provision of real-time IP telemetry solutions
- provision of real-time quality coding of data
- migration of historical data to WDTF compatible databases.

These priority investments are salient to the Bureau's water information mission in that they improve water availability forecasting, improve information provision to the public and will improve the flood and severe weather services.

# Appendix 1(c) – Department of Primary Industries NSW

*Draft Strategic Water Information Management Plan*

## Section A

Water is a critical ingredient in primary production. Striking the balance between extractive uses and environmental water requirements is an incredible challenge – not only for governments but for all primary industry enterprises. Farmers, foresters, fishers and miners know the value of water to their businesses and equally the importance of sustaining the environment from which water is extracted.

This challenge is made all the more complex as governments and communities come to understand the impacts of climate change upon water resource availability. New South Wales primary producers require secure access to water resources. This needs to be matched with commitment by primary industries to adopting best practice methods and technologies to continually improve water management.

To service the diverse needs of primary industries stakeholders, Industry and Investment NSW (NSW I&I) has a substantial science and research capacity and has also established itself as a leader in the provision of advice, information, education and training services. The water activities of NSW I&I are often focused at the farm to paddock scale and our expertise here is recognised. These functions set NSW I&I apart from other natural resource management agencies, which are primarily focused on the larger catchment scale and the use of regulatory approaches. This capacity, in combination with water policy and socioeconomic expertise, gives credibility to NSW I&I's role as a strong voice for primary industries in Government decision-making processes.

NSW I&I collects water information to allow efficient use of water, better management of water losses, maximising returns from available water and water quality issues are addressed. NSW I&I also leads research to ensure the impact of landuse at the point scale on water is understood, and that recommendations and policy to support new land management systems are based on this knowledge.

NSW I&I has statutory responsibility for the management of areas that affect and/or are influenced by (either directly or indirectly) water quality and quantity.

NSW I&I (Mineral Resources) is responsible for water issues as part of the impact assessment of certain activities including exploration and underground mining. Operational focuses include maintaining water quality and quantity for surface and groundwater. For surface mining operations, expertise is focused on rehabilitation. NSW I&I will maintain the role of assessing the impacts of underground mining until the end of 2010 when companies are required to have approval under Part 3A, or development consent under Part 4, of the *Environmental Planning and Assessment Act 1979* (NSW).

From a fisheries ecosystems perspective, these functions include aquatic habitat protection and rehabilitation, threatened species conservation, management of commercial and recreational fisheries and aquaculture. Key areas of interest include maintaining or improving sustainable flow regimes for aquatic habitats and fisheries

resources, including threatened species in order to maintain or improve aquatic ecosystem health.

Forests NSW (a public trading enterprise and Division within NSW I&I) is required to monitor and manage water quality to comply with obligations under the Integrated Forestry Operations Approvals. Forests NSW expertise includes water quality monitoring and understanding of the water needs of native forestry (particularly flooding forest types). NSW I&I (the Forests NSW and Science and Research Divisions) is also involved in projects that monitor plantation usage of water.

From an agriculture perspective, there is no statutory responsibility specifically related to water management. Instead expertise is focused on applied research, education and training in areas such as improved crops requiring less watering greater water-use efficiency recycling and reuse of waste waters and also reducing salinisation, waterlogging and polluted accessions to surface and groundwater sources.

## Section B

### Forestry streamflow monitoring

Forests NSW collects water information predominantly at the small catchment scale. It operates a network of 35 stream gauging stations in catchments that are between 0.1 and 45 $km^2$ in area. Stage is measured at these stations with a combination of optical shaft encoders and pressure transducers, all upgraded to either Druck pressure transducers or Unidata shaft encoders as a result of the first round of M&E funding. All field data are recorded on data-loggers, which are in the process of being upgraded to Campbell CR800 loggers as a result of the first round of funds. At this stage all loggers are downloaded at site in the field as none have telemetry installed.

Additionally, Forests NSW operates turbidity probes at its gauging stations and at most sites stage-activated water samplers (Isco and Gamet) are used to collect water samples for laboratory analysis of turbidity and suspended sediment concentration. Manual storage rain gauges are situated within the majority of catchments monitored and supplemented by a smaller number of tipping bucket pluviometers.

All of Forests NSW water information is held within a Hydstra database. Forests NSW has a licence for both the Time Series and Water Quality modules within Hydstra. It has been successfully using the HyBOMexp program since November 2008 for sending the required data to the Bureau via its FTP site.

### Weather stations

There are weather stations located on 17 NSW I&I Research Stations around NSW, some manual, some automatic, sometimes both. There are various combinations of data being automatically or manually fed into the Bureau of Meteorology (the Bureau) or not linked at all. Five are directly linked to the Bureau database (Gosford, Grafton, Trangie, Tocal and Yanco) with a further six being manually downloaded to the Bureau. Data collected usually depends on research needs at the site or is based on some community or historical need. The reading can be once or twice daily (0900 and possibly 1500). On most stations the process is labour intensive and takes a trained

operator up to an hour a day, seven days a week. Storage and use of data varies from site to site.

Six new automatic weather stations have been installed over the past five years and data downloads from these stations via GSM modems is currently a 'manual' operation.

### Monitoring impact of landuse on water in upland catchments

NSW I&I has a network of ten highly instrumented upland dryland catchments in NSW, in which components of the water balance are being measured from Wagga Wagga in the south to Quirindi in the North. The project addresses the need for long-term high quality and high resolution hydrological data. The sites are all well-described and measurements are being taken at strategic locations within the catchments for up to 15 years.

Traditional hydrology methods are used to monitor soil water with automatic loggers and neutron probes, evapotranspiration by Bowen ratio instrumentation, piezometers for groundwater levels and Electrical Conductivity (EC), stream gauging for streamflow and EC and climate station. The data is collected by automated data-loggers and manual sampling, especially important for calibration procedures which guarantee data quality and comparability across a range of sites. The data is quality assessed and collated into common datasets and analysed and reported by a small team of Research Hydrologists with specialised expertise.

In addition to the areas above where NSW I&I is currently registered as a provider of water data with the Bureau, NSW DPI has been collecting water quality and drainage volume data at research sites on farms with coastal acid sulphate soils. The aim of this water monitoring has been to evaluate the effectiveness of management practices to reduce downstream acid export and water deoxygenation. This research has provided some of the most detailed data of acid drainage processes of any site in Australia. Currently, this monitoring has been suspended due to completion of research grants. However NSW I&I has considerable skill and investment in equipment to employ in relation to acid drainage monitoring. There is currently a gap in knowledge of water quality processes associated with strategies which aim to retain excess water in wetlands for grazing.

## Section C

The management of water in a primary industries context is a clear priority of NSW I&I. Water management is recognised as one of the four strategic priorities of the Divisions of Science & Research and Agriculture, Biosecurity & Mine Safety. Water is also the focus of one of four internal actions plans of the department, which pull together the work that is being done across the divisions into a cohesive, consolidated and strategic approach. This is a cross-divisional plan that coordinates and directs NSW I&I's collective efforts. Monitoring is an essential element of any approach to improve water management.

**Forests NSW** has recently negotiated a five-year strategy for the continuance of its water monitoring network to at least 2013. Within budgetary and resourcing constraints, the existing network will adequately provide the types of water information required, i.e. there are no identified data gaps in that sense. However, upgrades to some of the

infrastructure, monitoring equipment and supporting equipment are required to increase data collection efficiency, minimise data loss and further increase the accuracy of recorded information.

The first round of Bureau funds has enabled Forests NSW to upgrade its data logging and stage recording infrastructure. This initial investment focussed on improving the reliability of water quantity (*Q*) data collected and transferred to the Bureau. Areas identified for future upgrades are those relating to the introduction of automated data collection and remote transfer, increased reliability of rainfall and in-situ water quality measurements, and investment in ancillary equipment required to improve the accuracy of velocity-area gaugings and station rating curves.

### Weather stations

During 2007 NSW I&I conducted a comprehensive review of the network of 17 weather stations located at research facilities. This review has resulted in a new strategy for weather stations within NSW I&I. The strategy will see a network of fully automated weather stations with finer data resolution than can presently be collected. This network will be fully compatible with the Bureau standards and facilitate the contribution of data under the Bureau Survey for Water Regulations Online. In addition it will allow NSW I&I scientists real-time access to comprehensive weather data for water research and monitoring projects. This strategic approach was the basis of Project 7.2 that has been supported under the 2008/09 round of the Modernisation and Extension of Hydrologic Monitoring Systems Program Fund.

### Water monitoring in upland catchments

This activity (Key Sites) commenced under the NSW Salinity Strategy and has continued with the support of the National Action Plan for Salinity and Water Quality. It is now conducted using internal resources of NSW I&I and in collaboration with DECCW. It commenced in recognition of a lack of credible scientific data on which to make decisions about landuse recommendations and practices. It is collecting, analysing and reporting data for one of the only comprehensive and scientifically credible studies in Australia that is validating conceptual and computer models for hydrology under a range of common landuses. The research is challenging much of the commonly held conceptual understanding of hydrology processes that are used as the basis for investment of public funds and natural resource policy development.

## Section D

The activities of NSW I&I that are registered under the *Bureau's Survey for Water Regulations Online (Category B)* continue as priorities for NSW I&I water information and monitoring. Forests NSW have identified the following priorities:

- increased reliability of rainfall networks
- increased reliability of in-situ water quality data
- installation of telemetry
- improved station ratings.

Additional priorities include monitoring in regard to:

- acid sulphate soils in coastal catchments
- flow regimes and impact of landuse on fish populations
- increased adoption of water-efficient practices
- understanding and reducing the impact of mining on aquatic ecosystems
- water management risks that threaten water dependant ecosystems and aquatic industries
- development of water accounting and reporting standards including MER.

The points above must not be considered to be in order of priority. Further actions within NSW I&I are required to put these multi divisional activities into an order of priority.

# Appendix 1(d) – Sydney Catchment Authority

*Draft Strategic Water Information Management Plan*

(See also 'Draft Water Monitoring Plan – 4 March 2009) attached separately)

## Background

The SCA has numerous obligations under its Operating Licence regarding reporting and reviewing its water monitoring program, and the identification and implementation of actions to improve the program.

Two specific obligations are particularly relevant to the contents of the Strategic Water Information Management Plan (SWIMP). There are:

- the annual production of a Water Balance and Leakage and Loss report, including progress against identified improvement actions
- the requirement to undertake a complete review of the water monitoring program. A draft report outlining the outcomes of the review thus far and proposed future steps has recently been prepared and circulated to stakeholders (including the NSW Office of Water) for comment and endorsement. This report, along with the process of further Review development, largely satisfies the requirements of the SWIMP. The draft report is currently being restructured in response to feedback on the draft, and the opportunity will be taken to incorporate the suggested format for the SWIMP where appropriate.

The following section identifies those parts of the current draft Water Monitoring Program 2010–2015 that fulfil the requirements for the SWIMP.

Where necessary, reference to other initiatives is included briefly below to supplement the content of the draft report.

## Section A

Chapter 1 of the draft Water Monitoring Program 2010 – 2015 outlines the various drivers for water monitoring and the management questions the SCA seeks to answer using the water monitoring data.

## Section B

Chapters 2 to 8 of the report outline the monitoring program, with each chapter focussing on monitoring at particular 'locations' (or water quality protection barriers) or for particular purposes. Of most relevance to the current scope of the SWIMP are
Chapter 5 – Monitoring of Lakes and Storages,
Chapter 6 – Catchment Monitoring, and
Chapter 7 – Monitoring Downstream of Storages.

Chapter 10 discusses data storage and management.

## Section C

The draft Water Monitoring Program 2010 – 2015 represents the outcomes of the ongoing review of the SCA's water monitoring program, for *routine* monitoring. Chapter 13 of the draft report outlines the scope, process and timing for the further steps of the ongoing review.

The draft report therefore represents the outcome of a critical assessment of the routine water monitoring currently undertaken by the SCA. The report identifies a number of initiatives that have been identified in response to gaps or changes required, including:

- Section 5.4 – recent, current and proposed improvements to on-line monitoring systems in *lakes and storages*
- Section 6.4 – recent, current and proposed improvements to on-line monitoring systems in *catchments*
- Section 8.3 – the current review of the *Cryptosporidium* and *Giardia* monitoring program
- Section 10.1 & 10.2– objectives of a review of the SCA's water monitoring data handling and storage systems, currently being scoped.

## Section D

The outcomes of the ongoing phases of the review of the Water Monitoring Program, in particular those aspects outlined above, will influence the future priorities and direction of future investment in water monitoring capability and systems within the SCA.

Key aspects of the current investment program relevant to water monitoring include:

- expansion of the SCARMS monitoring and modelling system to the Shoalhaven System
- proposals to incorporate algal modelling into existing reservoir models
- the ongoing Hydrometric Renewals program – this rolling program aims to replace aging assets, introduce new technology and standardisation across the system in order to maintain, and where appropriate, increase accuracy and reliability
- review of the SCA's Communications Strategy, including telemetry
- ongoing review of the SCA's SCADA strategy, including moving the telemetry and water monitoring data onto a common platform where appropriate
- ongoing research into best practice for evaporation estimation methods
- ongoing calibration of meters and hydrometric equipment
- replacement of thermistor chains at strategic locations with state of the art systems and technology.

# Appendix 1(e) – State Water Corporation

*Draft Strategic Water Information Management Plan*

## Background

As a stand-alone State-owned Corporation, State Water Corporation (SW) is identified as a water management authority and a major utility. It incorporates, into a single business, all of the NSW bulk water delivery functions outside Sydney Catchment Authority, Sydney Water Corporation and other water supply authorities' areas of operations. SW owns 20 major storages, 280 weirs and delivers water to about 6,200 customers along some 7,000 km of river delivering on average 5,500 GL/year.

SW delivers water to irrigation corporations, country town water supply authorities, farms, mines, and electricity generators by releasing water from its dams and storages into rivers to be accessed by water users. In the process of achieving efficient delivery of this water, it makes use of a network of streamflow gauges owned by the NSW Office of Water and storage recorders and SCADA systems owned by SW.

Under the Operating Licence and *Water Management Act 2000* (NSW) SW has numerous obligations regarding its bulk water delivery business. Some of these responsibilities are river operation including water delivery, short-term forecasting, wetland monitoring, flood forecasting and emergency planning. SW also facilitates the compliance procedures established by regulators such as NSW Office of Water, NWI and MDBA by collecting, collating and analysing water information and providing the necessary information and reports.

## Section A

There are two major types of water information that are required for efficient bulk water delivery, monitoring and reporting, that is, hydrological data and water order and usage data. In NSW, the hydrological data is managed within the corporate Hydstra database shared by NSW Office of Water and SW, and water order and usage data is managed within State Waters Water Accounting System.

Most of the hydrological data is telemetered and is electronically available. However, there are still a number of sites where daily readings are taken manually and are not electronically available. By upgrading the gauging network it will improve the quality of water information, help efficient transfer of data to the Bureau and provide reliable readily available information to stakeholders.

The main SW Drivers in achieving efficient and reliable water delivery would be:

- review accuracy of current monitoring system and enhance it to achieve optimum efficiency. A recommendation of the draft consultant's report is to increase the spatial distribution of the gauging network to increase water delivery efficiency
- rationalisation and automation of data distribution systems
- closing gaps in current monitoring network
- compliance with *Water regulations 2008* and Bureau requirements.

## Section B

Meteorological data in many sites is currently gathered manually. By installing automatic weather stations on main storages under State Water control, the timely delivery of Meteorological data for water delivery purposes would be facilitated. The implementation of this equipment will provide more accurate, timely and effective information for the management of storages enhancing the management of water resources around the state.

Collection of storage level and other relevant storage data is currently made using several methodologies, varying from manual-read gauges to telemetered SCADA data. Upgrading instrumentation on major storages level recorders will enable SW/NSW Office of Water/Bureau to collect more detailed and accurate storage measurements in a timely manner, which will increase accuracy and efficiency, particularly in times of floods and low flow conditions.

The Thiess Survey of Menindee Lakes storages in 2003 revealed that the available water at Wetherell was 60,000 ML less than what NSW Office of Water/SW believed to have been contained in Wetherell at that time. By improving accuracy of existing water storage measurement networks through the development or improvement of storage capacity tables would enhance the efficiency of water delivery.

## Section C

Recent studies undertaken by Rivers Environmental Restoration Program (RERP) and other interest groups have identified gaps in:

- accuracy of current monitoring network
- hydrological data due to sparsely populated gauging networks in some parts of the State – possible accuracy gap
- transmitting information due to non-availability of telemetered gauges in some parts of the network – technology gap
- diversion data. It is recommended improved diversion meters including facilities for flow verification audits be installed, which are considered necessary for the effective management of available water resources in all regulated rivers.

### Data distribution

- Category 5 and 6 data due to non-availability of storage information in electronic format – inventory Gap.
- timely delivery of gauging and metered diversion data
- Menindee data due to manual-read, sparsely populated gauging network
- accuracy of current monitoring network.

## Section D

The future priorities and direction of investment in water monitoring capability within the SW depends on the outcomes of the current investment program proposed by SW.

Key aspects of the current investment program relevant to SWs water delivery and monitoring program include:

- identification of data requirement of the Bureau and automate the systems to transfer data/information to the Bureau
- automation of meteorological monitoring
- upgrade instrumentation of storage and weir level recording equipment
- upgrade the accuracy of storage capacity tables
- software development to automate the transfer of Temporary Transfer figures to the Bureau
- installation of accurate measuring devices monitoring equipment
- identification of isolated manual data management systems and their automation
- automation of data collation and transfer systems to the Bureau
- improvement to forecasting of water demands and river ‘losses’ to improve water delivery efficiency
- better event forecasting for effective environmental releases
- improvement to management of transfer between storages to achieve better environmental outcomes
- providing improved water monitoring networks to meet objectives of NWI.

# Appendix 1(f) – Sydney Water Corporation

*Draft Strategic Water Information Management Plan*

## Section A

### The organisation

Sydney Water supplies drinking water, recycled water, wastewater services and some stormwater services to over four million people in Sydney, the Illawarra and the Blue Mountains. An area of operations covering around 12,700 $km^2$.

### Water

Sydney Water supplies more than 1.4 billion litres of water to more than 1.7 million homes and businesses each day. Water is treated at nine water filtration plants and distributed to customers via a network of 266 service reservoirs, 148 pumping stations and nearly 21,000 kilometres of water mains.

### Wastewater

Sydney Water collects and treats more than 1.2 billion litres of wastewater from homes and businesses each day. The sewerage network includes about 23,700 km of sewer pipes and 669 sewage pumping stations transporting wastewater to 31 sewage treatment plants.

### Recycled water

Sydney Water has many recycling schemes in place that reduce discharges of treated wastewater to the environment and reduce demand on water supplies. These schemes currently produce approximately 25 billion litres a year. This is planned to increase to 70 billion litres a year by 2015.

### Stormwater

Sydney Water maintains 443 kilometres of stormwater drains serving around 25 per cent of metropolitan Sydney and operates 65 Stormwater Quality Improvement Devices (SQIDs), which include devices such as trash racks, litter booms and sediment traps.

### Water information drivers

Timely and accurate water information is essential for operating such a large and complex system. Key drivers for improved water information include regulation, strategic planning and water efficiency. Four examples of these drivers are detailed below.

## Operating licence

The Independent Pricing and Regulatory Tribunal (IPART) is an independent body that oversees regulation in the water, gas, electricity and public transport industries in NSW. IPART oversees the implementation of the Sydney Water Operating Licence. The objective of this licence is to enable and require Sydney Water to lawfully provide services within its area of operations. Consistent with this objective, the licence requires Sydney Water to:

- meet the objectives and other requirements imposed on it in the *Sydney Water Act 1994*
- comply with the quality and performance standards in the licence
- recognise the rights given to customers and consumers
- be subject to operational audits of compliance with the licence.

Within six months from the commencement of each five-year licence, Sydney Water must develop and provide to IPART a monitoring and reporting protocol that includes how Sydney Water will record, compile, monitor, measure and report against the service quality and system performance indicators (Schedule 1), customer service indicators (Schedule 2) and environmental performance indicators (Schedule 3).

Compliance with these requirements requires Sydney Water to maintain sophisticated monitoring and data systems. Regular audits and reviews of these systems by IPART and third parties drive continuous improvement.

## Environment protection licences

The NSW Department of Environment, Climate Change and Water licences Sydney Water's networks that transport wastewater to 31 sewage treatment plants. Treated wastewater is reused or discharged to rivers or the ocean in accordance with strict licence conditions. Inland plants discharging to the rivers treat waste to high levels. These licences include requirements for comprehensive monitoring and data collection that are also linked to licence fees (through load-based licensing) and the prioritisation of future investment through Pollution Reduction Programs.

## Strategic planning

Sydney Water supplies water to 4.3 million people. The NSW Department of Planning projects that the population will increase to 5.3 million by 2031. This growth increases the demand on existing water and wastewater systems and leads to a need for new assets, including new sources of water.

The NSW Governments *Metropolitan Water Plan* outlines the measures that ensure Sydney, the Illawarra and the Blue Mountains have enough water now and in the future. The Plan is adaptive and takes account of emerging information and circumstances. It seeks to make wise investments in water supply and water efficiency programs. The Plan's progress is reviewed every year and is updated every four years based on the latest information, including water information collected and reported by Sydney Water, to ensure the most effective and appropriate solutions are in place.

### Leak management

Sydney Water is investing over $400 m between 2006 and 2009 to reduce leaks. In 2008-09 Sydney Water will inspect 21,000 km of pipes for hidden leaks – that's equivalent to the entire network. Sydney Water will also replace over 100 km of water mains and install 60 water pressure management schemes. It is easily the largest leak reduction program in Australia and has reduced Sydney's total real losses from 188 ML/day in 2002-03 to 117.5 ML/day in 2007-08. Successful implementation of the program requires detailed and accurate water information.

## Section B

Water information is collected and managed in the following critical areas of Sydney Water.

### Hydraulic Systems Services

Hydraulic Systems Services is responsible for the delivery of integrated hydraulic and telemetry operations services of the water and wastewater systems. This includes:

- operation of the System Operations Centre, which monitors and controls 1100 of Sydney Water's water assets ranging from dams, reservoirs, river and rain gauging stations, pumping stations, major valves and water quality and pressure monitoring stations in the water reticulation network
- optimisation of the trunk water and wastewater systems operation to achieve least $/ML cost (including energy management)
- management of monitoring and control systems such as IICATS and SCADA
- administration and utilisation the Hydstra Database.

IICATS is an acronym for Integrated, Instrumentation, Control, Automation and Telemetry System. Sydney Water Corporation (SWC) uses the IICATS as the means of efficiently monitoring and controlling its operating facilities.

SCADA is an acronym for Supervisory Control And Data Acquisition. SCADA is a control system that allows operators at a central site to remotely monitor and control equipment in the plant.

Sydney Water's Hydstra Database is currently being upgraded and will be utilised for the provision of water information to the Bureau.

### Monitoring Services

Monitoring Services role is to deliver approved monitoring programs and to support the delivery of Research and Development projects. It is responsible for sampling, field testing, laboratory analysis, and associated data and information management of Sydney Waters environmental and water monitoring and hydrometric services. It also delivers some external environmental and water monitoring programs, primarily for the Sydney Catchment Authority and local government.

Sydney Water's Monitoring Process Management System (MPMS) is certified to Quality Standard ISO 9001. Analytical and field services are accredited by NATA to ISO 17025 in the fields of biological and chemical testing and sampling. The MPMS is included in Sydney Water's certification under ISO 14001 for its Environmental Management System.

### Business Intelligence

Business Intelligence (BI) encompasses a broad range of applications, technologies, and processes that support the analysis and interpretation of information in order to understand and manage the business better. By integrating the data from a variety of Sydney Water's operational applications into one central repository (the Enterprise Data Warehouse), Sydney Water is able to gain better awareness of its assets and business processes. From this awareness comes the ability to incorporate changes that will improve efficiency while minimising risks. BI provides:

- a single **centralised, and trusted source of quality business information** thus eliminating the need for individual, unsupported applications that have limited availability and usability
- an **integrated view of the business** so that analysis can be done across functional areas of information
- **self-service from the desktop** so that individuals throughout the business can conduct their own analysis and reporting rather than having a heavy reliance on people in other business units
- **more timely information** as the data will be current as of close-of-business on the previous day.

To date there are four BI projects that have been completed. These projects have seen the following information captured in the Enterprise Data Warehouse (EDW):

- IICATS (**telemetry information** from IICATS including events, alarms, flow rates, water pressure levels)
- Monitoring (**biological, chemical and other sampling and testing information** from LIMS and other monitoring applications)
- EKAMS (**effluent sampling and testing information**)
- Finance (**financial information** from FMIS & AURION)
- The Enterprise Data Warehouse will be utilised for the provision of water information to the Bureau.

## Section C

The benefits to Sydney Water through improved water information include:

- prioritisation of capital expenditure
- optimisation of operating costs
- energy savings

- improved maintenance programs through the availability of better operational information
- better response to emergencies
- improved strategic planning
- reliable reporting mechanisms for regulatory and Operating Licence reporting.

While Sydney Water implements a process of continuous improvement in the gathering and management of water information, there is a need to:

- ensure data management systems and software are up-to-date
- improve processes for the transfer of data to the Bureau
- explore opportunities for the use of web services for data provision
- improve the quality of metadata, including geo-location of monitoring sites and standardisation of definitions and descriptions
- expand the use of quality assurance procedures across all categories of information
- pilot improved field procedures, especially metadata and real-time data transfer.

## Section D

Priorities and strategies for improving Sydney Water's water information include:

- completion of data extraction and transfer routines to export information from Customer BI within the Enterprise Data Warehouse for reporting categories 7h through 7l
- allocation of IT personnel to improve data integrity and work with the Bureau on queries relating to data errors or data quality
- develop and implement a data management application to manage data transfers between Sydney Water and the Bureau, allowing the tracking of all files sent and allow business users to report on success and failures and manage re-sends and errors
- review existing quality procedures and implement a quality management framework
- evaluate historic water quality data to investigate opportunities to import pre-2008 data for reporting category 9.

# Appendix 1(g) – Hunter Water Corporation

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

### The organisation

Hunter Water Corporation (HWC) is a State-owned Corporation providing water and wastewater services for over half a million people in the lower Hunter region. There are 220,600 properties connected to the water network and 208,660 to the wastewater network.

The HWC area of operation covers 5366 $km^2$ with a population of 517,273 in the local government areas of Cessnock, Lake Macquarie, Maitland, Newcastle, Port Stephens, Dungog and small parts of Singleton.

Bulk water is supplied to small parts of the Great Lakes area and there is capacity to supply up to 35 megalitres (ML) of water per day to the Central Coast. HWC also provides some stormwater services to the lower Hunter, with 100 km of stormwater channels in Cessnock, Newcastle and Lake Macquarie.

HWC delivers an average 205 ML (one ML equals one million litres) of water per day. Its raw water sources are: Grahamstown Dam (190,000 ML capacity), Chichester Dam (21,500 ML), Tomago Sandbeds (60,000 ML) and Anna Bay Sandbeds (16,000 ML).

HWC collects, treats and then delivers drinking water to its customers and then transports, treats and disposes of the region's wastewater.

Wastewater is collected and treated to a very high standard and clear effluent is discharged to waterways or reused where it is economically and environmentally beneficial.

### Water information drivers

Timely and accurate water information is essential for operating an urban water supply network. Key drivers for improved water information include regulation, strategic planning and water efficiency. Five examples of these drivers are detailed below.

### Strategic planning

HWC supplies water to over 520,000 people. The NSW Department of Planning projects that the population will increase to 680,000 by 2031. This growth increases the demand on existing water and wastewater systems and leads to a need for new assets, including new sources of water.

Planning for this growth is outlined in the H250 Plan, which describes the range of demand and supply side actions that will be implemented over time to ensure an adequate supply of water to the people of the Lower Hunter. Long time series of rainfall data, streamflow data, evaporation data and historic demand and storage behaviour are required to accurately understand and thus predict future behaviour of HWC

catchments, dams and customers. The development of accurate mathematical models to simulate these systems, which depend heavily on quality water information being available, has never been more important than it is now, with the emerging challenges associated with climate change and climate variability.

### Energy management

Quality water information is an essential ingredient when planning for and operating systems to minimise energy usage. Energy usage is a major consideration when planning for pumped water supply systems, when designing treatment processes for both potable water supply and waste water disposal and when considering new water source options such as desalination and recycling.

### Operating Licence

The Independent Pricing and Regulatory Tribunal (IPART) is an independent body that oversees regulation in the water, gas, electricity and public transport industries in NSW. IPART oversees the implementation of the Hunter Water Operating Licence.
The objective of this licence is to enable and require HWC to lawfully provide services within its area of operations. Consistent with this objective, the licence requires HWC to:

- comply with the quality and performance standards in the licence
- recognise the rights given to customers and consumers
- be subject to operational audits of compliance with the licence.

Compliance with these requirements requires HWC to maintain complex monitoring and data systems. Regular audits and reviews of these systems by IPART and third parties drives continuous improvement.

### Environment protection licences

The NSW Department of Environment, Climate Change and Water licenses HWCs networks that transport wastewater to 18 waste water treatment plants. Treated wastewater is reused or discharged to rivers or the ocean in accordance with strict licence conditions. Inland plants discharging to the rivers treat waste to high levels. These licences include requirements for comprehensive monitoring and data collection that are also linked to licence fees (through load based licensing) and the prioritisation of future investment through Pollution Reduction Programs.

### Water management licence

The NSW Office of Water licenses HWC to extract groundwater and surface water for urban water supply. There are extensive data collection and reporting requirements listed in the HWC Water Management Licence, including the monitoring of extraction rates, the monitoring of groundwater levels, and the monitoring of reservoir behaviour. The WML also includes a range of operating requirements, such as environmental water releases from dams and weirs, and constraints on the extraction of water at various locations, that necessitate the collection of water information for both operational and compliance reasons.

## Section B

The current water information systems in place at HWC are described in the following paragraphs. A full listing of HWC sites will be provided separately in excel format.

### SCADA system

HWC uses the Serck Controls Ltd SCX SCADA system to monitor and operate its network of reservoirs, pumping stations, pipelines, water treatment plants, waste water treatment plants and other telemetered systems. This system acquires and stores operational data from an extensive telemetry network. While the SCADA system does store historic operational data, it is not generally used to store long-term historic data. In terms of water data, the primary focus of the SCADA system is to accurately collect and store data, which is then transferred to another database for secure storage. Water data collected by the SCADA system includes rainfall data, flow rates in pumps, pipes and rivers, water levels in dams, rivers and reticulation reservoirs, and appliance operations (e.g. weir gate operations, pump run times, etc). The SCADA system also includes basic reporting of integrated 24 hour flows at a number of points.

### Hydstra system

The HWC Hydstra V10.1 system is used to store data from the SCADA system at raw resolution. It is also used to store river flow data collected by NSW Office of Water. The Hydstra system includes a range of data manipulation tools that allow easier access for data users than can be provided by direct access to the SCADA system.

### EDRS system

EDRS stands for Engineering Data Reporting System and is the HWC strategic water information database. The EDRS system went live mid 2010 and replaced the previous ENINQ system. EDRS is the primary database of key daily water resource and water supply data. EDRS stores a combination of manual monitoring and automatic monitoring. SCADA is linked to EDRS to allow transfer of data from automated monitoring sites. EDRS includes a WDTF module to facilitate the transfer of data from HWC to the Bureau in line with the Water Information regulations. Development of EDRS and the WDTF module received funding assistance from Modernisation and Extension Funding program.

### Telemetry system

HWC uses a radio telemetry system to transfer data from monitoring equipment in the field into the SCADA system.

### Monitoring network

#### Surface water data

HWC relies on the services of the NSW Office of Water to provide flow monitoring and streamflow gauging services at a number of key locations on the Williams River,

Chichester River and Wangat River. High quality river flow data exists from 1930s onwards at the key sites. HWC records continuous water level data at Chichester Dam, Grahamstown Dam and Seaham Weir, and discharge data from Chichester Dam. HWC calculates inflow to Chichester Dam by back calculation. HWC records water extraction from the Williams River at Balickera WPS.

### Groundwater data

HWC collects groundwater level data from an extensive network of piezometers throughout the Tomago, Anna Bay and Stockton sandbed systems. The groundwater data is collected manually at a variety of timescales. Most of the data is collected quarterly or monthly, with a small number of sites monitored weekly or daily.

### Climate data

HWC also owns and operates an extensive network of tipping bucket rain gauges that supply data via the telemetry network into the SCADA system. HWC also relies heavily on the Bureau network for high quality meteorological data for the purpose of water resource planning. Some of the weather stations in the Bureau network are operated by HWC.

### Potable water consumption

HWC operates telemetered flow meters an all water treatment plants that record water supply into the water reticulation networks. In addition, HWC monitors water storage in all reticulation reservoirs and thus determines, by calculation, the daily water usage from the water reticulation network. HWC uses a combination of magnetic flow meters and ultrasonic transit time flow meters to monitor the flows being produced by the various water treatment plants.

### Recycled water supply

The volume of recycled water supplied is metered at a small number of locations. At most locations, however, recycled water supply is generally estimated from pump run times and nominal pump capacities.

### Waste water discharge

Waste water flows are metered either entering or leaving waste water treatment plants.

### Customer metering

All HWC potable water customers are metered. Domestic water meters and smaller non-domestic water meters are read 3 times per year. The meters for larger customers are read monthly. There are a small number of customers with telemetered water use meters that supply continuous data real-time. The customer types (e.g. residential, commercial, etc) are recorded for each customer in the billing system.

#### Urban water use breakdown

Water use for individual customers is calculated for a particular period using a pro rata distribution of customer metering information. Urban water usage is broken down into consumption categories by aggregating customer consumption based on the customer type. Unmetered consumption is the difference between the total supply from the sources (as calculated in EDRS) and all metered customer consumption.

## Section C

Section C contains a critical assessment of each of the system components identified in Section B.

### SCADA system

The HWC SCADA system provides a fit for purpose data acquisition and storage system. It is a relatively modern SCADA system and offers a wide range of flexibility with respect to input and output of data. The SCADA system will supply water information directly to the new EDRS system.

### Hydstra system

The HWC Hydstra system provides an effective data management tool for a range of in-house purposes.

### EDRS system

As of October 2010, the EDRS system is operational and the WDTF export is functioning. There are, however, a number of teething problems with the new system and HWC and its contractors are continuing to address the outstanding issues. HWC is also planning further upgrades to the system that will address a number of data gaps in the system to date including population of water quality information within the system.

### Telemetry system

The HWC radio telemetry network is actively maintained to ensure adequate transfer of data from field sites to the SCADA system.

### Monitoring network

#### Surface water data

The HWC network of surface water monitoring, in conjunction with the NSW Office of Water network, provides adequate data for the water resource planning activities undertaken by HWC. The data collected is adequate in terms of both spatial coverage and accuracy. However, HWCs former plans for the construction of a new dam at Tillegra on the Williams River, would have required the expansion of relevant aspects of the surface water monitoring network. These requirements were included in design considerations for the abandoned dam project.

### Groundwater data

The HWC groundwater monitoring network is characterised by excellent spatial coverage and poor temporal resolution. It is a large network with data available for most sites since the mid 1970s. The HWC groundwater data network has proven to be adequate for past hydrogeological modelling exercises, and provides adequate data to monitor aquifer performance though time.

### Climate data

The HWC rain gauge network provides reasonable quality data for over a large area of operations. Operation and maintenance of the HWC rain gauge network could be improved. HWC is investigating options to improve the quality of rainfall data collected by its network.

### Potable water consumption

The flow meters used by HWC are fit for purpose.

### Recycled water supply

HWC measurement of recycled water supply is less accurate than the methods used to measure flows in other parts of the business. There is considerable scope to improve the accuracy of recycled water supply measurement through the installation of flow metering.

### Waste water discharge

HWC measurement of waste water discharges is considered to be fit for purpose.

### Customer metering

HWC metering of customer water use is considered to be fit for purpose.

### Urban water use breakdown

The methods currently used by HWC to reconcile overall water supply with customer water use records from the billing database involve considerable manual data manipulation. This process could be streamlined to improve ease and minimise the risk of errors by improvements to HWC data handling methods. HWC is in the process of developing business intelligence (BI) tools for this purpose.

Another deficiency in the process is that the breakdown of urban water used into various consumption categories, including the assessment of unaccounted for water, cannot be calculated explicitly over short time intervals due to the length of time between customer water meter readings. The calculation is considered to be reasonably accurate over longer time-frames, and is considered to be as good as is practically possible for the current technology of customer water metering.

## Section D

Priorities and strategies for improving HWC's water information include:

- develop and implement a data management application to manage data transfers between HWC and the Bureau
- develop BI tools to assist HWC extraction of customer billing data for the purpose of calculating urban water use breakdown into categories 7h through 7k
- install telemetered meters on recycled water supply systems that aren't currently metered and/or telemetered
- develop improved linkage between the HWC SCADA and Hydstra systems.

# Appendix 1(h) – Bega Valley Shire Council

*Draft Strategic Water Information Management Plan*

## Section A

Bega Valley Shire Council is listed as Category D (owners or operators of major storages) and Category F (urban water utility) under the *Water Regulations 2008*. Therefore, it is responsible for providing the Bureau of Meteorology with the following types of hydrologic monitoring data:

- surface water resource information
- groundwater resource information
- information on major and minor water storages
- meteorological information
- information about urban water management
- information about water restrictions
- water quality information
- descriptive and reference information about water information in the other categories.

The main monitoring requirements for Bega Valley Shire Council include:

- water supply and sewerage system operations, control and analysis
- water supply and sewerage system licences
- water supply and sewerage system performance reporting to the NSW State Government
- water quality for the NSW Drinking Water Quality Program
- water quality for receiving environments associated with effluent re-use and disposal schemes.

## Section B

Our current data management system comprises manual data collection (e.g. water levels, grab samples) and input into spreadsheet files for storage and analysis. Radio telemetry and SCADA is also used for operational control and monitoring.

## Section C

Bega Valley Shire Council's existing data management systems for hydrologic monitoring data require improvements to enable more efficient and timely data capture. Integration of monitoring systems would improve the timeliness of hydrologic data for analysis and/or transfer to the Bureau of Meteorology. The efficiency and reliability of

Council's data management system would also be improved by direct import of water quality monitoring data from the laboratory.

## Section D

The first priority of Bega Valley Shire Council is to identify which commercially available data management system (or combination of) is most suited to Council's monitoring, data management and reporting requirements. The selection of a data management system that best suits Council's requirements will ensure funds are allocated effectively when purchasing such a system. It will also maximise the efficiency and reliability of data management and data transfer to organisations such as the Bureau of Meteorology.

# Appendix 1(i) – Wyong Shire Council

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

The Central Coast is one of the fastest growing areas in Australia. Being north of Sydney and part of the Greater Sydney Metropolitan Area, the region is heavily influenced by population growth in Sydney. The Central Coast is close enough to the city to make it possible to commute for work. It is also popular to those looking for a change in lifestyle and for retirees wanting to move out of the city. Population growth of the Central Coast during 1991-2001 was 2.1 per cent per annum, nearly double that of Sydney and NSW as a whole.

Water supply on the Central Coast is provided by Gosford City Council and Wyong Shire Council. Both Councils are designated as water supply authorities under the *Water Management Act 2000*. The water supply system is a joint system within both local government areas and is managed by a strategic advice from the joint committee of the two Councils called the Gosford-Wyong Councils Water Authority (GWCWA) formed in April 1977.

The water supply system currently in operation is the result of long-term planning for the future water supplies for the Central Coast as a whole, which dates back to 1975. The Gosford and Wyong Councils, in conjunction with the NSW Government developed the Joint Water Supply Scheme, which was reviewed in 1985, and forms the basis of the system currently in operation.

The Joint Water Supply Scheme depends on four coastal streams, three dams and three weirs. These comprise of:

- Mangrove Creek Dam and Mangrove Creek Weir on Mangrove Creek
- Mooney Mooney Dam on Mooney Mooney Creek
- Wyong River Weir on Wyong River that supplies water into Mardi Dam (an off-stream storage)
- Ourimbah Creek Weir on Ourimbah Creek that also supplies water into Mardi Dam.

Water from the Mangrove Creek catchment downstream of the dam and water released from Mangrove Creek Dam is captured at Mangrove Weir. Water captured at the weir and water from Mooney Mooney Dam is pumped to the Somersby Water Filtration Plant for treatment. Water captured from Wyong River Weir and Ourimbah Creek Weir is pumped into Mardi Dam for storage and then released into the Mardi Filtration Plant for Treatment. Water from Mangrove Creek Dam can also be released into the Wyong River from a tunnel linking the two systems called the Boomerang to Bunning Creek Tunnel to supplement low flows in the Wyong River. Treated water from the Somersby and Mardi Water Treatment Plants is then fed into the water reticulation systems for delivery to customers.

The water supply system is designed around capturing the streamflow from the rivers and creeks, with the dams providing backup storage during periods of low streamflow.

Streamflow records show that the average annual flow in these streams is about 180,000 ML per year, well in excess of the water supply requirements for the Central Coast community. For the most part, all of the water requirements can be drawn directly from the streams. There are periods when streamflows are too low. When this occurs, water is released from Mangrove Creek Dam to Mangrove Creek Weir or to the Wyong River Weir via the Boomerang to Bunning Creek Tunnel.

Table below shows the capacities and catchment sizes for each of the elements forming the Gosford-Wyong Joint Water Supply Scheme.

**Table 25: Capacities and catchment sizes for each of the elements forming the Gosford-Wyong Joint Water Supply Scheme**

| | Catchment Area $km^2$ | Dam Storage Capacity ML | Average Percentage Contribution to Water Supply (1993 to 2003) | Average Historical Streamflow 1885-2004 (Simulated using historical rainfall) ML/y |
|---|---|---|---|---|
| Wyong River Weir | 355 | NA | 31.3% | 86,100 |
| Ourimbah Creek Weir | 88 | NA | 11.1% | 26,700 |
| Mardi Dam (receives pumped water from Wyong R and Ourimbah Ck) | NA | 7,400 | NA | NA |
| Mooney Mooney Dam | 39 | 4600 | 14.9% | 17,200 |
| Mangrove Creek Dam | 101 | 190,000 | 30.8% | 18,400 |
| Mangrove Creek Weir | 140 | NA | 11.9% | 30,500 |
| **Total** | **723** | **210,000** | **100.0%** | **179,500** |

## Section B

The Gosford City Council and Wyong Shire Council, which manage the Central Coast water supply system, have adopted Water Plan 2050. The Water Plan 2050 is the result of extensive technical studies and exhaustive community involvement. It sets out the strategy to secure and sustain our water supply systems over the next 45 years. Linking of Mardi and Mangrove Creek Dams by 21 km pipeline is the highest priority project under this plan for which designs are being finalised. This pipeline would enable water harvested from Ourimbah Creek and Wyong River during high flows to be temporarily stored in Mardi Dam before transfer through to Mangrove Creek Dam. This project is planned to be commissioned in the year 2011. This project would entail the establishment of a high precision stream gauge at the site of weir on Wyong River for monitoring the extracted flows and those allowed to flow downstream of the weir as environmental flow (as per the Environmental Sharing Plan being finalised with NSW Office of Water).

GWCWA (Gosford Wyong Councils Water Authority) is working on the idea of integrating the water information (hydrological and other water data) from both councils

to ensure the data collection process is automated, accurate, and current and also has sufficient coverage. For this purpose, three new automatic rain gauge stations are proposed. It is also proposed to build in-house capability for calibration of flow valves particularly which monitor the flow extraction from rivers/ creek and transfer between both councils. There is only one weather station on the Central Coast, not fully connected to the council's telemetry system. It is proposed to improve the telemetry link for this weather station to provide current information to the Bureau. Two more automatic weather stations are proposed, one each at Mooney Mooney and Mardi Dam. This would improve the meteorological coverage of the area.

Any flow released from Mangrove Creek Dam down into the creek has to traverse about 20 km before it reaches the Mangrove Creek Weir. It is proposed to set up a stream gauge station some where near Dubbo Gully on the Mangrove Creek.

## Section C

**Table 26. Data gaps and improvement opportunities**

| Sr. no | Gap/potential improvements | Comments |
|---|---|---|
| **1** | Improvement and development of processes for collection, storage of data from both Gosford and Wyong Councils at central location and providing water information to the Bureau | Water data management improvement |
| **2** | Establishing Telemetric Stream Gauge on Wyong River to monitor the site for environmental and water accounting purposes:<br>· design and selection of equipment<br>· purchase of equipment<br>· installation of equipment<br>· commissioning. | It will improve the control over extraction of water from the river, particularly in the light of Environmental Water Flows. |
| **3** | · telemetric link for Mangrove Creek Dam (MCD)<br>· weather station data<br>· dam level. | This data is not received through telemetry at the moment but it will be useful to link this to telemetry. |
| **4** | Installing stream gauge to monitor releases from Mangrove Creek Dam to Weir and connecting to telemetry. | This will improve the data for environmental flow monitoring. |
| **5** | Improving Rainfall Gauge network by installing rain gauges at three sites: Bucketty (MCD catchment), Kooree (Mangrove Creek Catchment) and Hay (Wyong River Catchment). | The rainfall gauges scoping study done by Manly Hydraulic Laboratory has recommended installation of these gauges to improve the coverage of rainfall data for GWCWA catchments. |
| **6** | Establishing weather stations at Mardi and Mooney Mooney Dams. | To improve weather information at the dam sites. |

## Section D

### Priorities

- improving Wyong river flow measurement for monitoring of environmental flows
- improving data management system by integrating the input from both councils
- improving meteorological information dataset by installing weather station and improving communication for the existing weather station
- improving rainfall gauge coverage for Wyong River and Mangrove Dam catchments.

# Appendix 1(j) – Shoalhaven City Council

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

Water information required by Shoalhaven City Council includes real-time flood information such as rainfall data and stream level information. This data enables Council to monitor flood events and provide early warning to residents via the SES. The Council's flood ALERT system also serves as a backup system to the Bureau Enviromon System for the Shoalhaven Area and provides the SES with flood intelligence as required.

Shoalhaven Water also collects water source data as required under section 7(a) via telemetry and this information is provided to Bureau via an FTP site.

Shoalhaven City Council's Environmental Services Section collects water quality data from regular tests undertaken in rivers, estuaries and coastal lakes.

Key stakeholders and clients of the data collected by Shoalhaven City Council are (please note this list is an indication only):

- Shoalhaven City Council
- Bureau of Meteorology
- State Emergency Services
- Local Emergency Management Committee
- Government agencies, e.g. RTA, DECCW
- landholders of property in flood prone areas
- consultants
- general public interest

Key drivers for wanting to improve the system are:

- better network coverage is required as the Shoalhaven has a large number of flood-prone catchments. Many areas are prone to flash flooding and real-time data is vital in providing information to the SES
- any gauges are being placed in catchments where no historical data exists and the collected new data can feed into flood studies that are about to be undertaken
- increased interest in real-time data by Emergency Services as well as the media

## Section B

Shoalhaven City Council runs the following data collection systems:

- Enviromon – collation of ALERT radio telemetry data (the system currently includes 30 rainfall gauges and 21 water level gauges – the distribution of gauges can be viewed on the Bureau website)
- FTP – inter-agency data transfer for water source data from SCC to tlhe Bureau
- Access database – water quality data recording.

## Section C

### Data issues and opportunities

- There is a need to continuously expand Council's network of rainfall and stream gauges in order to enable real-time flood data collection in catchments that currently have no historical records. This information is vital for future flood studies as well as the calibration of existing flood models.
- Estuary and coastal lakes entrance management is an increasingly contentious issue in many of the city's catchments. Water level and rainfall data to inform entrance management strategies are vital.
- Automation of data transfer is a high priority in order to streamline data sharing procedures with the Bureau.
- Maintenance of hardware in the field to collect data is also an ongoing issue for Council as it puts pressure on budgets and staff resources to enable the required maintenance to be undertaken.
- As stated above, data gaps exist as there are a large number of catchments within the Shoalhaven Council area. Council runs a long-term flood program and investigations are progressively undertaken in order to identify data gaps and the corresponding priorities to fill those gaps.

## Section D

### Priorities

- filling of data gaps – funding for additional rain and stream gauges
- keeping the system up-to-date – funding for maintenance and upgrades of existing gauges
- training of staff and local SES volunteers in the use of Enviromon
- upgrading data transfer capabilities for water source data

# Appendix 1(k) – Murrumbidgee Irrigation

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

### Murrumbidgee Irrigation Area

The Murrumbidgee Irrigation Area (MIA) is one of Australia's premier agricultural regions located in southern central NSW covering an area of approximately 660,000 hectares of intensive irrigation with around 3,350 farms. It consists of the irrigation areas of Yanco around Leeton, and Mirrool around Griffith, and the irrigation districts of Benerembah, Tabbita and Wah Wah. A map of the MIA is shown in Figure 12. The MIA falls within the Murrumbidgee catchment and forms part of the Murray-Darling Basin.

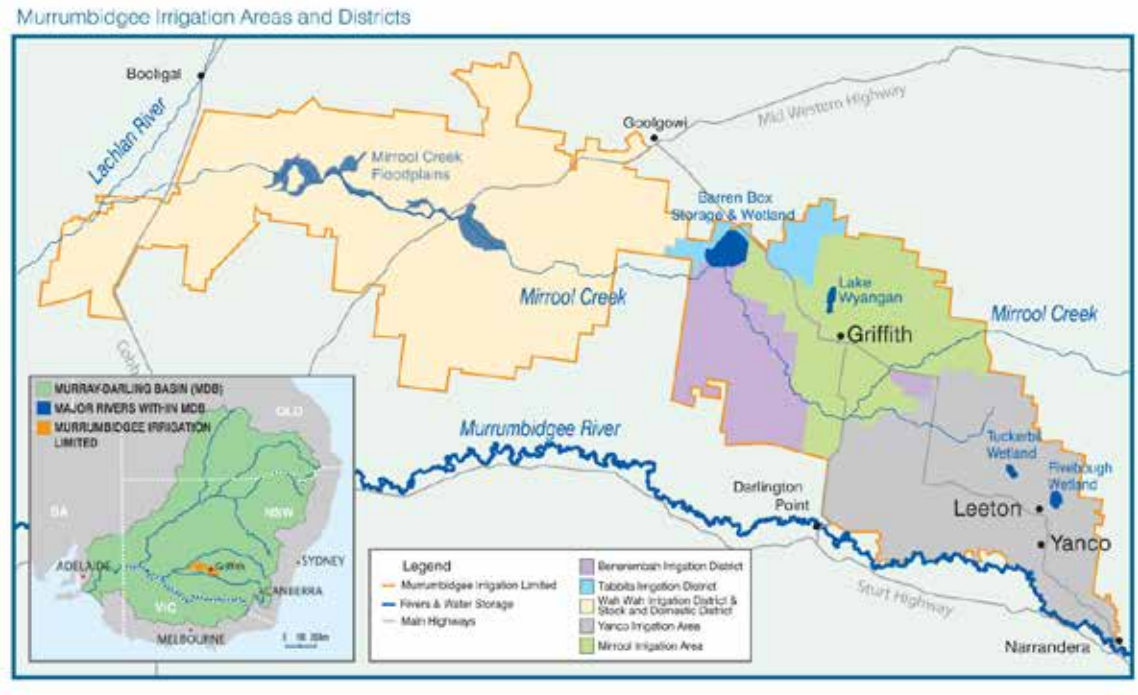


**Figure 12: Map of the Murrumbidgee Irrigation Area** *(Source: Murrumbidgee Irrigation)*

The MIA includes the city of Griffith (population 25,000), the town of Leeton (population 12,000) and many smaller regional centres. Water for the MIA is sourced from the Murrumbidgee River through the main canal east of Narrandera and the Sturt Canal at Gogeldrie near Leeton. The water is distributed predominately in open supply channels to customers in the MIA and in several small irrigation districts downstream to Barren Box Storage and Wetland as well as to local government.

## Murrumbidgee Irrigation (MI)

Murrumbidgee Irrigation is a not-for-profit, customer-owned irrigation corporation (unlisted public company) responsible for providing irrigation water to around 1800 shareholder/customers in the MIA. It is also responsible for water pricing, the development and maintenance of infrastructure, and pollution control. Murrumbidgee Irrigation is a committed partner with the community to ensure the sustainability of the region.

Murrumbidgee Irrigation operates under the legal and regulatory framework established by the *Water Management Act 2000 (NSW)* (the Act), the Water Sharing Plan for the Murrumbidgee Regulated River Source 2003 made under section 50 of the Act, and the *Protection of the Environment Operations Act 1997 (NSW)*. Other key legislation that applies includes the *Water Act 2007* (Cwlth) that will enable water resources in the Murray-Darling Basin to be managed in the national interest, optimising environmental, economic and social outcomes.

Murrumbidgee Irrigation has a number of licences and approvals for water supply works, drainage works, flood control works, and to divert water from the Murrumbidgee River for distribution to customers as follows:

- Water Use and Water Supply Works approvals issued by the NSW Office of Water under the *Water Management Act 2000* – to ensure that any impact on the environment and other water users is minimised
- Environment Protection Licence issued by the NSW Department of Environment, Climate Change and Water under the *Protection of the Environment Operations Act 1997* – sets prescribed environmental standards.

## Water information drivers

Accurate and timely water information is critically important for the efficient operation of any irrigation area. In the MIA, we collect water information for a number of reasons, which have been explained in more detail below.

### Efficient operation of the area

Water information is being collected at numerous places within the MIA to ensure that water delivery to our customers is timely and efficient. It also helps us identify priority areas for infrastructure upgrade, including channel lining and replacement of open channels with pressurised pipes.

### Licence compliance

As mentioned above, MI has a number of licences with State Government departments. Parts of these licences require MI to collect specific information such as water quality at certain key points in our system, collected at key times throughout the season. Some of this information is used to ensure that our drainage water quality is within EPA guidelines. Other information is about the amount of water we drain out of our area of operation.

### Billing

As part of a recent pricing review, changes have been made to the allocation of costs between fixed and variable charges associated with our water products. The water information we have collected over time helps us better understand where our costs are, particularly in the recent drought years.

## Section B

MI has an extensive flow metering and monitoring network throughout the Murrumbidgee Irrigation Area (MIA). This includes Dethridge wheels or Doppler meters or other electronic metering devices at most irrigation outlets (approx 3000), irrigation escape flows and flows through regulators and off-takes within our supply system are monitored at approximately 220 sites, while AFFRA meters at our two River Off-takes measure the amount of water that enters the MIA. In addition, we have flow gauging stations at various critical points within as drainage system as well as at the five discharge points (four river drains and one floodway) from which water can leave the MIA. Further to that we have a network of seven weather stations within our area.

The information collected is stored and analyses in various systems, including:

- Rubicon's Irrigation Management System (IMS)
- SCADA
- US Utility Services website.

## Section C

MI is currently implementing a new enterprise-wide Information Management System. This system will greatly enhanced integration of the various data management systems currently in place. The following opportunities have also been identified that will improve water information data through the new platforms:

- upgrade of flow gauging stations at river drain sites to allow more accurate water balance calculations (now in place)
- upgrade of the radio link between the main river off-take and our office to increase the accuracy and reliability of data (now in place)
- installation of a SCADA historian to allow analysis of past flow records (recently completed)
- improvement of metadata, particularly the geo-location of flow monitoring sites.

MI is committed to continuously improving its data and metering capabilities. As such we have commenced the replacement of all Dethridge wheels with Doppler meters and also replaced our River Off-take flow meters with AFFRA units. MI, in association with Thiess Services, uses a 'Rivercat' for the efficient and accurate calibration of our River Off-take sites.

## Section D

From a water Information point of view, MI's vision is that:

- water information will be available to Irrigation and Customers Services staff on a near real-time basis, using the Internet and SCADA to ensure our system is run at the highest level of efficiency.
- we operate beyond licence compliance by implementing a risk-based water quality monitoring program, which includes risk mitigation strategies such as the capacity to prevent discharge of contaminated water to the river
- we are able to provide important water information, including historic data, to the Bureau
- we are able to participate in the process of developing the Pilot National Water Account. Since the Murrumbidgee Catchment is one of the pilot areas, it is important that the irrigation provider responsible for the majority of irrigation water delivery in that catchment is involved in ensuring that the National Water Account becomes a useful exercise.

# Appendix 1(l) – Cabonne Shire Council

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

Apart from information required by Council for its own water supply purposes, Council is required to provide information to the following organisations:

- Bureau of Meteorology – daily water level and storage volume at both dams for the purpose of national water information collection
- NSW Office of Water (Dubbo Office) – information relating to water restrictions, dam water levels, quality of treated water and rainfall on a four weekly basis for the purpose of monitoring regional water supply status and performance
- Dam Safety Committee (Sydney Office) – quarterly report detailing weekly observations of dam water levels, rainfall, seepage flows in gallery drains and piezometer readings for the purpose of monitoring dam safety.

## Section B

At Molong Creek Dam, Council has in place the following information collection technologies:

- ultrasonic and pressure-based water level detection
- telemetry system linked to master station at Molong
- rainfall – manual reading only on weekly basis
- seepage flows measured manually on a weekly basis
- piezometer readings read manually on twice weekly basis.

At Borenore Creek Dam, Council has in place the following information collection technologies:

- ultrasonic and pressure-based water level detection
- telemetry system linked to master station at Molong
- rainfall – manual reading only on weekly basis.

## Section C

Data transferred by telemetry to the Molong master station can be read on an instantaneous or historical basis only. The system allows for alarms to be raised under certain circumstances. The data is now used for conversion to other data and is transferred to the Bureau automatically.

Improvement is needed in the following areas:

- a remote monitoring system should be installed at Molong Creek Dam for the purpose of providing dam safety information (seepage flows and piezometer readings) on at least a three times a week basis as required by the NSW Dam Safety Committee and the NSW Office of Water
- telemetry monitored rainfall recording systems providing real-time rainfall readings at Molong Creek and Borenore Creek Dams are needed for closer monitoring of that parameter, particularly for flood warning purposes
- a seismic monitoring station is to be established in the vicinity of the two dams in order to closely monitor seismic events in the region. This is a requirement of the NSW Dams Safety Committee and the NSW Office of Water.

## Section D

The following projects are Council's remaining goals in order of priority:

- Molong Creek Dam – remote monitoring of seepage flows and piezometer readings including the installation of a pluviometer
- establishment of a seismic monitoring station in the vicinity of the two dams

# Appendix 1(m) – Port Macquarie Hastings Council

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

Port Macquarie-Hastings Council is a Local Water Utility supplying reticulated water to and collecting sewage from approximately 28,000 properties within the Hastings area on the mid-north coast of NSW.

Council requires raw water information such as river flow, water quality, water extraction volumes to manage the water supply system within its water licence conditions while ensuring that water supplied to customers will meet Australian Drinking Water Quality Guidelines. Council monitors rainfall at 29 sites to assist it manage the sewerage systems during wet weather events. Council provides rainfall and river level information to the Bureau via their EnviroMon System.

Key stakeholders and clients of this data include:

- Council
- NSW Office of Water
- National Water Commission, National Performance Reporting
- Bureau of Meteorology, Flood Warning Services

## Section B

### Data collection systems:

- Council's Water Supply Old System SCADA – ELPRO SCADA 2000 (over 100 sites) – soon to be decommissioned
- Council's New Water Supply System SCADA – ELPRO SCADA C (over 100 sites) and new Historical Database built in 2009/10 using M&E funding
- Council's Sewerage System SCADA – AZEDA WIZCON (approx 250 sites).
- EnviroMon – collects rainfall (19) and water level (6) information at 19 sites across the Hastings.
- Council already had two comprehensive monitoring and control systems which monitor and store almost all of s required water data. The Round Three M&E funding allowed the development of a new historical database and the WDTF software to enable retrieval and transfer of water data.

## Section C

### Data issues and opportunities

Data issues have been solved due to the Bureau grant funding and all required water data is now being transferred to the Bureau using WDTF protocols. Council officers

and now need to learn more about the new historical database to utilise it to its full potential.

## Section D

As far as Port Macquarie Hastings Council is aware all actions have been completed. Council has completed the SCADA upgrade & software development commitment and is now transferring all required water data using WDTF protocols.

# Appendix 1(n) – Murray Catchment Management Authority

The Murray Catchment Management Authority was established in 2004 under the Catchment Management Authorities Act 2003 (CMA Act). It is a statutory body that coordinates natural resource management in the NSW Murray Catchment and ensures that regional communities have a significant say in how natural resources are managed.

The NSW Murray Catchment, bounded by the Murray River to the south and the Murrumbidgee River catchment divide to the north, spans an area of 35,170 square kilometres.

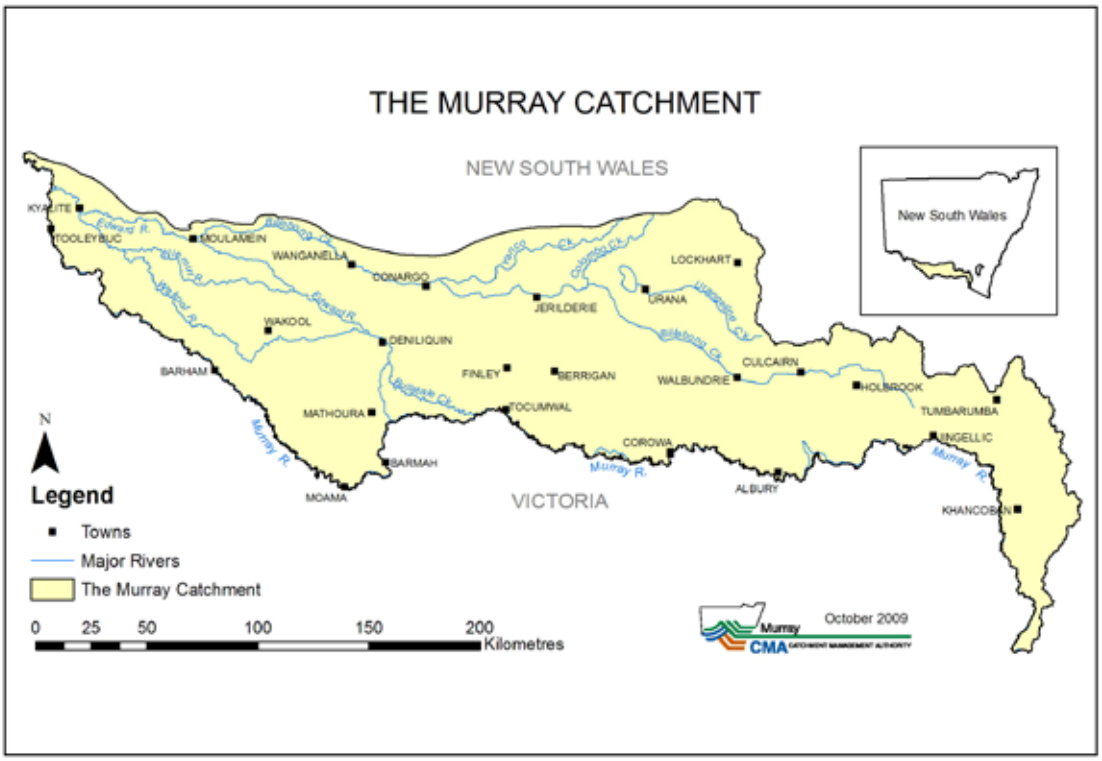


**Figure 13: The Murray CMA Area of Operations**

## Section A

### Jurisdictional information

The Murray CMA is listed as a Category G person under the *Water Act 2007* (Cwlth) regulations and is required to provide information on surface water, groundwater resource, meteorological, water quality and reference information as listed in Tab A. The Murray CMA does not collect data in many of these areas and relies significantly on Category A and Category B persons (namely the NSW Office of Water, NSW Department of Environment, Climate Change and Water and the Murray Darling Basin Authority) for data to inform management activities. While traditionally the Murray CMA

activities have focussed on riparian restoration, the CMA is now contributing to and collaborating with peers on broader water management issues including water sharing, environmental water management, instream aquatic habitat rehabilitation and water quality monitoring.

### Water Information Drivers

The Murray CMAs objectives are to improve the condition of water-dependent assets while assisting regional communities to make informed decisions about water management and adjust to reduced water availability.

The CMAs interests in water information and monitoring lie specifically in 2 areas:

1. Aquatic ecosystem health – to support the State Plan Targets
   - Assessing current resource condition
   - Detecting and monitoring environmental changes resulting from intervention activities such as riparian protection
   - Identifying the effectiveness of water sharing plans in supporting instream values
   - Detecting and monitoring threats.
2. Monitoring environmental flows – to support environmental flow decisions by state and Commonwealth water holders
   - Assessing flow distribution (Compliance monitoring/accounting)
   - Monitoring the effectiveness of environmental flows
   - Improving modelling and predictive capacity
   - Improving risk management practices.

Environmental flow information requirements are expected to grow in order to satisfy Commonwealth and State water holder expectations, justify resource allocation and adaptively manage flows to optimise environmental outcomes.

The CMA is not in a position to directly gather information against all these objectives but intends to collaborate with other partners to access and use information collected to inform management.

Key driving processes within the Murray catchment include:

- Commonwealth Framework for Environmental Water Actions
- Murray Darling Basin Plan
- Macro Water Sharing Planning.

## Section B

### Water Monitoring Network

The Murray CMA has established a community stream sampling project to expand knowledge on the condition of inland waterways. The project began in 2007 and engages volunteer community monitors to collect information on both permanent and ephemeral streams which are fed into the project. Salinity (electrical conductivity), pH and turbidity are collected monthly in permanent streams. In ephemeral streams, a series of rising stage samplers are installed to collect water samples during flow events with bottles analysed for salinity and sediment. A data confidence plan has been developed and Quality Control/Quality Assurance measures implemented to ensure data quality. The data is used to inform knowledge gaps in sediment and salinity across the catchment, inform the prioritisation of on-ground works, identify suitable management actions and confirm results from sediment and erosion modelling. In addition this program has been supported by a inter agency collaborative technical working group with expertise to ensure the program meets agreed standards. A professional officer has been appointed full time to support the program, collect water samples for scientific use and QA all data.

### Data management

In 2009, the Murray CMA was offered a data management system (Unidap Solutions WaterQ Database) through funding provided by Bureau to establish a common platform for NRM/CMA regions for water quality reporting and data transfer to the Bureau. The CMA is currently training staff and transferring historical data collected under the Community Stream Sampling project into the system. The software is principally employed for storing water quality data, however, it has the potential for wider applications, e.g. macroinvertebrates, fish etc.

## Section C

The Murray CMA has identified the following gaps in water information and monitoring investment and systems in the Murray catchment.

### Gap 1: Lack of strategic review and development of a collaborative framework for water monitoring

In developing the Riverine Strategy and other programs (CSS), technical advisors suggested a gap in coordination of monitoring activities, data management and data access at the catchment level. A strategic review of monitoring activities is required to:

- define water information needs
- define roles and responsibilities and opportunities for collaboration
- identify potential efficiency savings
- prioritise water monitoring activities
- define monitoring methodology and data storage.

### Gap 2: Lack of long-term commitment to monitoring programs

A significant number of water monitoring sites administered by the NSW Office of Water have been decommissioned within the catchment. The CMA understands that irrigation organisations are also reducing monitoring activities. Funds for supporting monitoring activities are limited. Funding programs are often designed to meet a political or program cycles which results in short-term snap shots activities, questionable use of public funds, reduced ability to gain meaningful data for analysis to assist with trend or condition assessment. An opportunity exists to collaborate widely within the catchment to identify strategic water monitoring objectives and needs.

To meet a shortfall in existing monitoring the Murray CMA with funding partners have established a Community Stream Sampling project. Funding is due to expire in June 2010. The CMA is exploring alternative options to resource and maintain this program to enable continuity of monitoring that meets the regional needs.

### Gap 3: Inadequate spatial location of surface water monitoring sites to meet environmental water delivery requirements (needed for decision-making, compliance and resource condition monitoring)

The Murray CMA is facilitating the development of an Environmental Water Management Plan for the Edward-Wakool System. In collaboration with key partners, considerations will be made to ensure monitoring networks:

a) adequately meet environmental water holder expectations (including water accounting and flow distributions)

b) enable adaptive management to optimise environment outcomes

c) enable adequate risk management.

Consideration will specifically be given to flow, EC, pH, and dissolved oxygen. There is potential to reinstate decommissioned sites and retrofit existing sites to include additional parameters and strategically located new sites to meet Commonwealth and State Environmental Water Holder needs thereby enhancing the opportunity to access environmental water.

### Gap 4: Limitations of existing gauging stations within the catchment to effectively support water sharing planning and implementation

In NSW, Macro Water Sharing Planning is lead by the NSW Office of Water. The Murray CMA interests lie in protecting instream values. Development of water sharing rules are restricted based on existing monitoring infrastructure. There is potential to enhance ecological outcomes and water sharing compliance by strategically considering additional coverage in areas with significant instream values sensitive to flow changes or where competition for water is high.

While some monitoring of unregulated systems occurs, resources have focussed on monitoring in the regulated system. Many stations on ephemeral streams have been decommissioned or ceased. Understanding flow patterns and water extraction will be important in managing flows to meet ecological, social and economic values and defining water sharing arrangements.

The development and implementation of the Murray Darling Basin Plan will also warrant enhanced water information.

### Gap 5: Lack of coordinated information management systems.

While some agency data is available on the web, there is significant information collected and held in various locations (e.g. irrigation corporations, research organisations, NRM bodies, Landcare, etc). Metadata availability is also limited generating risks in data application. The capacity to access data that could inform management is therefore limited.

The Murray CMA commissioned a hydrogeological data review in 2008 to consider and assess (strengths and weaknesses) of all groundwater monitoring programs undertaken the catchment in an historical context. This was undertaken as a step towards any future monitoring support or program implementation. The report highlights the ad hoc nature of the programs, the lack of integration, the limited QA, review process and that a number of databases had been created and information was held information in discrete locations. Importantly the review indicated that a catchment wide strategic approach had not been considered at any time.

The Murray CMA has adopted the Unidap Solutions WaterQ Database for storing water quality information. The database is currently limited to water quality, however, with modification it could be expanded to include other indicators such as macrophytes, riparian vegetation, fish and macroinvertebrates. The CMA would welcome support to expand the capability of the WaterQ database to provide a system capable of storing all water information and facilitate data access.

**Gap 6:** *Inadequate water quality network to identify threats, estimate risks and allow for adaptive water quality management – including spatial location of stations and indicators monitored*

There is limited capacity using current water monitoring stations to identify salinity trends, salt loads and influencing factors. Evidence now demonstrates that end of valley targets are an inadequate measure of water quality and programs are far more effective if they are responsive to needs and located within valley (e.g. strategic and targeted sub-catchment monitoring). Monitoring within a landscape context is viewed by the Murray CMA as critical to effective water quality monitoring. Poor monitoring program design has occurred in the past due to limited understanding of hydrogeological landscapes. Focus of water monitoring programs has been historically discrete and not integrated (i.e. surface, baseflow, sediment and groundwater programs not aligned) limiting capacity to interpret data.

There is inadequate monitoring to establish flow/water quality relationships. A range of agencies met in May 2008 to discuss knowledge needs associated with fish kills, attributed to low dissolved oxygen and potentially sulfidic sediments in the Edward-Wakool system following a managed flow event. The NSW Office of Water commissioned the Murray Darling Freshwater Research Centre to document agreed knowledge gaps. Establishing flow/water quality relationships was identified. An appropriate monitoring network is required to enable this recommendation. Opportunities exist to establish collaborative projects to improve our understanding of water quality and flow interactions.

### Gap 7: Lack of information about groundwater dependent ecosystems to support sustainable management

There is a lack of information about groundwater dependent ecosystems (GDEs) and levels of dependency. Water Sharing Plans are being prepared in the absence of this information leading to reduced confidence in capacity of the plans to maintain the health of GDEs. The Water Sharing Plan for the Lower Murray Groundwater Source specifies that further studies of groundwater dependent ecosystems should be undertaken.

The Murray CMA is considering how GDEs can be identified, levels of dependency determined and prioritised. Limited information on wetlands is available that could inform further investigation. A whole of catchment assessment of GDEs is not feasible. From an efficiency perspective it would be preferable to test for groundwater dependency of high priority GDEs. The Murray CMA will be identifying priority assets across the catchment over the next 18 months. Funds are currently not available within the CMA to support determining groundwater dependency.

## Section D

The responses included in this paper have been developed in consideration of the Authority's role in water management, i.e. improving the condition of aquatic habitats and contributing to environmental water management. The Murray CMA is not in a position to fund the gaps identified herein but relies on such information to inform natural resource management. We have a genuine desire to contribute to the development of a strategic monitoring framework within the Murray catchment to ensure multiple objectives are met in collaboration with interested parties and efficiencies achieved.

The CMA is currently working with key stakeholders to identify specific water information requirements in the Edward-Wakool System to support environmental flow management and risk management. Implementation of recommendations will be a priority.

# Appendix 1(o) – MidCoast Water

*Draft Strategic Water Information Management Plan*

## Section A

MidCoast Water (MCW) is the local government authority responsible for reticulated water supply and sewerage system in the Greater Taree and Great Lakes local government areas. MidCoast Water is structured as a County Council.

The area stretches from Johns River in the north, to Karuah in the south, taking in Taree, Wingham, Forster, Tuncurry, Krambach, Stroud, Bulahdelah, Tea Gardens and Hawks Nest. MCW supplies water to 38,800 households. Nearly 90% of customers are serviced by the Manning Water Supply System. MCW runs three small water supply systems in Tea Gardens, Bulahdelah and Stroud.

MCW is listed as category D and Category F under the *Water Regulations 2008*. Apart from information required by MCW for its own water supply and sewerage services, we are required to provide information NSW DECCW and Bureau of Meteorology.

## Section B

MCW runs the following data collection systems utilised for water information requirements:

- SWIFT system — covering control and monitoring of the Manning Water Supply System. Reports of storage levels, volumes of water extracted and used, and operational water quality monitoring results can be obtained from the system
- MCW SCADA system — covering control and monitoring of the small water supply systems and the sewerage system
- Water Quality Management — using the MCW LIMS and Water Quality database.

## Section C

MCW existing SCADA system requires some improvements to enable more efficient and timely data transfer into MCW information management system. The efficiency and reliability of water quality data capture can be improved by automation of the results from the MCW LIMS into the Water Quality database. Reporting of the historical data (more than 5 years old) requires extensive resources to collate information kept at various locations and databases in different format.

## Section D

Priorities for improving MCWs water information system:

- fully automate data transfer from the MCW Laboratory LIMS into the Water Quality Database and improve reporting format
- collate historical information from various databases/spreadsheets into WDTF

# Appendix 1(p) – Clarence Valley Council

*Draft Strategic Water Information Management Plan- Updated from SWIMP 2010*

## Section A

Clarence Valley Council ('Council') provides reticulated water and sewer services to the residents of the Clarence Valley, including the major towns of Grafton, Maclean and Yamba. All major towns are sewered by Council and reticulated water is provided to over 20,000 properties throughout the Clarence Valley. Council also operated the newly constructed major water storage facility called 'Shannon Creek Dam'. This off-stream storage (from Nymboida River) is managed by Council but was built in partnership with the Coffs Harbour Council, as the dam is capable of servicing the water needs of both Council areas.

Council currently uses various sources of water information such as river flows, water extraction volumes, water storage reservoir volumes, water and sewer quality, and river effluent releases. This water information is used to manage the water supply system and sewage treatment system to ensure compliance with licence conditions, as well as ensuring water supplied to customers will meet Australian Drinking Water Quality Guidelines.

Council are required to provide water information to the following organizations:

- Bureau of Meteorology – Category D data for daily water level and storage volume at Shannon Creek dams and Category F information (urban water utilities)
- NSW Office of Water – for Annual Performance Reports
- NSW Department of Environment, Climate Change and Water – for Sewer Treatment Works annual returns.

## Section B

### Water monitoring networks and technologies

Water information is acquired both manually and automatically. Some examples of information acquired automatically (via telemetry) include:

- Shannon Creek Dam - water level detected at dam, rainfall gauges at dam
- Bulk Water transfers - to from Coffs Harbour and their Karangi Dam
- Nymboida River – flow, turbidity.

The Clarence Valley Council does not currently have a single data management information technology system. Currently water flow and quality data is stored unsystematically in a range of formats (e.g. spreadsheets, databases, handwritten notes, PDF, telemetry). This limits the data enquiries and usefulness and limits the efficiency of data transfer between CVC and organisations mentioned in Section A. The following are some examples of water data acquired and stored manually:

- reticulation water quality info (e.g. micro and chemical testing)
- reservoir water quality info (e.g. Shannon Creek Dam, Lake Hiawatha)
- Lake Minnie Water – water quality and water extracted
- effluent river releases into Clarence River – quality and quantity.

## Section C

### Gaps in water information systems

Our gap is consistent to Gaps 30 and 36 identified in the 2009 NSW SWIMP.

The obvious gap in the Clarence Valley Council's water information systems is the simple the fact that no information system exists. Creating a data management system would enable more efficient data transfer and enquiries.

## Section D

### Priorities

Council's highest priority for investment in water information is to implement a system that will contain water information for water and sewage, be easily queried and automatically and electronically provide data to the Bureau of Meteorology.

Clarence Valley Council will need to identify which commercially available data management system (or combination of) is most suited to Council's monitoring, data management and reporting requirements. The selection of a data management system that best suits Council's requirements will ensure funds are allocated effectively when purchasing such a system. It will also maximise the efficiency and reliability of data management and data transfer to organisations such as the Bureau of Meteorology.

# Appendix 2 – Water monitoring reviews



## A2.1 NSW water monitoring reviews

The NSW monitoring network is a substantial asset and as been subject to many reviews and assessments to ensure it maintains its effectiveness, efficiency and relevance. Recent reviews are summarised below, with more comprehensive explanations presented in section B of this report.

Many of the reviews focused at a management scale and identified gaps in programs as opposed to specific gaps in data. Many recommendations therefore focus on policy level gaps and emphasise types of data that are currently lacking rather than noting any gaps in existing data or systems. For example, a common gap was a lack of a program to collect data regarding surface water and groundwater hydraulic conductivity.

All relevant gaps identified by previous reviews were considered for the gaps analysis in section C of the SWIMP.

### A2.1.1 NSW Office of Water 'Network Matrix'

The NSW Office of Water network review is current, and ensures that the network is efficient and resources are optimised. The review relies on network users such as regional hydrographic staff, hydrologists and modellers to update network information through a Network (User/Uses) Matrix. The Matrix system allocates priority to each station depending upon the number of users and uses of the site. Users are those individuals or agencies who use the data from that station, and the uses relate to which data collection programs require data to be collected from that site. Major users are also requested to allocate a level of priority to each station to assist with any decision-making when attempting to discriminate between stations. Both the user and uses information, and priority determinations are updated when the information changes. Responses to management directives can be immediate as the information is always current, and easily accessible.

## A2.2 Recent monitoring reviews

### A2.2.1 National Land and Water Resources Audit

The National Land and Water Resources Audit (Audit) was undertaken in 2000 to facilitate improved natural resource management decision. The Audit was comprehensive in its objectives and aimed to not only identifying the current status of the Australia's land, vegetation and water resources, but include economic assessment of any recommended changes, establish a national information system, and provide a framework for monitoring land and water resources in a on-going and structured way.

Each State and Territory was individually assessed and NSW had a number of gaps identified relative to ability to achieve sustainable management of its land and water resources. The gaps are presented more comprehensively in section B of this report, but Table 27 below has a summary of the findings. The findings are grouped into Surface Water, Groundwater and Estuaries.

**Table 27: Gaps in surface water data for sustainable management of land and water resources**

| Surface Water | Findings from the National Land and Water Audit for NSW, 2000 |
|---|---|
| **Current Status:** A recent review of the Departments surface water monitoring network showed that 90% of current surface water sites (700 sites state-wide) are currently meeting water reform or stakeholder objectives. Of these 700 sites, approximately 350 sites are on unregulated watercourses in coastal and inland catchments. It is anticipated, that in the medium term, additional surface water monitoring sites will be established in unregulated stressed coastal catchments to support Water Reform objectives. These reforms include water trading and water and environmental assessments to improve water use efficiency and environmental sustainability. | |
| GAP | Australian Bureau of Agriculture and Resource Economics (ABARE) data does not match the Surface Water Management Area boundaries. |
| GAP | NSW needs links between environmental health and river flows that are representative of regional ecological populations |
| GAP | There are no financial data (cash flow, equity etc) for representative water user units in SWMAs or groups of SWMAs. |

| | |
|---|---|
| GAP | There are no representative user risk management decision criteria in SWMAs or groups of SWMAs |
| GAP | There is currently no reliable and cost-effective methods of obtaining information on water use, crop types and irrigated areas for unregulated rivers, and GMUs which are not metered |
| GAP | Need to develop water resource system models for unregulated rivers and accuracy of those models where they are not supported by streamflow data |
| GAP | Need to develop operational decision tools for unregulated rivers |
| GAP | Need to establish environmental flow performance measures |
| GAP | There are no established interrelationships between surface water and groundwater, i.e. impacts on streamflow losses |
| GAP | What are the forestry impacts on streamflow? |
| GAP | Cumulative impacts of farm dams on the hydrology of rivers and basins. |
| GAP | Environmental impacts of flow pulsing in regulated rivers to mimic natural flow patterns in regulated rivers. |
| GAP | Ecological value of small streams in providing colonisation and food supply to main-stream ecology. |
| GAP | Level of management uncertainty derived from models based on long-term climatic data but calibrated with short water system management data. |
| GAP | The collection and storage of time series salinity data |
| GAP | Establishment of effective groundwater data systems that address quality control, accessibility and timeliness |

**Table 28: Gaps in groundwater data for sustainable management of land and water resources**

| Groundwater | Findings from the National Land and Water Audit for NSW, 2000 |
|---|---|
| **Current Status:** The main data deficiencies in relation to groundwater management are reliable usage data, except in the few areas where abstractions are completely metered and fully recorded, and there is long-term sequential salinity data. Water level monitoring data are available for most of the long established alluvial aquifer Groundwater Management Units (GMUs), but in many of the more recently defined areas the length of record is very short. There are little or no water level monitoring data for quite a few of the GMUs. An issue for management will be to determine which GMUs are likely to be subject to sufficient demand to warrant implementation of monitoring, requiring the installation of a costly observation bore network. | |
| **GAP** | There is no real usage data and this is important for the determination of sustainable yields. |
| | There are no physical descriptions available for the aquifer, and this information is required for the determination of sustainable yields. |
| GAP | Determination of sustainable yield also requires proportion of recharge necessary to maintain dependent ecosystems. This information is currently not available either. |

**Table 29: Gaps in estuary data for sustainable management of land and water resources**

| Estuaries | Findings from the National Land and Water Audit for NSW, 2000 |
|---|---|
| For 979 estuaries in Australia, estuary condition was assessed, and key geomorphologic drivers identified. In NSW this task was difficult due to a paucity of data and a high-level of co-ordinated investment was identified as a first step to a solution. | |
| GAP | There is not enough estuarine data so complex natural biophysical processes are poorly understood. |

Through the Audit process, NSW acknowledged policy changes that would affect its ability to achieve improved water management. Those that relate to water management are outlined in the Supplementary Report. Below is a summary of those with a direct link to water monitoring.

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Summary of issues identified by NSW during the Audit, with a link to water monitoring. *(Refer to section B for a complete list.)*

- NSW will continue to develop water markets to offset the limits on additional growth as result of the Cap and Water Sharing Plans. A key issue for effective water trading will be clarification of access and use rights and the security of those rights. The proposed provision of a register of water entitlements with details of volumes, security, third party interests and full disclosure of prices paid will assist market operation.
- The expansion of dryland salinity in the uplands of the NSW portion of the Murray-Darling basin will place increasing pressure on maintaining flows within those river valleys for dilution needs. Dealing with the problem at its source is the preferred solution.
- As the implementation of flow sharing rules are being undertaken by separate operational bodies the water resource manager will require improved performance indicators for flow and environmental outcomes. Annual operating plans will be an increasing requirement of the regulator with annual disclosure of performance as an important compliance tool. Sanctions or penalties for non-compliance are an area that needs further work.
- Community acceptance of drought as a reality rather than an abnormality also needs some attention. Users need to understand the reality of the trade-off between security, the price of water and the risk of restrictions. Annual availability of water for use on rivers is subject to climatic variability; user decisions are assisted by information on future water availability. The opportunity to use improving seasonal climate forecast methods need s to be added to the existing forecasts that are based on historical flow data.
- Water resource system models will be increasingly used for audit purposes, requiring reliable information on water use, crop types, irrigated areas and user management decisions.
- There is a clear need for improvement in the methods used to estimate average annual recharge, the needs of dependent ecosystems and, consequently, of the

sustainable yield which is the difference between them. For groundwater management, these areas should be a focus for future research.

After the Audit was completed there agreement to re-establish and support a formal technical forum for the exchange of information and experience in all aspects of hydrological data collection, processing and distribution. The activities undertaken by the NLWRA had shown that there had been a divergence in hydrological data collection techniques, terminology, etc. since the early 1990s that had made the development of a nationally consistent picture extremely difficult. Increased communication would not solve this issue totally, but it could contribute to improving these aspects of hydrological data collection. Also, it would pay dividends through reduced duplication of effort and potentially a faster more efficient learning and development environment. Sadly, while the idea was good and a committee was created, the commitment to ongoing funding and operation of the group was lacking and no real progress was made by this group.

### A2.2.2 NSW Integrated Monitoring, Evaluation & Reporting Framework for NR Management – August 2002

This framework was set up to develop requirements for NRM monitoring, evaluation and reporting in NSW to support Commonwealth investment in natural resource management. The focus was on developing consistent methods for monitoring that could be linked to assessment and evaluations processes that were associated with negotiated environmental 'targets'. The reporting of the results was also outlined to ensure end uses of monitoring and evaluation are adaptive management and reporting of outputs and outcomes (short and long-term) to investors, including governments and communities

The exercise helped to develop and shape monitoring, evaluation and reporting programs, but did not identify any current gaps in monitoring across NSW.

### A2.2.3 State Water Monitoring Coordination Committee – May 2003

The Water Chief Executive Officers of NSW government agencies created the State Water Monitoring Coordination Committee (SWMCC) to address a coordinated whole-of-Government approach to water monitoring in NSW. In March 2001 the Government approved the development of a *State Water Monitoring Strategy*. As a first step to developing this Strategy, *An Interim Approach for Water Monitoring in NSW* was set up to review, coordinate and streamline current water monitoring in NSW.

The report focused primarily on ecological monitoring and set interim protocols, common procedural methods, quality assurance and control provisions. The report also identified

77 indicators used by NSW governments and agencies in their monitoring programs. The majority of indicators fall into the physical/chemical and biological categories which reflected the traditional nature of water monitoring work in NSW.

An assessment of any overlap of the monitoring effort showed no overlap or duplication between major State government programs. This comparison did not take into account local government programs and this comparison would be the next logical step.

Across the State, the spatial coverage of the long-term water quality monitoring datasets was relatively sparse. The agreement among programs in the suite of variables that have been measured also varied. Many of the programs are themed and those with similar themes (e.g. geomorphology, hydrology, and water quality) generally measure similar variables.

The greatest difference among similarly themed programs was the number of indicators and the frequency at which they were measured which reflected individual agency programs.

**Gaps:** The gaps analysis did not identify spatial and temporal gaps, so the following list is not exhaustive

1. A relatively small selection of sites is currently used for fixed site monitoring.
2. Limited monitoring is currently being conducted to assess the ecological condition of waterways.
3. There is currently limited ongoing biological and microbiological monitoring in estuarine and coastal systems, although shorter-term investigations/monitoring in specific areas has been done in many coastal regions, and a long-term microbiological monitoring program is run by Beachwatch in the Sydney, Hunter and Illawarra regions.
4. There is no ongoing long-term monitoring of riparian vegetation across the State.
5. Regular monitoring of contaminants in water, sediments and flora/fauna in terms of ecological condition does not occur as part of any ongoing program.

The above gaps are those derived from the process of compiling a list of agency monitoring programs. The Interim Approach was designed to identify current monitoring programs as a basis for considering future programs.

### A2.2.4 AWDIP Report 3 Inventory of Water Data Standards, Protocols and Infrastructure – January 2004

The *Australian Spatial Data Infrastructure* (ASDI) was to provide the overarching framework for accessing water data Australia wide. The operating model was to be a distributed network of databases, linked by common standards and protocols, each managed by the relevant custodian. Hence, the concept of the ASDI was not to establish a centralised database, but to link access to databases managed by individual government and industry custodians. ANZLIC had developed management principles, guidelines on the responsibilities of data users and custodians, data access and pricing policies and metadata protocols.

For the purposes of the project, water resource data was subdivided into the following categories:

1. *Aquatic biota* – the ecological datasets such as relating to macroinvertebrates, fish, plants and algae, most typically collected for monitoring and evaluation of river/wetland/catchment/aquifer health
2. *Hydrogeology* – the data relating to the characterisation of aquifers and other geological features

3. *Hydrology* – datasets such as water level, volume, flow velocity or pressure that relate to the movement of water. These cover a broad range of water features such as rivers, dams, wetlands, groundwater, storm water or industrial effluent
4. *Meteorology* – datasets related to climate, notably rainfall, evaporation and evapotranspiration
5. *Water quality* – data relating to the physical, chemical and biological condition of water
6. *Water management* – information such as allocation, sustainable yield estimates and water use that form the basis of management, policy and regulation of water resources.

#### Data standards

As part of AWDIP it was identified that the water data infrastructure required data and processes to be consistent, requiring the development of national data standards and protocols. These could not be developed without recognising existing standards or initiatives that are relevant to water data. The collation of relevant standards and protocols needed to focus on three distinct areas, namely those relating to:

1. *Data Delivery Standards* – standards to enable data access and exchange, particularly in the context of operating a distributed database network
2. *Spatial Data Standards* – data standards that relate to spatial data in a generic sense, including issues such as data quality, metadata and coordinate systems and
3. *Content Standards* – data standards specifically relating to the water sciences to ensure that databases made accessible in the infrastructure contain consistent data. These standards relate to aspects such as data models, dictionaries, codes, definitions and nomenclature.

The Australian standards for the major datasets relating to the SWIMP project were identified for many of the datasets. A full description is outlined in section B.

### A2.2.5 Knowledge gaps for groundwater reforms – May 2004

A workshop under the National Water Initiative (NWI) was organised in 2003 to scope the full extent of the knowledge gaps relating to groundwater management. The gaps were grouped under 5 broad headings. While each heading topic is not relevant to the current SWIMP, they may become more relevant in later SWIMPs as more types of 'data' is integrated into the report e.g. Biological.

**Table 30: Knowledge gaps for groundwater reforms**

| Groundwater Reform Topics | Gaps noted at the NWI workshop |
|---|---|
| 1. Groundwater dependent ecosystems | · The ecology of GDEs is outside the scope of this report, but information is required on the different temporal and spatial scales that operate for hydraulically connected surface/groundwater systems. These systems need to be conjunctively managed to achieve environmental flows whilst maintaining a productive groundwater pumping economy. |

| Groundwater Reform Topics | Gaps noted at the NWI workshop |
|---|---|
| 2. Integrated management of surface and groundwater resources | · To manage for stream depletion in connected rivers, information is needed on the proportion of groundwater pumped that results in depletion of streamflow and the time lag or response function of this impact. These are dependent on the hydraulic connection between the river and aquifer and the proximity of groundwater pumping to the river and other potential sources of water capture.<br>· There is a lack of understanding of the importance of water quality and the processes controlling water quality in the hyporheic zone, coastal zone and in the different zones in a stream/aquifer system e.g. Riparian. |
| 3. Water level response management | · Information is required on actual aquifer water level response at a sub-catchment level. Without this data the application of sustainable yields is limited due to local unsustainable declines in water levels. |
| 4. Landuse changes | · The hydrological impacts of different land-use types on aquifer behaviour, including the change in the volume of recharge, the change in discharge patterns, flooding and waterlogging is not well understood. This would be greatly assisted by the development of robust recharge and discharge estimation techniques.<br>· There is little knowledge of the impacts of landuse on groundwater quality, particularly, the location of waste disposal sites, aquifer storage and recovery programs, effluent treatment/irrigation sites, intensive agriculture, mining activities and residential development. |
| Other knowledge gap areas that impact on the NWI | · Inadequate understanding on the salinisation of aquifers<br>· Poor understanding of seawater intrusion processes<br>· Lack of understanding on how climate variability should be accounted for in groundwater management (e.g. sustainable yield, accounting rules, water level management)<br>· Water accounting frameworks<br>· Fossil waters (high storage/low recharge)<br>· Data accessibility. |

The gaps focused on policy and scientific knowledge gaps but a significant result of the workshop was the determination that the lack of progress in some areas of water reforms was in fact a government resourcing and priority setting issue rather than a knowledge gap. The development of tools that would assist resource managers make more informed decisions was recommended.

### A2.2.6 OECD Workshop on Agriculture and Water: Sustainability, Markets and Policies – Nov 2005

The ABS wanted to develop a program to deliver water statistics to government decision-makers as well as to the general public. In particular, the ABS endeavoured to supply data that would assist with the assessment of the impact of Council of Australian Governments (COAG) water reforms.

ABS recognised that water statistics encompassed a vast range of activity, much of which the ABS did not have the resources, expertise or desire to fully comprehend or

document. For example, information relating to hydrological cycles, meteorology, streamflow and water quality. The ABS instead focused its attention and resources on the statistical areas that are core to water accounting and related economic statistics as outlined in Table 34. In general, this is the physical flow (supply and use) of water in the Australian economy and the economic statistics relating to water suppliers (e.g. the water supply industry) and water users (e.g. farms that irrigate).

**Table 31: Identified data requirements for water supply and use in Australia**

| Issue | Data Requirements |
|---|---|
| Supply | · Volumes of water supplied (delivered through infrastructure and licensed to self-extract)<br>· Volume of waste water discharged by water suppliers<br>· Volumes of reuse water supplied<br>· Losses in water supply systems |
| Use | · Volume of water used by individuals, industry, crop types, etc<br>· Source of water used by individuals, industry, crop types, etc<br>· Volumes of reuse water used by individuals, industry, crop types, etc<br>· Volume of water discharged by individuals, industry, crop types, etc<br>· Volume of water traded<br>· Efficiency of water use practices<br>· Changes in water use practices over time by different industry sectors |
| Economic | · Cost to supply water<br>· Charges for water use<br>· Value of production from water use (ideally net and not gross value)<br>· Value of water and water rights (including water trading)<br>· Value of water storage and delivery infrastructure |
| Environmental | · Environmental flows<br>· Water quality<br>· Emissions |
| Other | · Area irrigated by crop type<br>· Irrigation techniques and scheduling tools<br>· Water stocks<br>· Farm dams<br>· Responses of farmers to drought<br>· Water recycling by industry<br>· Domestic rainwater tanks<br>· Water drainage |

The ABS also identified key data gaps in the data including actual water use by user type and the location where water is supplied and used (to enable the production of high quality regional data). They also identified that there was a lack of integration of physical, economic and social data relating to water use. Table 2 outlines some of the

data gas in water statistics that the ABS identified. It refers to specific data, and outlines the benefit of collecting this data.

**Table 32: Current data gaps in water statistics and benefits of collection**

| Gap | Data provider | Benefit of collection |
|---|---|---|
| Volume of water supplied (including reuse water) | Water suppliers | Regular (annual) compilation of national and state figures on total volumes supplied by the water supply industry |
| Details of customers (including reuse customers) | Water suppliers | To show the levels of use (and importance) of water in various industries<br>Industry value added by water users<br>Balancing of water accounts |
| Volumes of water used | Water users (e.g. industries) | To assist with balancing water accounts |
| Source of water | Water users | To show the importance of water to each industry<br>Economic value added by water to each industry |
| Ownership of water rights (and actual usage) | Government agencies/water regulators | Distribution of water rights by industry<br>Assessing and forecasting impacts of different levels of water availability and increased water prices |
| Discharges of waste water | Government agencies/water regulators<br>Water suppliers | Help monitor impacts on receiving waters<br>To assist with balancing water accounts |

### A2.2.7 Australian Water Resources 2005 – May 2006

The primary purpose of the Baseline Water Resources Assessment (BWRA) was to provide the National Water Commission (NWC) with a baseline picture on a range of water management and resource issues from which future comparisons, and the success of NWI reform processes could be measured. In addition to defining water resource knowledge gaps critical to the success of NWI initiatives, it was a requirement of the BWRA to develop a repeatable framework and to work towards the establishment of an ongoing water data information infrastructure.

In doing this the Assessment examined and reported on a number of themes including surface water and groundwater.

The themes were assessed at National Scale, with priorities for each state noted. The results for NSW are summarised below, with more detail in Section B of this report.

### Theme – Surface water

**Table 33: Gaps in surface water data**

| ISSUE | GAP and comments |
|---|---|
| Farm dam usage and evaporation losses | Inadequate data available. Estimates are possible in areas where dam surface water and volumes are known. In NSW there is only partial coverage of estimates provided by landholders: |
| Stock and Domestic water rights | This usage is not licensed and there is no data on actual usage to determine if this type of usage is significant |
| Instream losses to evaporation and groundwater | No data is available on this, apart from a few estimates in catchments that have calibrated water resource models. These model estimates however are likely to include model errors and other sources of error so their accuracy is questionable. |
| Daily streamflow (natural and current) | Lack of data, and difficulties with access to available data. The areas where this data is available are as follows:<br>· Naturalised data: Principally limited to areas in NSW where IQQM is available. Access to this data is likely to require contacting the individuals within the organisations who operate the models.<br>· Current data: Again data for current conditions would be accessed from the modellers. Streamflow records do not represent current conditions in those catchments where development has occurred within the record period of the gauge concerned. Some gauged data will be available for 100 years, but few sites will not have been impacted by development over the past 100 years.<br>· A significant portion of catchments would have at least 40 years of streamflow records at active gauging stations; however there are still many remote areas that have no gauged streamflow information at all. Monthly data may be available at some locations for a longer period than daily. |

### Theme – Groundwater

**Table 34: Gaps in groundwater data**

| Issue | GAP and comments |
|---|---|
| Groundwater–Surface water connectivity | Lack of data. Groundwater quality information is generally limited and primarily restricted to salinity measurements. Groundwater observation or monitoring bores represent approximately 5 per cent of all groundwater bores in Australia |
| Spatial and temporal distribution of the data | Uneven availability of information that is especially pronounced between the Groundwater Management Units and Unincorporated Areas, but is also evident within these divisions. |
| The lag time between current and future management plans, | The impacts from management decisions are not immediate. To participate in iterative resource planning requires knowledge of previous planning decision frameworks, and this data is generally no collected or retained. |
| SW-GW connectivity allocations | No data for connected surface water and groundwater systems, resulting in unknown implications for water allocation, availability and GDEs. |
| Quantification of seawater intrusion, and Groundwater quality. | Lack of data on seawater intrusion, and the impacts on groundwater quality. |

The federal Bureau of Rural Sciences coordinating this review suggested the following are priorities for future, longer term work that will focus and improve the assessment of groundwater resources:

- Groundwater data are required at regional levels for management purposes,
- Coordination of the management of groundwater resources across State and Territory borders is still required, particularly to eliminate edge effects,
- Further work is required on the determination of sustainable yield, groundwater-surface water connectivity, groundwater dependent ecosystems and groundwater allocations based on sustainable yield,
- Uniformity in the definitions of terms, determinations, methodology and groundwater units should be considered, including sustainable yield, surface water-groundwater connectivity and groundwater dependent ecosystems,
- The adequacy of groundwater monitoring networks in the Groundwater Management Units and Unincorporated Areas should be considered, and
- Identification and measurements of groundwater recharge, discharge, groundwater-surface water connectivity, groundwater storage and movement and the calculation of sustainable yield need to be enhanced by detailed field surveys, monitoring, data analyses and interpretation

### A2.2.8 NSW Natural Resources Monitoring Evaluating & Reporting Strategy Aug 2006

This strategy was a government initiative to focus all levels of government in NSW on a common system of monitoring, evaluation and reporting on natural resource condition.

The NSW Government had adopted a range of standard and targets for some key ecological indicators, and wanted to establish a monitoring, evaluation and reporting (MER) system to report against the targets. The MER approach uses two main types of monitoring programs, resource condition monitoring and performance monitoring. “Resource condition monitoring” follows trends in particular aspects of a natural resource (“indicators”) to understand whether the overall health of the resource is changing. For example, the number of native fish species present is a commonly used indicator of riverine ecosystem condition. Resource condition monitoring shows whether NRM targets are being met. It does not, however, explain what caused the observed trend. That needs to be identified through a different process, such as a detailed study.

Once the cause for the observed trend has been established, “performance monitoring” is used to determine whether remedial action is effective in reversing that trend. Performance monitoring is useful in designing more effective NRM programs.

**Table 35: Some of the 13 State-wide targets for natural resource management**

| | |
|---|---|
| 1. | By 2015 there is an improvement in the condition of riverine ecosystems |
| 2. | By 2015 there is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses |
| 3. | By 2015 there is no decline in the condition of marine waters and ecosystems |
| 4. | By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained |
| 5. | By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems |

### A2.2.9 Australian Water Resources 2005 Level 1 – Oct 2006

A two level assessment of Australian Water Resources was undertaken to determine gaps in the consistency, extent and availability of information to provide for robust resource management.

Level 1 assessment provides high-level performance indicators of Australia's water management, based on information provided by the states and territories.

Level 2 assessments provide data, analysis, and discussion to progress understanding of Water Availability, Water Use, and River and Wetland Health. They are discussed in section 2.10

The Australian Water Resources Level 1 assessment has so far demonstrated a number of gaps including the following that are relevant to NSW:

- Inability to provide information in a readily accessible manner
- Terminology and descriptions of key parameters or attributes is quite varied. States and territories do use different language to describe key components of water resource management (e.g. allocations /entitlements/use/diversions) and this can produce confusion when reporting and analysing data. The use of NWI – sourced descriptions is helpful to some extent.
- Some technical definitions (such as sustainable yield) and the methods for determining these are highly variable across states and territories. In some cases the definition is based on a technical assessment of resource capability and in other cases it is a figure based on current extractions or entitlements. In a similar manner, the description of farm dams or catchment storages needs further refinement and definition.
- The lack of consistent definitions and methodology for assessing level of development and over allocation is considered to be a significant gap/limitation. In some areas there are also inconsistencies between assessed over allocation at a Basin scale compared with component water systems (e.g. Murray-Darling Basin, Snowy River).
- Knowledge of actual water use and actual levels of resource development (through measurement and metering) is variable. Further improvements in the

measurement of environmental and agricultural water use are required to achieve a more accurate total water balance.

- Lack of integration between those parts of each jurisdiction looking after water availability issues (e.g. resource allocation) and those responsible for managing the health of the assets (e.g. river health). In some cases the project team has had to approach different groups in each state and territory to obtain information and this has highlighted the apparent lack of coordination within the jurisdiction

### A2.2.10 Australian Water Resources 2005 Level 2 – May 2007

Level 2 assessments provided data, analysis, and discussion to progress understanding of Water Availability, Water Use, and River and Wetland Health.

The report determined the data gaps in relation to water balance models, i.e. determining the reliability of the data and information and ascertaining the issues in obtaining the data.

The conclusions were that the water balances include a diverse list of components (71 in total) but that it is principally composed of six components:

1. Opening Storage
2. Inflows to Surface Water
3. Inflows to Groundwater
4. Outflows from Surface Water
5. Outflows from Groundwater
6. Closing Storage

Of the seventy-one different components making up the water balance, there was **no data** from NSW on the following components:

1. Non-renewable groundwater storages
2. Soil-unsaturated zone storage volume
3. Snowpack storage volume
4. Desalinisation as a surface water inflow source (note: Perth Desalinisation plant became operational on the 20th November 2006 and so would be included in future water balances for Perth)
5. Groundwater system gains from septic tanks
6. Extraction to ASR from Groundwater (most ASR sources are surface water based from either floodwaters, urban drainage or other surface or re-use sources)
7. Extraction to economy outside of entity from Groundwater (i.e. groundwater is extracted and used on site or within the entity)
8. Seepage from streams to groundwater (and vice versa)

Generally there were no additional components to the water balance after the initial trial was undertaken, however there were several sub-components of the original water balance items added in to the balance where the information was available, (e.g. rainfall runoff to rainwater tanks in the capital city water balances).

Other relevant water data monitoring related comments from the report conclusion include:

- Evapotranspiration from the water balances shows a lack of consistent and reliable data on ET from groundwater and surface water. This not only occurs in those areas which are data deficient, but also areas which have been extensively monitored such as the Murray-Darling Basin
- Current entitlement data does not appear to include self extracted groundwater and surface waters such as farm dams. When comparisons of this data with extractions and diversions is undertaken, this can lead to extractions being greater than the entitlement volumes and the appearance of over-use within an area.
- Groundwater/ surface water interactions need to be assessed to determine the impact of extractions and diversions from these sources on the other resource. More than 20% of the water balance areas had a high-level of interaction even when assessed based on the limited information available. Further work is required to understand the significance and potential for double counting of the water resources in each of the catchments.
- Generally major storages are well known. Minor storages such as farm dams are not well known and need further work to understand the impact on the streams and catchments.
- Groundwater resources are not well known in most areas. Further work is required to understand the use and sustainability of groundwater resources.

### A2.2.11 CSIRO – Water Availability in the Murrumbidgee – Jun 2008

A review of the gauging network in the Murrumbidgee concluded that the river system was reasonably well gauged and well understood. Gauged and ungauged inflows, end-of system flows and diversions are very close between simulations and accounts and suggest relatively low uncertainty. The authors stated that the greatest uncertainty is associated with the estimation of monthly diversions and river and wetland losses that appear to occur in three specific reaches at the upper end of the system (Wagga to Narrandera, Narrandera to Darlington Point and Darlington Point to Hay Weir), but also in other reaches in the lower part of the Murrumbidgee.

In summary, “The region is the ninth most densely gauged region in the MDB. The density of the streamflow, rainfall and evaporation gauging networks is up to twice the MDB average. Most of the streamflow gauging covers the Murrumbidgee and Tumut rivers, Billabong and Mirrool creeks, and the upper Murrumbidgee contributing tributaries. Rainfall gauging is well distributed but more concentrated in the upper Murrumbidgee and the Australian Capital Territory. Evaporation gauging occurs mostly in the irrigation areas, Wagga Wagga and the Australian Capital Territory.”

“Groundwater interactions appear to play a role in the accounted part of the Murrumbidgee surface water system. Modelling by this project suggests that it represents a very small net gain of about 5 GL/year or 0.1 per cent of total gains.”

### A2.2.12 CSIRO – Uncertainty in river modelling across the Murray-Darling Basin – Oct 2008

This review in uncertainly in river modelling across the Murray Darling Basin developed water accounts for a number of reaches in each region of the Basin. The aim was to reconcile all streamflow gauging data and diversion records in a simple monthly time step model.

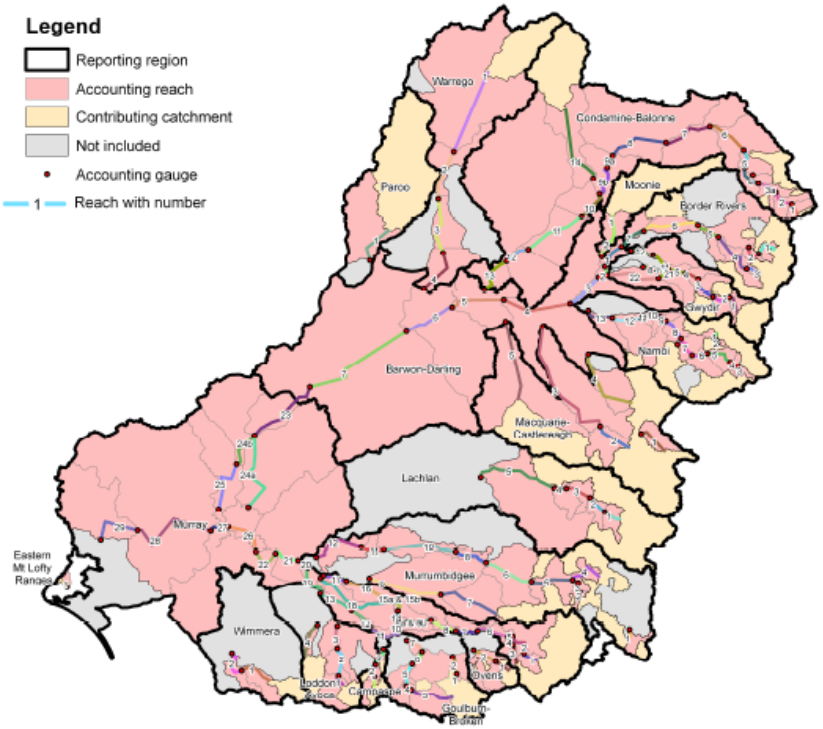


**Figure 14: Murray Darling catchments used in Developing Water Accounts**

The number of rainfall, evaporation and streamflow gauges in each region for which data was available after 1990 in Table 11 below. Because of the differences in size between regions, they also expressed the same numbers as a density, i.e. the number of gauges per 1000 km$^2$. For the sake of comparison only, a relative ranking was calculated by averaging the regions ranking in terms of the density of rainfall, evaporation and streamflow gauges.

The authors concluded that:

> The distribution of gauges is uneven across the MDB and the network can be more than ten times more dense (e.g. Campaspe region) or less dense (e.g. Paroo region) than the basin average. The most sparsely gauged regions are the dry north-western regions (Paroo, Warrego, Moonie and Barwon Darling). The most densely gauged regions are the Victorian and South-Australian regions and the Namoi region.
>
> Rainfall gauging is partly a function of population density; note for example the high number of gauges in and around the Australian Capital Territory and the low number of gauging in the headwaters of the Murray River. The adequacy of

rainfall gauging for modelling streamflow generation depends on the amount of rainfall (as higher rainfall broadly means greater runoff generation), the spatial variability of rainfall, and the length of observation compared to natural variability.

In general, streamflow gauging appears to vary with the importance of river water resources and the complexity of the surface water system. Whether the gauging network is sufficient in a region depends on several factors, for example whether:

– the quality of streamflow gauging is adequate

– the period of observation is sufficiently long to cover an adequate range of climate extremes and any trends in river management of development that have occurred

– gains or losses between two successive streamflow gauges are of a different order of magnitude or largely occur at different times and so can be separated

– different loss terms (diversions, direct evaporation, wetland losses, groundwater exchanges) are of different order of magnitude or largely occur at different times and so can be separated

– river losses, including uses, above the headwater gauges do not need to be known, and are small or correlated well with runoff generation (and this relationship is not expected to change)

– flow patterns and water balance terms beyond terminal gauges (e.g. on distributaries) do not need to be known and have no effect on other regions

**Table 36: Rainfall, evaporation and streamflow gauges in each region after 1990**

| Region | Number of streamflow gauges* | Accounting reaches | Gauged component | Attributed components | Unattributed components | Unattributed components per reach | Fraction gauged | Fraction gauged or attributed |
|---|---|---|---|---|---|---|---|---|
| | | | GL/y | | | | per cent | |
| Paroo | 4 | 1 | 677 | 353 | 108 | 108 | 59% | 91% |
| Warrego | 8 | 3 | 77 | 1,022 | 377 | 126 | 5% | 74% |
| Condamine-Balonne | 102 | 14 | 910 | 1,553 | 2,065 | 159 | 20% | 54% |
| Moonie | 3 | 2 | 227 | 18 | 69 | 35 | 72% | 78% |
| Border Rivers | 75 | 7 | 1,669 | 614 | 780 | 111 | 54% | 75% |
| Namoi | 44 | 12 | 975 | 917 | 745 | 62 | 37% | 72% |
| Macquarie-Castlereagh | 60 | 13 | 1,465 | 419 | 990 | 76 | 51% | 66% |
| Gwydir | 91 | 7 | 2,029 | 1,306 | 754 | 151 | 50% | 82% |
| Barwon-Darling | 30 | 7 | 3,472 | 1,540 | 2,480 | 354 | 46% | 67% |
| Lachlan | 76 | 5 | 1,488 | 369 | 728 | 146 | 58% | 72% |
| Murrumbidgee | 116 | 12 | 6,447 | 1,478 | 2,735 | 228 | 60% | 74% |
| Murray | 174 | 29 | 16,453 | 7,132 | 14,022 | 484 | 44% | 63% |
| Ovens | 39 | 2 | 2,059 | 1,114 | 340 | 170 | 59% | 90% |
| Goulburn-Broken | 122 | 7 | 4,502 | 983 | 1,029 | 147 | 69% | 84% |
| Campaspe | 30 | 3 | 251 | 163 | 248 | 83 | 38% | 63% |
| Loddon-Avoca | 58 | 4 | 281 | 146 | 161 | 40 | 48% | 73% |
| Wimmera | 41 | 2 | 179 | 45 | 54 | 27 | 64% | 81% |
| Eastern Mt Lofty Ranges | 17 | 1 | 24 | 7 | 5 | 5 | 67% | 86% |
| **MDB** | **1090** | **128** | **43,184** | **19,178** | **27,691** | **216** | **48%** | **69%** |

**Table 37: Number of rainfall, evaporation and streamflow gauges in each region**

| Region no | Region Name | Ranking | Area | Number of gauges* | | | Average rainfall | Gauging density (per 1000 km$^2$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | x1000 km$^2$ | Rainfall | Evaporation | Streamflow | mm/y | Rainfall | Evaporation | Streamflow |
| 1 | Paroo | 18 | 36 | 23 | 0 | 2 | 311 | 0.6 | - | 0.1 |
| 2 | Warrego | 17 | 77 | 88 | 1 | 6 | 422 | 1.1 | 0.0 | 0.1 |
| 3 | Condamine-Balonne | 13 | 137 | 455 | 13 | 58 | 514 | 3.3 | 0.1 | 0.4 |
| 4 | Moonie | 16 | 15 | 29 | 0 | 2 | 528 | 2.0 | - | 0.1 |
| 5 | Border Rivers | 8 | 44 | 253 | 7 | 45 | 641 | 5.8 | 0.2 | 1.0 |
| 6 | Gwydir | 9 | 25 | 83 | 3 | 38 | 644 | 3.3 | 0.1 | 1.5 |
| 7 | Namoi | 6 | 40 | 245 | 5 | 54 | 633 | 6.2 | 0.1 | 1.4 |
| 8 | Macquarie-Castlereagh | 11 | 73 | 253 | 5 | 81 | 544 | 3.4 | 0.1 | 1.1 |
| 9 | Barwon-Darling | 15 | 142 | 98 | 3 | 29 | 328 | 0.7 | 0.0 | 0.2 |
| 10 | Lachlan | 14 | 86 | 205 | 8 | 62 | 461 | 2.4 | 0.1 | 0.7 |
| 11 | Murrumbidgee | 10 | 87 | 419 | 8 | 89 | 530 | 4.8 | 0.1 | 1.0 |
| 12 | Murray | 12 | 208 | 431 | 26 | 151 | 340 | 2.1 | 0.1 | 0.7 |
| 13 | Ovens | 3 | 8 | 76 | 4 | 32 | 1004 | 9.7 | 0.5 | 4.1 |
| 14 | Goulburn-Broken | 2 | 22 | 226 | 8 | 100 | 764 | 10.1 | 0.4 | 4.5 |
| 15 | Campaspe | 1 | 4 | 40 | 2 | 29 | 594 | 10.1 | 0.5 | 7.3 |
| 16 | Loddon-Avoca | 5 | 25 | 134 | 4 | 51 | 430 | 5.4 | 0.2 | 2.0 |
| 17 | Wimmera | 7 | 31 | 107 | 6 | 36 | 403 | 3.5 | 0.2 | 1.2 |
| 18 | East Mt Lofty Ranges | 3 | 5 | 57 | 1 | 16 | 463 | 12.1 | 0.2 | 3.4 |
| | **MD Basin** | | **1,062** | **3,222** | **104** | **881** | **457** | **3.0** | **0.1** | **0.8** |

### A2.2.13 SCA Water Monitoring Program – July 2009

SCA undertook a comprehensive review of their water monitoring programs with a view to developing and implementing an effective and efficient integrated program of monitoring for water quantity and quality. This program was to be delivered in two parts, with the first report describing proposed routine monitoring components and a second report in October 2009 targeting and investigative monitoring projects will be identified and documented.

The SCAs water monitoring program covers the SCAs area of operations from the catchments to the inlets to water filtration plants and rivers downstream of water supply dams and weirs. Monitoring includes physical, chemical, biological, hydrological and meteorological parameters through on line, field sampling and laboratory analysis. This monitoring review was restricted to the geographical area covered by the SCAs water monitoring program, including the catchments, storages and rivers downstream of the water supply infrastructure.

The SCAs area of operations comprises approximately 16,000 square kilometres of catchments. Land-uses within the area of operations are diverse and have the potential to impact on water quality and as such it is important that a catchment monitoring program is in place to assess any threats to water quality.

SCAs monitoring activities were divided into five key areas:

1. Monitoring downstream of storage
2. Catchment monitoring
3. Monitoring of lakes and storages
4. Dam safety monitoring
5. Monitoring of picnic area water supplies

Some monitoring issues identified in the review included:

- Long-term routine water quantity and water quality monitoring sites be maintained into the future as part of an integrated Hawkesbury Nepean environmental monitoring program. Some obvious gaps in the current monitoring program occur where some indicators need to be aligned with predicted changes in the catchment, or in areas where change following management intervention is likely to occur.
- Adequate catchment monitoring is undertaken to allow an assessment of the threat of a range of landuses impacting on water quality.
- Any part of the monitoring program that has been identified as necessary for long-term trend analysis for lakes and storages should retain the same monitoring sites, frequencies, parameters and reporting methodology. A major objective for the new monitoring program will be to maintain an appropriate balance between removing redundant monitoring and maintaining the integrity of long-term datasets for trend analysis
- New chlorination facilities have been implemented for SCAs picnic areas and new monitoring sites have been selected to assess the effectiveness of chlorine disinfection.

- Ongoing monitoring of raw water supplied for treatment at the off-take point of lakes or the inflows to Water Filtration Plants (WFPs) prior to the water treatment process be maintained to ensure that both quantity and quality meet customers' requirements. Telemetered instruments at critical points in the raw water supply system provide real-time information on changes in water quality and quantity. Sampling of water at the raw water supply points provides additional information on specific water quality characteristics.

# Appendix 3 – M&E program benefits / NSW agency inputs

There were  five reports received in 2011, and they have been inserted below.

- NSW Department of Industry and Investment (now called DPI)
- Sydney Catchment Authority
- Department of Environment, Climate Change and Water (DECCW) now called OEH, with assistance from Manly Hydraulics Laboratory (MHL):
- Sydney Water
- State Water

## Industry and Investment NSW

*Notes for Technical Reference Group on Water Monitoring*

### Instrumentation / Telemetry

Across the Industry and Investment NSW (NSW I&I), water monitoring projects can be divided into three main categories:

7. Stream gauging and water quality monitoring (suspended sediment, turbidity) in 35 small forested catchments, including a range of coastal native forests and inland pine plantations (**Bureau Project 7.1**)
8. Weather stations – located at 17 research stations throughout NSW (**Bureau Project 7.2**)
9. Dryland water balance and salinity monitoring in ten upland catchments (Key sites) from Wagga to Quirindi (**Bureau Project 7.3**).

In the **2008/9** round of M&E funding, NSW I&I (formerly DPI) was successful in attaining funding for three projects across each of the categories:

**Project 7.1** – funding was used to upgrade and replace data-loggers, pressure transducers and optical shaft encoders in the WM network.

**Project 7.2** – funding was used to replace the data-loggers at six existing AWSs and to install complete AWSs at two new sites (Dareton and Narrabri). Telemetry has been upgraded at all eight sites to router rather than modem status. All eight sites will now be Bureau compatible although NSW I&I will continue to download data.

**Project 7.3** – funding was used to upgrade stream gauging, climate and groundwater stations with data-loggers, turbidity sensors, EC sensors, pyrometers, RH and temperature sensors, barometric pressure sensors, wind speed and direction sensors, solar radiation sensors and modems for telemetry.

In the **2009/10** round of funding, NSW I&I was successful in attaining funds for one project:

**Project 7.1** – funding has been received for a project to improve water balance estimates across the Forests NSW stream gauging network by improving station ratings. The funding will be used to purchase ultra-sonic Doppler units for continuous velocity measurement and to purchase a total station which will be used for accurate surveys of gauging stations to be utilised in a project to better model flows that exceed the present rating curves.

### Future priorities

Across NSW I&I, the following have been listed as priorities for water monitoring/investment:

- acid sulphate soils in coastal catchments
- understanding the effect of changes to landuse on interception
- flow regimes and impact of landuse on fish populations

- increased adoption of water-efficient practices
- understanding and reducing the impact of mining on aquatic ecosystems
- water management risks that threaten water dependant ecosystems and aquatic industries
- development of water accounting and reporting standards including MER.

More specifically, Forests NSW has identified the following priorities:

- increased reliability of rainfall networks
- increased reliability of in-situ water quality data
- installation of telemetry.

### Benefits of M&E funding to date

The funding received by NSW I&I has been of enormous benefit. Across the department much of its water monitoring equipment was outdated and in urgent need of replacement. The M&E funding has injected much-needed capital into these projects and undoubtedly increased the reliability of data collected, extended the working life of the stations involved and improved the department's capability to transfer data to the Bureau, as required under the *Water Regulations*.

### Recommendations for future bids

Forests NSW is likely to submit bids for the following:

- upgrades to its pluviometer and storage rain gauge network
- telemetry to provide real-time data from gauging stations (possibly satellite and/or radio-modems in remote sites)

NSW I&I is likely to submit bids for the following:

- upgrades to its existing field instrumentation network including telemetry to provide real-time data
- upscaling measurements to key areas by adding additional instrumentation

### State-wide issues

NSW I&I believes there are opportunities for better cross-agency collaboration in the field of water monitoring. The technical reference group (TRG) is a good starting point for opening discussions regarding the availability of and need for new or improved technologies to effectively and efficiently meet the various objectives of water monitoring programs. Perhaps the most obvious opportunity is to collaborate on funding applications to increase the possibility of obtaining bulk-discounts with suppliers. Another opportunity exists to develop consistent standards for water monitoring to be applied by all agencies within the jurisdiction.

Current NSW I&I water research activities are examining the effect of changes to landuse on the paddock water balance. This is particularly relevant to the current

interest in quantifying interception of water. NSW I&I activities are measuring landuses outside the current focus of interception research and may provide valuable research for evidence based policy.

## Sydney Catchment Authority

*Bureau of Meteorology Modernisation and Extension Program Outcomes Summary*

### (1) Project 4.2 Upgrade of stream gauging stations

#### Project description

Prior to the commencement of this modernisation project, approximately 65 of the SCAs water level monitoring sites were fitted with Mace HM2000 data loggers. These are no longer supported by their manufacturer and were replaced. The funding from Bureau was used to upgrade 27 of the Mace logger sites in 2008/09. The sites involved are water level sites at SCA storages, inflow monitoring sites and licence reporting sites.

#### Activities undertaken

When the data loggers were replaced, each site was fully upgraded. This involved:

- Replacement of the data logger
- Replacement of the site wiring to the standard of the newly installed sites
- Reprogramming of the data logger to provide consistency of logger configuration
- Replacement of modems (if installed)
- Upgrade of the telemetry to an IP based system where NextG coverage is available.
- Replacement of existing analogue sensors with SDI-12 digital sensors
- Replacement of all lightning protection.
- Documentation of the upgrade
- Delivery to the SCA of details of the installed equipment for inclusion in the SCAs MAXIMO database and reporting to the Bureau.

## (2) Project 4.3 Standardise programming of field loggers

### Project description

The SCA has 77 telemetered water level monitoring sites. Many of these sites monitor parameters other than water level, such as temperature. Historically there were different types of data logger and the loggers were installed at different times by different contractors. As a result the data loggers did not store data in a consistent format. This caused difficulty when the information from the data loggers was downloaded to the SCAs computers. This project was to reprogram the loggers so that the data retrieved from the loggers is as consistent as possible.

### Activities undertaken

The types of logger in service were catalogued and the data order in each examined.

There are three basic types of data-logger at water level sites:

- The Mace Hydromace2000 (many being replaced under Project 4.2)
- The Campbell Scientific CR10X/CR510 family
- The Campbell Scientific CR1000/CR800 family

Each of these loggers has its own native data format.

There are also significant differences in the complexity of the sites. Some simply monitor the water level; others monitor varying numbers of water quality parameters. Some sites also have one or more automatic water samplers.

A consistent data format was defined and adopted as the standard. As a result all sites with Campbell loggers (including those installed under Project 4.2) have been programmed to deliver data as per the adopted standard.

## (3) Project 4.4 Replacement of rain gauges and data loggers

### Project description

This project involved the replacement of the older data loggers and rain gauges at 45 SCA rain gauge sites. When either a rain gauge or data logger was replaced, the condition of all the wiring on site was be assessed and replaced as required. Modems (where applicable) were be replaced at the same time as the data loggers.

### Activities undertaken

The M&E funding was used to upgrade 45 rain gauges. At 11 sites, both the rain gauge and data logger were replaced, at 13, the rain gauge only was replaced and at 20 sites, the data logger was replaced.

Where coverage was available, NextG IP capable modems were installed.

## (4) Strategic benefits

As a consequence of the SCAs projects funded under the Modernisation and Extension Program, the vast majority of sites have:

- new, modern data-loggers and modems
- new rain gauges
- upgraded, consistent physical configurations and wiring
- all relevant data recorded in the SCAs asset management database

Important strategic benefits include:

- consistency of equipment and programming will improve the reliability and efficiency of data transfer to existing systems and facilitate conversion to new formats and systems in the future
- enablement of IP capability, with resulting increases in communications reliability, flexibility and cost efficiencies
- simpler, more efficient maintenance and upgrade processes
- more timely and reliable data to both the SCA and Bureau during major inflow and flood events
- in the long-term, more accurate and complete datasets for water resources assessment and planning

## Manly Hydraulics Laboratory (MHL)

Bureau Modernisation and Extension Program – Summary of Progress

The following summarises the program improvements funded under the Bureau of Meteorology's Modernisation and Extension program, achieved by Manly Hydraulics Laboratory (MHL) within the Department of Environment, Climate Change and Water (DECCW).

### Benefits to DECCW monitoring program

- Capital upgrades that provided funds to upgrade an ageing network of data loggers and sensors unable to be renewed previously due to State funding constraints
- Renewal of an ageing telemetry system unable to be renewed previously due to State funding constraints
- Renewal of an ageing database and content management system unable to be renewed previously due to State funding constraints
- The upgraded data network is essential in monitoring long-term changes in flooding and tidal characteristics as a result of climate change and associated sea level rise.

### Benefits to NSW

- Co-ordination and rationalisation at a State level of all major monitoring programs via the NSW Technology Reference Group in Water Monitoring
- Working towards the supply of data in specified format

Considering the benefits achieved so far under the program and the direction water monitoring is taking at a national level, DECCW and MHL will be targeting further improvements in the following areas.

### Future opportunities for DECCW

- Telemetry upgrade – complete capital upgrade to IP modems
- Telemetry investigation – ensure redundancy for priority flood warning stations. Noting IP Telemetry is relatively new in Australia. Initial reports suggest during times of inclement weather IP telemetry may not meet set standards for reliability.
- Real-time quality assurance – for data provision to Bureau NSW Flood Warning Centre, Bureau AWRIS database and the State Emergency Services
- Development of the database and content management system to incorporate an asset management system and facilitate quality water data storage, access and transfer to Bureau and other stakeholders.
- Co-ordinate digitising, transfer and the metadata for all the additional stations not required to be sent under the current Regulation (i.e. 50 years of gauging exercises and project water quality and level data)

- Development of a more robust, streamlined OHS compliant gauging station
- GPS survey of the entire network to ensure regionally consistent datums

**Future opportunities for NSW**

- Further co-ordination of data delivery systems to streamline and rationalise NSWs monitoring network
- Co-ordination of instrumentation standards across NSW
- Co-ordination of data quality standards across NSW
- Co-ordination of metadata requirements across NSW
- Contribution to quality standards at a national level
- GPS survey of the entire network to ensure regionally consistent datums
- Development of a more robust, streamlined OHS compliant gauging station

**Future opportunities for the Nation**

- Real-time quality assurance – to ensure end user of the data understands the quality of the dataset prior to use.
- NSW driving reform in data quality and instrumentation standards
- Following implementation of new MHL database and content management system, MHL systems could be used to help pilot future AWRIS development.

## Office of Environment and Heritage NSW

Notes for Technical Reference Group on Water Monitoring

The Coastal and Floodplain Programs Unit of OEH is responsible for the management of the NSW Coastal Environmental Data Network. Manly Hydraulics Laboratory (MHL) maintains and operates the data network under an annual performance based contract with OEH. The data is used by OEH, the Bureau, SES and local councils for the purposes of flood warning/forecasting as well as being an important input into the preparation of Floodplain, Estuary and Coastal Management Plans. The data is also used to monitor the likely impacts from climate change and associated sea level rise.

The current network is made up of 220 river and estuary water level recorders, 72 rainfall gauges, 17 ocean tide gauges, 4 offshore tide storm surge gauges and seven deepwater waverider buoys.

### Bureau Modernisation and Extension Program

In the 2007/08 and 2008/09 rounds of M&E funding, OEH (formally DECCW) was successful in securing funds to upgrade the 237 individual stations that make up the water level network. These stations are located in the tidal and non-tidal reaches of all the significant waterways of coastal NSW. The data logging instrumentation at these stations was around 20 years old and had become outdated and unserviceable. The replacement of the aging equipment to current technology has substantially improved the quality, reliability and accessibility of this extensive network of water level recorders. In addition to the upgraded data-loggers and new telemetry system, additional pressure sensors were installed at 92 key monitoring sites. These additional sensors provide improved data reliability and recovery via a backup system, especially during major flood events, and will enable further development of real-time quality controlled data. This project has allowed OEH to close data gaps identified in the NSW SWIMP, namely Gap 4 Data capture and transfer not meeting time requirements and Gap 31 Lack of telemetry system full telemetry.

Also in 2008/09 OEH received funding to remodel, update and migrate OEHs water quality database. In the past, OEHs water quality data was stored as multiple electronic files in a variety of formats, and was difficult to access or transfer in a user requested format. The upgraded database enables the efficient storage, access and timely provision of all OEHs water quality data to internal and external stakeholders, including meeting OEHs requirements under the *Water Act 2007* (Cwlth) for the supply of water quality data to the Bureau on an ongoing basis. This project addressed data Gap 19 Insufficient water quality in electronic format (data at risk) and Gap 30 Water quality database unable to export in WDTF format.

In the 2009/10 round of M&E funding, OEH obtained funding to upgrade the MHL Database and Content Management System. The existing data management systems were outdated and redundant, and there was a real risk of irrecoverable system failure that could result in a disruption of data provision to the Bureau, OEH and the general public. The upgrade will result in improved data security and reliability in water data management within OEHMHL and the processes for the transfer of data to the Bureau in WDTP format. The project will meet the objectives identified in data Gap 36 Core database unable to meet current and future data management needs and delivery

needs and Gap 26 Surface water database unable to export data in WDTF format. It is proposed to seek further funding in 2010/11 to enhance and further customise the database and content management system to provide improved integration across NSW government agencies.

OEH also received funding 2009/10 for the first stage in upgrading the telemetry system for all the water level and rainfall recorders to Internet Protocol (IP) telemetry. Data is currently transferred from these remote sites via a dial-up internal modem system. This upgrade will improve data transfer reliability, compared with existing dial-up systems, and provide a fallover system for communications to these sites. It is aligned with meeting the data gaps 4 and 31 outlined above. It is proposed to seek further funding in 2010/11 to complete the IP telemetry upgrade.

### Benefits of the Modernisation and Extension Program

The funding received by OEH under the Modernisation and Extension Funding Program, over the first three funding rounds, has been critical in updating ageing water monitoring equipment and data management systems that would not have been possible under current state funding levels. The M&E funding has allowed improved data access and reliability in water data management and improved the processes for the transfer of data to the Bureau under the *Water Act 2007* (Cwlth). The upgraded data network will be essential in monitoring long-term changes in flooding and tidal characteristics as result of climate change and associated sea level rise.

### Future funding bids

OEH is likely to submit bids for the following:

- a continuation of funding under round 3 to upgrade the remaining hydrometric stations to include IP telemetry,
- a continuation of funding under round 3 to further upgrade the database and content management system,
- develop a Total Asset Management Plan (TAM) for the coastal and floodplain network to quantify funding requirements that will ensure assets are operated and maintained sustainably into the future.
- development of a gauging station of the future that would include no maintenance, minimum OHS risk and self QA and calibration,
- undertake GPS heighting survey on gauging stations to meet specified horizontal datum accuracy,
- development of an asset management plan for the hydrometric network including asset replacement strategy related to the M&E funding,
- upgrade select gauging stations that do not currently met OHS and risk management standards,
- development of a replacement system for the current Bureau radio telemetry system,
- improved real-time data quality assurance and quality coding, and

- digitising and transfer to database of all historical data (including tidal gauging, water quality and level data).

### State-wide issues

OEH has identified the following state-wide issues related to water monitoring:

- support for the NSW Technology Reference Group in Water Monitoring to co-ordinate all major water monitoring in NSW, including instrumentation, and data quality standards,
- improving the quality of real-time data through quality assurance and quality coding,
- adaptation of the current data network to meet additional management priorities (e.g. estuary health and flow), and
- discharge monitoring during flood events at key sites.

## Sydney Water

Bureau of Meteorology – Modernisation and Extension Program Benefits

Programs implemented by Sydney Water under the Bureau of Meteorology Modernisation and Extension program funding have provided significant benefits to hydrometric monitoring networks and improved water-related data and information delivery. The following summarises improvements made and some benefits realised since implementation of the 2008/09 programs.

Funds provided in 2008/09 were used for the following improvements.

### Upgrade rainfall and inland STP data loggers

Modernisation of Sydney Water operated metropolitan rainfall and inland STP monitors with the replacement of ageing, dial-up data loggers with 125 Halytech Spider™ IP data loggers has resulted in the following improvements:-

- A significant reduction in the number of logger failures in the hydrometric networks particularly with the elimination of ‘modem – logger lock up’ problems formerly associated with older, dial-up loggers with external OEM modem.
- With its easily programmable functionality the new logger has provided a simple and effective ‘push data’ telemetry system with data being sent independently from each individual site via GPRS to an FTP server each day or up to each hour as required
- The GPRS telemetry system provides a data delivery ‘guarantee’ and has reduced the reliance on specialised, centralised, dial-up polling programs which required additional maintenance and subject to failure and late data deliveries
- Each site data logger transfers data automatically at pre programmed times via GPRS and the Ethernet to an FTP server from where it is automatically processed to Hydstra or *re-directed* as raw data to elsewhere as required

- Threshold alarms can now be sent from logger to logger via SMS and this has allowed for additional controlling, activation of water samplers and a simple yet effective metropolitan catchment based high rainfall alarm system
- The overall network reliability has improved (generally 100% recorded)
- The new loggers have enabled simple, automatic data send as well as dial-up access for configuring, remote firmware upgrade or interrogation
- The overall reliability and high-level data capture has resulted in more timely, validated information being provided and in future will be the 'standard' logger used across various Sydney Water hydrometric networks

### Differential Global Positioning System (DGPS)

The provision of funds for a DGPS for use by hydrometric and field sampling teams has resulted in the following improvements:

- Easy to use Hemisphere R220™ DGPS with sub-metre capability has provided improved metadata of water quality samples taken at drinking water catchment sites sampled by Sydney Water Field Services team
- Sub-metre accuracy provides a means to locate specific sampling points and an added assurance of repeatability
- Accurate geo-coding of hydrometric sites and in particular sensor location, morphology, assets or other features which may describe the information collected from sites

### Data extractions from source systems

Our partnership with Bureau has also enabled us to upgrade some of our source systems and to write scheduled data extraction and send processes. Storage, Water Quality and meteorological data are being extracted from a variety of sources, summarised and transmitted to the Bureau on a weekly basis without any human intervention.

## State Water Corporation

Bureau of Meteorology – Modernisation and Extension Program Benefits

The funding facilities under the M&E program have resulted in wide ranging improvements to water monitoring, data management and data dissemination systems within State Water Corporation (State Water). The most important outcome is the ability to provide timely and better quality information dissemination to the Bureau through the central database of the Office of Water as well as to provide this water information to State Water's huge customer base.

Under the M&E program State Water has under taken the following projects:

- Upgrades to Level Recorder instrumentation of all of 20 major storages
- Installation of modern and up-to-date Automatic Weather Stations (AWS) at ten of the major storages. State Water would be submitting a proposal to continue with the modernisation and installation of AWS in the remaining ten major storages in the Round 4 of funding under M&E program
- Modernising and developing a data management tool, called Koncentrator, to harmonise discrete surface water datasets from multiple sources within State Water Corporation, facilitating the rationalisation and automation of data distribution systems
- The bathymetric survey of State Water controlled storages and weir pools, to allow the development of more accurate capacity tables, increasing operational efficiency, particularly in times of low flow conditions. More accurate storage data will enable better water resource management decisions to be made and provide accurate and robust set of data to the Bureau complying with *Water Regulations 2008* and Bureau requirements.
- To develop, test and implement a web based manual data entry tool, which will facilitate data entry on storage levels, releases, diversions, stream levels, etc from non-automated sites
- Installation of pressure measurement systems for storage with hydro-electric power generation capability.

The key objective of these projects were to provide accurate surface water and meteorological data monitored at State Water's major storages and transfer to the Bureau of Meteorology in a timely, formatted and efficient manner. The proposed systems that would develop under M&E program will provide more accurate, timely and effective information for the management of storages enhancing management of water resources around the state and providing an automated process to deliver the water data to the Bureau of Meteorology as required under *Water Act 2007* (Cwlth).

The priorities and key aspects of the future investment under M&E program relevant to water delivery and monitoring program of State Water include:

- Identification of data requirement of the Bureau and automate the systems to transfer data/information to the Bureau
- Automation of meteorological monitoring

- Upgrade instrumentation of storage and weir level recording equipment
- Upgrade the accuracy of storage capacity tables
- Software development to automate the transfer of TT figures to the Bureau
- Installation of accurate measuring devices monitoring equipment
- Identification of isolated manual data management systems and automation of the same
- Automation of data collation and transfer systems to the Bureau
- Providing improved water monitoring networks to meet objectives of NWI
- Close gaps in current monitoring network
- Improved forecasting of water demands and river 'losses' to make river operation more efficient – telemetry or other methods to improve demand capture and compliance monitoring
- Flood operation – rainfall runoff predictive capacity, improve timing of storage pre-release against tributary flows
- Better event forecasting for more effective environmental release
- Review accuracy of current monitoring network by Identify NWI/Bureau compliant standards
- Seasonal forecasting – improve management of transfers between storages
- Seasonal forecasting better management of environmental allocations
  - airspace operation of storages
  - More flexibility in access for water users
- Consistent and efficient handling of information at times of floods and low flow conditions

The harnessing of the investment in the stated areas will result in improved understanding of water balance and the ability to deliver contemporary water accounting. Coupled with this will be improved reporting of water resource assessment and support for environmental sustainability.

# Appendix 4 – Data gap resolution analysis

**Table 38: Gap Analysis M&E ROUND 5— 201012012**

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improved measurement, logging and currency system for ground-water, stream flow and their interaction | NSW7.04 | GAP 1: In some catchments the surface water network coverage is not fully meeting water information requirements<br><br>***Gap Resolution***<br>*Gap resolved for DII water monitoring activities in Kyeamba Valley near Wagga and near Quirindi on the Liverpool Plains*<br><br>Other gaps addressed; 3, 5, 8, 12, 14, 17a, 17b, 17c and 20. | 95,700 | **Purpose:**<br>· To continue to improve the accuracy and currency of the existing I&I NSW streamflow network and its interactions with groundwater monitoring.<br>· Improved accuracy will be achieved through the installation of up to date sensors, and data logging technology and re-rating of streams following large flood events.<br>**Outcome**:<br>· The installation of modems will allow timely information to be available to stakeholders.<br>· The use of accurate temperature sensors in both groundwater and surface water in conjunction with groundwater elevations will be used to estimate fluxes between the stream and the hyporheic zone.<br>· Information on groundwater / surface water interaction from this local model could be used for larger scale National Water Market models. |
| Coordination – NSW Water Monitoring and Data Provision to Bureau | NSW1.01 | Gap 21: Insufficient coordination for SWIMP activities at jurisdictional/lead agency level<br><br>**Gap Resolution**<br>*Gap resolved for Bureau activities in 2011/2012 and for 2012 SWIMP.* | 198,000 | **Purpose:**<br>· Coordinate activities which will assist the Bureau in fulfilling its water information objectives.<br>· Update and maintain current jurisdictional SWIMPs to clearly identify critical monitoring sites that support water sharing plans and or environmental flow monitoring within the Basin and that are not already in WMN09.<br>**Outcome:**<br>Employment of strategist who has coordinated NSW Office of Water activities and the development of a cross agency strategic investment plan. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Water Accounting Resourcing | NSW1.03 | Gap 5 Inadequate water mass balance information.<br><br>***Gap Resolution***<br>*Gap resolved for 2012 NWA. Some methods continue to be trialled and developed.* | 236,500 | **Purpose:**<br>· To partner with the Bureau to prepare water accounting reports for those regions specified in the partnership agreement.<br>· Development of water resource, water use and water market accounting procedures and methods to inform water planning, water markets, investment decisions and environmental management in the jurisdiction<br>**Outcome:**<br>· Support for the production of the National Water Account (NWA) 2011 and subsequent NWA's,<br>· Expansion of the water accounting geographical coverage of NSW,<br>· Development of tools to improve the quality and timeliness of water accounting information and enhance its ability to deliver groundwater information. |
| Installation of sensors and telemetry for monitoring of surface water-groundwater interaction | NSW1.05 | Gap 13 In some catchments, the groundwater network coverage is not fully meeting information requirements.<br><br>***Gap Resolution***<br>*At aprox. $30,000 a unit, this Gap is closing with improved number of telemetered sites, but in 2012 is only resolved at 50%.*<br><br>*Other gaps addressed include Gap 1, 31 and 47.* | 100,000 | **Purpose:**<br>The overall objective of this project is to increase the number of groundwater sites on telemetry across New South Wales. There will be 2 Phases.<br>· Phase 1 will result in the permanent establish of telemetry in some of the Office's existing groundwater/surface water interaction sites in six river valleys.<br>· Phase 2 of this project involves the expansion of the telemeter groundwater monitoring network into other crucial recently established water sharing plan areas or the expansion of the network into existing water sharing plan areas.<br>**Outcome:**<br>Phase 1: Improved knowledge about the flux exchange between surface water and groundwater. This information enables numerical models to be sufficiently constrained so they can provide more reliable estimates of river-aquifer water balances on a catchment scale<br>Phase 2: Increased monitoring network density and spatial distribution which results in better data availability, better accuracy and more appropriate management decisions. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Standardisation of Height Datums | NSW1.06 | GAP 6: Spatial location of monitoring sites<br><br>Gap 16: Spatial mapping of groundwater network<br><br>***Gap Resolution***<br>*Installing the benchmarks has been resolved. There is still outstanding work to be done on over 90% of groundwater sites and 40% of surface water sites. Gap resolution is:*<br><br>*Gap 6 – 75%*<br>*Gap 16 – 75%* | 100,000 | **Purpose:**<br>Phase 1 was conducted last funding round and most groundwater sites are completed. Phase 2 consists of continuing to improve the locational information and accuracy of groundwater bores and surface water gauging stations, by installing 150 'C" type benchmarks at selected sites and then surveying these benchmarks, selected surface water sites and groundwater bores to AHD (Australian Height Datum). This style of benchmark is seen as a cost efficient mechanism with great stability, particularly in unstable soils such as the Black Earths.<br>**Outcome:**<br>Completion of this project will enable:<br>1. The development of more accurate trends such as interactions between groundwater and surface water, better models and better management decisions based upon more accurate data as all sites would be tied to a known datum.<br>2. These datasets to become compliant with ISO19115 – Geospatial data<br>3. Other Government agencies would ave the confidence to place the acquired data on the SCIMS web page for use by anyone with web access.<br>4. Agencies such as State Water Corporation would have greater confidence in the water information and the resultant effects upon water delivery.<br>5. Inclusion of the standardised daraset into the Australian Hydrological Geospatial Fabric. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Historic Data Entry and Retrieval - Groundwater | NSW1.07 | GAP 11: Insufficient groundwater data in electronic format (data at risk)<br><br>***Gap Resolution***<br>*Gap close to resolution for all significant historical data. Gap also close to resolution for integration of recovered data into relevant models and information systems.*<br>*75% resolution of Gap 11 for NOW.*<br><br>*Other gaps addressed:*<br>GAP 19:<br>GAP 28:<br>GAP 30: | 110,000 | **Purpose:**<br>This project is the continuation of work commenced in Round 4 to recover and rectify historic data of strategic value and which is at significant risk of loss. The project has several components: It focuses on the recovery of data from the Great Artesian Basin Module of the Groundwater data base and reviews all water level data. It also aimed to:<br>· Continue the upload of the historic RLMP and Form AG data into the Groundwater Database System.<br>· Continue to extract groundwater quality data form existing hardcopies, digitise and enter into the corporate database.<br>· Maintain the historical drillers log data entry<br>· Implement data cleansing/rectification to enable easier data migration into the new corporate database as the new database has multiple keys and unique codes and more stringent data requirements. If this does not occurs these data will be lost.<br>**Outcome:**<br>This project improved the currency and relevance of existing data in the corporate databases which will lead to better informed management decisions in regard to modelling, climate change monitoring and management. There were several stages to the project.<br>Phase 1: a programming task that enabled the link to be established between LAS and GDS at an individual bore level<br>Phase 2: Data “cleaned” before it was transferred across to the new GW Hydstra database. The specifications for the new GW Hydstra database have included the link between the licensed extraction site/point and the bore, therefore cleansing of these data was required prior to transferring to the new database otherwise all these data would have been lost.<br>In addition this project is directly linked to Bureau proposal 5NSW01.10, NGIS Trial Integration which is predominantly about the categorisation of stratigraphy and developing classes of hydrological units. When data has been indentified for ingest to NGIS it will be referred to project 01.07 for quality review and edit as required. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Monitoring site location correlation and quality improvement | NSW1.09 | GAP 6: inadequate spatial location of water monitoring sites".<br><br>**Gap Resolution**<br>*Gap resolved only for method development. Will need to be applied to complete gap closure. Gap closure for NOW is 25%.*<br><br>*At the end of this project NOW will have all current surface water monitoring sites with adequate spatial location and 80% of discontinued sites with adequate spatial location.*<br><br>*Any future sites will have adquate spatial location.* | 110,000 | **Purpose:** While new sites are established with quality spatial locations, older and historical sites have varying quality in location. This project will update spatial location information for some of the older sites in the nework.<br>· Quantify the spatial quality of the current water monitoring sites held within the NSW Office of Water's databases in relation to the requirements of the NHGF<br>· Integrate those sites that meet the spatial quality criteria with the NHGF<br>· Propose, test and apply a methodology to improve the spatial quality of the remaining sites<br>**Outcome:**<br>The finished project will have completed the following tasks:<br>· Agreement with stakeholders on initial monitoring site location quality requirements<br>· Use of spatial analysis techniques to assess and quantify monitoring site location quality from existing NOW databases in relation to NHGF hydrological features<br>· Produce initial set of quality verified NHGF related monitoring site datasets<br>· Identify, test and apply other geo-processing techniques with additional spatial datasets to improve location quality of remaining monitoring sites where possible<br>· Develop methodology and quantify task for remediating the location quality of remaining monitoring sites |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| NGIS Trial Integration | NSW1.10 | Gap 10: Data quality and reliability in GDS<br><br>***Gap Resolution***<br>*Gap is not yet resolved. The eventual aim is to integrate with NGHF. This trial is leading towards this outcome and has involved the collation of existing reports and data on the geological stratigraphic units for the NOW groundwater monitoring network in the Lower Murray, Lower Murrumbidgee, Lower Lachlan, Lower Macquarie, Upper and Lower Namoi and Lower Gwydir alluvial groundwater sources in the NGIS format and has concentrated on the HydroGeological Unit and the BoreLine data tables of the NGIS data model.*<br><br>25% Gap Resolution for NOW for this issue relatvie to Gap 10.<br>Other gaps addressed by this project include<br>Gaps – 16 & 48, 38, 28 | 200,000 | **Purpose:** In project 4NSW01.25 NOW purchased and trialled Aqua Veo Arc Hydro Groundwater software. As part of the project the NOW has undertaken initial assessment of how existing groundwater data can integrate into the NGIS database structure. This project extended the existing work undertaken in 4NSW01.25. The intent of the project was to scope:<br>· Investigation for the creation and of an instance of an NGIS database within the NSW Office of Water corporate spatial database management systems.<br>· Investigate and document the feasibility of the ongoing management of the NGIS dataset.<br>· Indentify and document any implementation issues for NSW in the provision of data to the NGIS data model.<br>· Determine the ability to integrate Arc Hydro Groundwater software into the NSW Office of Water corporare systems<br>**Outcomes:**<br><br>NOW data is required to be provided to Bureau in the NGIS data model format and this project will have determined,<br>· potential issues with the NGIS data model from a NOW perspective,<br>· the ability to use the NGIS data model in Arc Hydro groundwater, and<br>· the ability of using Arc Hydro groundwater to undertake interpretation of existing data to improve the current database information. This will assist in improving the population of the NGIS data model and the level of knowledge of NSW aquifer systems for the development and implementation of water sharing plans. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Historic surface water data recovery and quality control of data recovered to date | NSW1.11 | Gap 9: Water storage and surface water data not in electronic format.<br><br>**Gap Resolution**<br>*Gap resolved only for method development. Will need to be applied to complete gap closure. Gap closure for NOW is 25%.* | 275,000 | **Purpose:** This is a continuation of Project 1.02 which has recovered a significant amount of surface water data which previously existed only on paper records, and has converted these to computer accessible format. The task now is to ensure that the data recovered is quality coded and upgraded to current standards, which are more rigorous than those existing at the time the data was collected.<br>· The objective is to provide the Bureau with the best available long term records of river flows to assist it in monitoring long term trends of climate variability.<br>**Outcome:**<br>The main focus of the 2011-2012 data entry (using 4 C100 data entry operators with up to 3 years experience each) was metadata, information from site History files. The metadata includes a wide variety of information on the station's performance, hydrologic characteristics and relationships to other sites in the catchment. This will provide valuable additional information to those auditing the site's data, and preserve the information as many of the files are in bad condition and stored away from easy access. |
| Extension of NSW Water Supply and Sewerage Performance Monitoring Database for additional Bureau indicators | NSW1.12 | GAP 44: Inefficiencies from inconsistent data storage of category 7 data<br>GAP 45: Inaccuracy of category 7 system data, and lack of quality assurance<br>**Gap resolution (Round 5):**<br>*Gaps 44 and 45 will be resolved relative to storage of data for the 29 new indicators for Category 7 data. The gap is not fully resolved for the automated transfer of the new data to the Bureau.*<br>*Gap 44 and gap 45 RESOLVED for the data collection, storage and accuracy of Category 7 data.* | 110,000 | **Purpose:** Previous projects NSW01.21(round 4) and NSW 1.20 (round 3). This project is the extension of the NSW Water Supply and Sewerage Performance Monitoring Database that was funded in rounds 3 and 4 to include 29 additional Bureau of Meterology indicators in order to provide Category 7 data to the Bureau in accordance with its 2011 requirements under the *Water Regulations 2008* from each NSW non-major urban water utility.<br>**Outcome:**<br>This project will ensure that data reported to the Bureau by NSW non-major urban water utilities via the NSW Database is accurate and consistent and that the data reflects the requirements and definitions provided by Category 7 under the *Water Regulations 2008* and includes all additional indicators required by the Bureau and that these agree with the definitions provided by the National Water Initiative under the National Performance Framework 2010-11. |

| ROUND FOUR<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| HYXL2BOM training in NSW | NSW1.15 | GAP 26: Surface water database system unable to export data in WDTF format<br><br>***Gap Resolution (round 5)***<br>*When the project is completed, Gap 26 will be resolved for small organisations that needed assistance with WDTF.*<br>Other gaps addressed:<br>Gap 27,Gap 29, Gap 30 and Gap 43.<br><br>Please consider this project in reference to project 8.01 | 38,500 | **Purpose:** NSW Office of Water (NOW) saw the need to develop a tool for the many small agencies without sophisticated data management systems looking to deliver data to the Bureau in WDTF format. This tool has been developed.<br>This project prepares training material and delivers training for NSW's smaller agencies looking to adopt HYXL2BOM as their data delivery tool.<br>The training would be directed at NSW agencies but the training material and methods can be adopted by other jurisdictions as well.<br><br>**Outcomes:**<br>· Promoted the use of the M &E funded HYXL2BOM program<br>· Provided a mechanism for smaller agencies to deliver data as required by the Bureua<br>· Encouraged the smaller agencies to contribute their data in WDTF format |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Water Licensing System Toolkit | NSW1.21 | Gap 25 Licensing database system unable to export data in WDTF.<br><br>***Gap Resolution (round 5)***<br>*When the project is completed Gap 25 will be resolved for NOW.* | 264,000 | **Purpose:** To undertake modifications to water licensing database to improve WDTF export functionality. The project will develop a Licensing System Toolkit that will:<br>· extract and formulate data required by NOW and State Water under Category 5 and 6 (*Water Act 2007* (Cwlth))<br>· automatically generate data reports with provision to attach report metadata to meet *Water Act* reporting requirements;<br>· transmit reports to Bureau according to a programmed schedule, in the required Water Data Transfer Format<br>· provide a capacity to respond efficiently to evolving National Water Market System Portal data requirements<br>· create a capacity to provide irregular reports (using consistent search criteria and formatting) to other Commonwealth agencies: MDBA; ACCC; NWC<br>· allow NOW to develop and maintain metadata in a consistent format for reporting<br>· provide secure web based external access to the Toolkit for external data access<br>**Outcomes:**<br>The project will provide a delivery mechanism under Category 5 items f, g, and h and Category 6 item d.<br>There will be improved accessiblity to water licensing data.<br>The development of user manuals and technical documentation will facilitate operations, ongoing maintenance and future enhancements. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Hydstra Water Data Transfer Format training | NSW1.22 | Gaps relating to WDTF but predominantly:<br>GAP 26: Surface water database system unable to export data in WDTF format<br>***Gap Resolution (round 5)***<br>*When the project is completed, Gap 26 will be resolved for small organisations that needed assistance with WDTF*<br>Other Gaps addressed include:<br>GAP 27, 29, 30, and 43. | 41,250 | **Purpose:** NSW Office of Water (NOW), as the NSW lead agency, saw the need to develop a tool for the many Hydstra agencies in Australia so that they could use WDTF to deliver and receive data direct from Hydstra. This tool has been developed.Initial training in this tool has been undertaken for the lead agencies This project extends the WDTF training for NSW's other Hydstra using agencies.<br>**Outcomes:**<br>· Increased awareness of the HYXL2BOM tool<br>· Adoption of this tool by smaller agencies<br>· Established links with the Bureau Support team for this product<br>· Development of training material for this product |
| NOW VPN Network for IP Devices | NSW1.25 | GAP 4: Data capture and transfer not meeting time requirements –<br>***Gap Resolution:*** *Through the provision of* a *statewide secure IP based wireless network for telemetry solutions which will provide a minimum of hourly data delivery this Gap is resolved existing NOW network.*<br>Other gaps addressed: GAPS 1,31 | 50,600 | **Purpose:** To install *VPN to:*<br>· significantly improve the reliability of data delivery<br>· allow all NOW devices to connect directly to its servers and negate the continuing effect of IP range changes and the resultant loss of data.<br>· Provide a statewide secure IP based wireless network for telemetry solutions which will provide a minimum of hourly data delivery<br>**Outcomes:**<br>· Increased reliability of data delivery<br>· NOW devices that connect directly to its servers and negate the continuing effect of IP range changes and the resultant loss of data. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Development of an automated process to increase transparency and accuracy for temporary and permanent water trade administration for Murrumbidgee Irrigation | NSW8.01 | GAP 40: Inability to collate water transfer licensing data efficiently.<br>**Gap Resolution**: *Gap 40 has been resolved for Murrumbidgee Irrigation. Gap 26 is also closed relative to category six.* | 74,800 | **Purpose:** to develop an automated process to increase transparency and accuracy for temporary and permanent water trade administration for Murrumbidgee Irrigation. This covers ongoing data under Item 6b and 6c of the Water Information Program.<br>**Outcomes**:<br>· Improved data delivery to the Bureau.<br>· MI currently provides the information for Section 6b and 6c to the Bureau in Excel format. This project will include an extract and delivery mechanism for data in WDTF. |
| IP Telemetry Upgrade Stage 3 | NSW5.01 | Gap 4: Data Capture and Transfer not meeting time requirements<br>Gap 31: Lack of Telemetry system full redundancy<br>***Gap Resolution***<br>*Gap 4 Has been resolved for MHL for the current technology. Outstanding issues relate to redundancy in the system (Gap 31).* | 60,500 | **Purpose:**<br>To upgrade the telemetry system of the coastal data network (237 water level gauges and 72 pluviometers) to an Internet Protocol (IP) telemetry solution.. Data from the network is currently transferred from these remote sites via a dial up internal modem system to MHL's database and data management system.<br>OEH received funding from the Bureau in 2009/2010 and 2010/11 to upgrade 215 high priority sites to IP telemetry via iQuest iCE3 modems. This project is for the third and final stage of the telemetry upgrade, converting the remaining 75 sites to IP telemetry. OEH purchased the modems while the project funds $55K were used for installation.<br>**Outcome:**<br>· This capital upgrade will improve data transfer reliability, compared with existing dial-up systems, and provide a fallover system for communications to these remote sites. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Bathymetric Surveys of Priority Storages to derive more accurate height, volume and surface area relationship - on going project | NSW2.02 | GAP 35: Insufficient knowledge of capacity of river storages<br><br>**Gap Resolution:** *All priority storages and weir pools are now complete. Outstanding work relates to less priority storages. Gap 75% resolved.* | 63,250 | **Purpose:** This project builds from previously funded projectes to survey weir pool areas to develop more accurate capacity tables, reflecting a better relationship between heights, volumes and surface areas, which would increase currency and accuracy of data as well as increase the operational efficiency of water delivery. The nominated weir pools are: Stevens Weir Pool, Redbank Weir Pool, Maude Weir Pool, Yanco Weir Pool and Berembed Weir Pool<br>**Outcomes:** Bathymetric surveys of State Water controlled storages tprovide more accurate data to allow the development of more accurate capacity tables, increasing operational efficiency, particularly in times of low flow conditions. |

**Table 39: Gap Analysis M&E ROUND 4— 2010/2011**

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Strategic Water Information Coordination | NSW01.01 | Gap 21: Insufficient coordination for SWIMP activities at jurisdictional/lead agency level<br><br>***Gap Resolution***<br>*Gap resolved for Bureau activities in 2010/2011 and for 2010/2011 SWIMP.* | 230,000 | **Purpose:**<br>· Coordinate activities which will assist the Bureau in fulfilling its water information objectives.<br>· Update and maintain current jurisdictional SWIMPs to clearly identify critical monitoring sites that support water sharing plans and or environmental flow monitoring within the Basin and that are not already in WMN09.<br>**Outcome:**<br>Employment of strategist who has coordinated NSW Office of Water activities and the development of a cross agency monitoring plan. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| NSW Performance Monitoring Database Extension | NSW01.21 | Gap 43: Inability to transfer category 7 data in WDTF format<br>Gap 44: Inefficiencies from inconsistent data storage of category 7 data<br>Gap 45: Inaccuracy of category 7 system data, and lack of quality assurance<br><br>***Gap Resolution***<br>*When the project is completed, the Gaps will be resolved for NSW Office of Water and 27 utilities across NSW*. | 175,000 | **Purpose:**<br>A previous project was funded to improve data capture and transfer Category 7 data. The upgraded database included additional screens to enable utilities to load the required Category 7 data into the database prior to data delivery to the Bureau. This process did not include any screening or error checking of the data. This new project will therefore include a facility for data evaluation and error checking. This will enable more effective and accurate reporting. It will also include a facility to enable utilities to report Category 8 data (water restrictions) using the database.<br><br>**Outcome:**<br>· Upgrade of database to include transfer of category 8 (water restriction) data<br>· Enabling quality control of data required for categories 7 and 8, thereby significantly improving the integrity of data transferred to the Bureau<br>· Extending the one stop shop for the Bureau in respect to NSW data for categories 7 and 8<br>· Facilitating data reporting for the 27 NSW utilities required to report category 7 and 8 data. |
| Water Accounting Resourcing | NSW01.15 | Gap 27: Inability to collate and delivery water accounting data efficiently.<br><br>***Gap Resolution***<br>*When the project is completed, the Gaps will be resolved for NSW Office of Water for 2010/2011.* | 250,000 | **Purpose:**<br>Retain existing contractors engaged under the 2009/10 Multi Year Funding bid to continue with the development of methodologies, production of information and data, and the transferring of this information and data to the Bureau for use in the Water Resource Assessment and National Water Accounts.<br><br>**Outcome:**<br>Enable NSW Office of Water to fully support Bureau in the production of the National Water Account optimising the accounting unit's ability to prepare accounting data, methodologies and procedures thus enabling reporting to the highest possible standard. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| IP Telemetry Upgrade Stage 2 | NSW05.03 | Gap 4: Data capture and transfer not meeting time requirements<br><br>Gap 31: Lack of telemetry system full redundancy in the NSW SWIMP.<br><br>***Gap Resolution***<br>*When this phase of the project is completed, over 75% of the entire DECCW network will be telemetered* | 150,000 | **Purpose:**<br>To upgrade the telemetry system of the coastal data network (237 water level gauges and 72 pluviometers) to an Internet Protocol (IP) telemetry solution.. Data from the network is currently transferred from these remote sites via a dial up internal modem system to MHLs database and data management system.<br>DECCW received funding from the Bureau in 2009/2010 to upgrade 100 high priority sites to IP telemetry via iQuest iCE3 modems. This application is for the second stage of the telemetry upgrade, converting 115 water level and rainfall sites to IP telemetry. It is envisaged that a funding application will be submitted under the 2011/12 Program to complete the final stage three of the project.<br>**Outcome:**<br>This capital upgrade will improve data transfer reliability, compared with existing dial-up systems, and provide a fallover system for communications to these remote sites. |
| Upgrade modems to improve data access at storage inflow and downstream river sites. | NSW04.03 | Gap 4: Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>*When the project is completed, priority gauges will be telemetered and the Gaps will be resolved in the short term for the SCA network. Overtime, all the gauges will need to be upgraded to a similar standard so the gap remains less than 50% closed.* | 235,000 | **Purpose:**<br>To improve access to data by replacing telemetry equipment (including modems, antennas and associated accessories) at a range of locations within the SCA's catchments. It will also allow faults at hydrometric stations that may compromise data quality to be detected earlier, improve response times, and result in improved data sets from those locations.<br><br>**Outcome:**<br>· The upgrade of this telemetry will facilitate the delivery of data sets to the Bureau of Meteorology.<br>· Installation of modems and accessories such as antennas |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Hydstra Enhancements - AHD Conversion and Stream Network Tools | NSW01.22 | Gap 35: Insufficient knowledge of capacity of river storages.<br>Gap 2: Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution***<br>*When the project is completed the Gaps will be closed with respect to the ability to have AHD conversion and graphic display of existing information. However, the work still needs to be undertaken so the gap remains only 50% closed.* | 45,000 | **Purpose:**<br>Develop enhancements to the Hydstra database system to provide:<br>a) A means of tracking gauge zero changes through the development of a time based rating system for all Hydstra users (all major mainland water agencies).<br>**Outcome:**<br>a) The ability to record gauge zero changes and have the data conversion from stage height to AHD built into Hydstra as a standard feature for current and historical data. |
| Tantangara Dam Environmental Release Monitoring | *NSW09.04* | Gap 1: In some catchments the surface water network coverage is not fully meeting water information requirements<br>Gap 34: Insufficient number of hydro-meteorological stations at critical sites, e.g. storages<br><br>***Gap Resolution***<br>*When the project is completed, the gap is resolved for Snowy Hydro for this section of the river.* | 37,000 | **Purpose:**<br>To improve the confidence in the measurement and accounting of flow releases to the Upper Murrumbidgee River from Tantangara Reservoir.<br><br>**Outcome:**<br>Procurement and installation of suitable technology (Acoustic Doppler) at Tantangara Dam (Part of the Snowy Mountains Scheme) that:<br>· Improved the monitoring of environmental, riparian and other required flow releases from Tantangara Dam into the Upper Murrumbidgee River system.<br>· Improved management of water resources within the Upper Murrumbidgee Catchment.<br><br>**Comment:** DID not sign funding deed so project will not proceed. |

| ROUND FOUR<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Converting ongoing EasyWater Information for category 5d and 5e to WDTF for provision to the Bureau | NSW08.07 | Gap 1: In some catchments the surface water network coverage is not fully meeting water information requirements<br><br>Gap 26: Surface water database system unable to export data in WDTF format<br><br>***Gap Resolution***<br>*When the project is completed, the gap is resolved for Murrumbidgee Irrigation for ongoing data under Item 5d and 5e of the Water Information Program.* | 39,000 | **Purpose:**<br>This project seeks to convert data from our EasyWater system**,** which contains all the water ordering and delivery data from the Murrumbidgee Irrigation Area, to a format which can be automatically sent to the Bureau via FTP. This covers new and ongoing data under Item 5d and 5e of the Water Information Program. This information is currently not in a format which allows MI to provide it to the Bureau.<br><br>**Outcome:**<br>Rubicon Systems Australia Pty Ltd has developed and implemented a software module integrated into the IPMG2 platform that allows data to be extracted and transmitted to the Bureau of Meteorology from the IPMG2 database on a user defined schedule. |
| Development of automated process for water trade administration for Murrumbidgee Irrigation | NSW08.08 | Gap 26: Surface water database system unable to export data in WDTF format<br><br>Gap 40: Inability to collate water transfer licensing data efficiently<br><br>***Gap Resolution***<br>*When the project is completed, the gap is resolved for Murrumbidgee Irrigation for temporary and permanent water trade administration.* | 68,000 | **Purpose:**<br><br>This project seeks to develop an automated process to increase transparency and accuracy for temporary and permanent water trade administration for Murrumbidgee Irrigation. This covers ongoing data under Item 6b and 6c of the Water Information Program<br><br>**Outcome:**<br>An automated transparent and accurate process for temporary and permanent water trade administration for Murrumbidgee Irrigation. This covers ongoing data under Item 6b and 6c of the Water Information Program and the projects also developed an extract and delivery mechanism for data in WDTF.<br><br>**Comments**:<br>Please note that this project is on hold as the Bureau advised that it is unsure if it can provide the WDTF for the data in question in time. |

| ROUND FOUR<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Develop and test SPIDER SMART FORM | NSW03.05 | Gap 4: Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>*When the project is completed, the gap is almost resolved (75%) for transfer of field metadata, pending outcome of trial.* | 35,000 | **Purpose:**<br>Facilitate and improve field metadata transfer from hydrometric monitoring sites by developing and testing an integrated 'form hosting', 'form storage' and metadata transfer system built into a standard Halytech Spider data loggers deployed at hydrometric monitoring by:<br><br>**Outcome:**<br>Development of an integrated 'form hosting', 'form storage' and metadata transfer system built into Halytech Spider data loggers for use in recording and transferring digital site visit entry records from field to a central database using Spider logger telemetry and Hydstra XML data import routines.<br><br>Telemetry transmission will utilise existing Spider communication channels – typically built-in GSM, Next-G or satellite modem to transfer metadata together with time series data files |
| NSW State-wide Hydrological Geospatial Fabric (NHGF) Project | NSW01.26 | Gap 46: Mapping of surface water features and their connectivity and characteristics<br>Gap 47: Fast and easy and affordable access to spatial data<br><br>***Gap Resolution***<br>*The gaps are less than 50 % closed. The information from this project will be used to support a complete revision, repositioning and integration of natural and man-made surface hydrology mapping in each of the catchments.* | 888,000 | **Purpose:**<br>To provide an integrated and complete coverage of available watercourse and water body mapping, and governance arrangements that will directly support the ongoing improvement of catchment, state and national scale water accounting and water resource assessment.<br><br>**Outcome:**<br>· Development of a State data coordination, management and governance strategy<br>· The integration and networking of all 1:25K, 1:50K and 1:100K mapping of watercourses and (man-made and natural) water bodies across the state into a single point of truth<br>· Repositioning of 10-20% of the 1:50K mapping which significantly exceeds current specifications<br>· Integration into the AHGF |

| ROUND FOUR<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Installation of ten Meteorological Stations on State Water Major Storages – ongoing project | NSW02.01 | Gap 33: Insufficient collection of meteorological data in electronic format<br>*Other gaps 4,30,34*<br><br>***Gap Resolution***<br>*When the project is completed, the gap is resolved for all the State Water major storages.* | 119,000 | **Purpose:**<br>To provide accurate meteorological data monitored at State Water major storages and transfer to the Bureau of Meteorology in a timely, formatted and efficient manner. The project consists of installing Automatic Weather Stations (AWS) on 10 of the remaining major storages under State Water control.<br><br>**Outcome:**<br>This project involves the installation and commissioning of 10 Automated Weather Stations (AWS) to the remaining major storages which will facilitate the provision of accurate and consistent meteorological data to the Bureau of Meteorology.<br>· The implementation of these systems will allow for provision of information in an automated process from major storages to be supplied to the Bureau from State Water controlled sites. This project will facilitate the unattended operation of current weather stations and data transfer without the need for manual reading, local data entry or communications (i.e. email, fax or phone call). The proposed system will be fully automated, and will provide data with little or no lag time ensuring that the Bureau is supplied with up-to-date and accurate information in a timely manner. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Historic Data Recovery | NSW01.02 | Gap 9: Water storage and surface water data not in electronic format<br><br>***Gap Resolution***<br>*When the project is completed, the gap is 75% resolved for all historical data*<br>*.* | 315,000 | **Purpose:**<br>To recover data, some of which are over 100 years old, from a large variety of different formats and different locations around the state. This project implements a project management plan from funded projects in Rounds 2 and 3.<br><br>All data is to be digitised, scanned or transcribed from paper records, put through a rigorous validation process and added to the existing archive, with metadata provided to the Bureau where it will be available for easy access.<br><br>**Outcome:**<br>· The extraction of a vast amount of metadata that exists in old departmental files, old registers, folders and other paper sources<br>· Processing of an additional 2,000 station years of historic surface water data (3,600 years were processed in 2008-9) from gauge readers' cards, recorder charts, registers and files as well as stage:discharge ratings (3,000 ratings), cross-sections (1,500 surveys) and manuscript data.<br>· Digitisation of historical storages data from the state's seventeen major storages<br>· Transcription of part of a large dataset including the Eastern, South and Badgerys Creeks (in Western Sydney), Mt Vernon, Hacking, Lidsdale and Fowlers Gap data. It includes streamflow and recording rain gauge and current meter gaugings or ratings from calibrated weirs.<br><br>Using tools that were not available at the time, the project has been able to check, verify and validate all the data processed using best practice techniques<br><br>Overall, the project has improved the currency and relevance of existing data in the corporate databases (esp. Hydstra, TRITON and GDS) and ensured better informed management decisions, particularly in regard to flood modelling and forecasting and in climate change monitoring and management. This historical data will be provided to the Bureau where it will be available for widespread use. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Historic Data Recovery (Groundwater) | NSW01.27 | Gap 11: Insufficient groundwater data in electronic format (data at risk)<br>Gap 28: Groundwater database unable to export data in WDTF format<br>Gap 10: Insufficient quality attributes for data stored in Groundwater Database (GDS)<br><br>***Gap Resolution***<br>*When the project is completed, the gap is resolved for the majority of available historic groundwater data.*<br>*.* | 150,000 | **Purpose:**<br>To recover groundwater data from a large variety of different formats and different locations around the state. This project implements a project management plan from a project funded in Round 2.<br><br>All data is to be digitised, scanned or transcribed from paper records, put through a rigorous validation process and added to the existing archive, with metadata provided to the Bureau where it will be available for easy access.<br><br>**Outcome:**<br>The project has:<br>· Processed paper and electronic information for up to 5,000 groundwater bores including in the Great Artesian Basin – including registration of previously unknown groundwater works, review and update of geophysical and geospatial data, entering and cleansing of groundwater water level and water quality data.<br>· Using tools that were not available previously, the project has been able to check, verify and validate all the data processed using best practice techniques<br><br>Overall, the project has improved the currency and relevance of existing data in the corporate databases (TRITON and GDS) which will ensure better informed management decisions, especially in regard to groundwater modelling and forecasting and in climate change monitoring and management.<br>This historical data will be provided to the Bureau where it will be available for widespread use. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Hydrometric-Instrumentation Asset Management (Phase 2) | NSW01.24 | Gap 3: Lack of adequate asset management and replacement for surface water monitoring network.<br><br>Gap 9: Water storage and surface water data not in electronic format.<br><br>***Gap Resolution***<br>*When the project is completed, the gap is 50% resolved.*<br>*.* | 80,000 | **Purpose:**<br>Develop a Hydstra software application for use in the field to accurately capture Hydrometric records. This project includes the specification, development, documentation and user acceptance testing of the software application within the 10-11 project year.<br><br>It is likely that this project will become a multi-year funded project. In 2011-12 FY the software application will undergo 6 month field evaluation with any necessary changes identified and reported for change to Hydstra so that the final product can be provided to all national Hydrometric professionals for use<br><br>**Outcome:**<br>A previous project (NSW Office of Water 1.11, round 3) made recommendations for an instrument asset management module for Hydstra as well as the identification of business areas not covered during the workshop that require further consideration (i.e. reporting requirements and operational data needs). This project has built from this to:<br>· develop a software application for Instrumentation Asset Management as well as the capture of related field data. |
| Align NSW Office of Water operating procedures and work instructions to NSW water standards | NSW01.05 | Gap 32: Inadequate water data QA system<br><br>***Gap Resolution***<br>*With completion of 3NSW1.06, NSW Office of Water has a strong framework on which to base its complete review of our current quality system which is occurring under 4NSW1.05. Completion of 4NSW1.05 will deliver NSW Office of Water a much more credible QA system for continuous water monitoring activities than has ever existed previously. 50% gap closure.* | 120,000 | **Purpose:**<br>Following the adoption of standards being developed by project 1.06, round 3 this project aims to:<br>· Review documents to ensure all procedures and work instruction comply with the requirements of the standards<br>· Train all NSW Office of Water field staff to update their understanding of their role in resource monitoring, data gathering and supply to major clients such as the Bureau.<br><br>**Outcome:**<br>· Greater assurance of data quality and for the first time, compliance with Bureau approved standards..<br>· The ability to indicate whether data meet standards or define where they fail to meet the standards. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Groundwater Bore Rehabilitation | NSW01.12 | Gap 12: Lack of adequate asset management and replacement for groundwater bores<br><br>***Gap Resolution***<br>*There are approximately 5,000 monitoring bores in NSW this project does not address them all, and the gap is less than 50% closed.* | 150,000 | **Purpose:**<br>This project aims to improve the accuracy of acquired groundwater data by upgrading the existing infrastructure, through the purchase of new assessment and measuring equipment, and using this equipment to improve bore infrastructure, aquifer knowledge and data availability to clients. In addition, sensors and telemetry will be installed in selected bores as a means of expanding the extent of electronic monitoring within the network ensuring a more efficient means of data acquisition and provision<br><br>**Outcome:**<br>More accurate groundwater data and assurance that all bores are 'up to standard' as part of the Groundwater Units drive to be quality assured under certification to ISO9001 standards. |

| ROUND FOUR<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improved Hydrogeological classification of Aquifer System in NSW | NSW01.25 | Gap 48: Hydrogeological classification of groundwater sources<br><br>***Gap Resolution***<br>*The completion of the project will ensure that NSW Office of Water groundwater monitoring bores in the inland unconsolidated water sharing plan and groundwater management areas have geological units assigned. The Office of Water will have investigated the potential to use ArcHydro Groundwater as part of the groundwater database and to assist in the analysis of the hydrogeology of alluvial groundwater management areas. Gap 75% closed for NSW Office of Water.* | 160,000 | **Purpose:**<br>To build on the round 2 NSW Office of Water Database Project that was updating the Office of Water groundwater data and database by:<br>· Collating available hydrogeological units information from existing reports, geophysical and geological logs for the inland alluvial aquifers systems and assign the appropriate hydrogeological unit to the geological and drillers logs of the State Groundwater Monitoring network sites to populate the Arc Hydro framework<br>· Acquiring copies of the Aquaveo groundwater and Subsurface analyst software to analyse and display the data entered into the Arc Hydro groundwater data model. Training in use of the software<br>· Assessment of the alignment of existing and new corporate database with the NGIS data model to be used with ArcHydro for GW<br>· Assessment of the usefulness of the ArcHydro for GW toolkit for use with the NGIS data model and to apply geological units and hence the ability to prepare geological cross sections<br>**Outcome:**<br>The collation of existing information on hydrogeological classification has assisted in<br>· establishing consistent classification of aquifer systems,<br>· consistent interpretation of bore logs for research, conceptual and numeric modelling purposes and<br>· the identification of water sources for water management planning purposes. |

| ROUND FOUR<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Calibration of sensors: training and technology | NSW07.01 | Gap 2: Streamflow data not meeting all accuracy requirements<br>Gap 8: Height/flow calibrations not meeting accuracy requirements<br>Gap 32 Inadequate water data quality assurance<br><br>***Gap Resolution***<br>*Gap is closed for existing sensors.* | 78,000 | **Purpose:**<br>To ensure that NSW I&I meteorological data is at a standard comparable to the Bureau's in-house data the project has been designed to provide testing of sensors for temperature, relative humidity, rainfall, wind and solar radiation.<br><br>**Outcome:**<br>· Improved quality of meteorological data from NSW I&I that is of a similar standard to the Bureau's own data.<br>· Test equipment replicating that used at the Bureau's ARIC was installed and used for staff training purposes at the Orange Agricultural Institute. |
| Where goes the water? - automatic evaporation pans | NSW07.02 | Gap 3: Lack of adequate asset management and replacement for surface water monitoring network.<br><br>***Gap Resolution***<br>*Gap is 50% closed. Pans assessed in a variety of locations, with future investment possible based on results.* | 90,000 | **Purpose:**<br>To install and assess Automatic Evaporation Pans across NSW, QLD and Victoria. The automatic pans have been developed at I&I and development has progressed to the stage that cumulative automatic evaporation data corresponds very closely to manually read data.<br><br>**Outcome:**<br>· Installation Automatic Evaporation Pans in a few locations to broaden the geographic spread of pan evaporation data.<br>· Development of technology to support the measurement of water evaporation, an important component of water accounting. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Development of an Integrated Water Data Management System Including Water Data Transfer Format (WDTF) Capability. | NSW20.01 | Gap 26: Surface water database system unable to export data in WDTF format<br><br>***Gap Resolution***<br>*Upon completion of the project, the gap will be closed for Clarence Valley Shire Council for data in categories 3,7 and 9.* | 31,000 | **Purpose:**<br>To obtain a single water data management system that would enable the efficient transfer of water data to the Bureau.<br><br>**Outcome:**<br>Purchase of a new water data system that will integrate with Radtel and provide WDTF to the Bureau.<br><br>Previously could only provide 7a and 7n data to the Bureau but now can provide<br>· 3a-3e data (major storage level) from the 30,000 ML Shannon Creek Dam, the off-stream storage for the Coffs Harbour and CVC areas.<br>· 9d data (instantaneous turbidity) from the Nymboida River Weir off-take location. |
| Enhance Data Management and develop Water Data Transfer Format (WDTF) | NSW17.01 | Gap 26: Surface water database system unable to export data in WDTF format<br><br>***Gap Resolution***<br>*Upon completion of the project, the gap will be closed for Wyong Council.* | 150,000 | **Purpose:**<br>To establish a joint data management system by consolidating data from both Gosford and Wyong Councils and extracting data in Water Data Transfer Format (WDTF) .<br><br>**Outcome:**<br>Consolidation of data from Gosford and Wyong Councils.<br><br>Compliance with *Water Regulations 2008* by improving the accuracy, consistency and speed of provision of specified data to the Bureau in WDTF.<br><br>**Comments**:<br>Both Gosford and Wyong Councils are separate Urban Water Utilities and required to provide Water Information to the Bureau under the *Water Regulations 2008*. Councils operate Joint Water Supply System. Presently water information is collected and kept separately in both Councils in disparate systems such as EXCEL, MS ACCESS.<br>Consolidation of both Councils data in Joint Database will help Councils extract and send required Water Information to the Bureau in the preferred Water Data Transfer Format at the required frequency jointly as one unit. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Standardisation of Height Datums | NSW1.07 | Gap 6: Inadequate spatial location of surface water monitoring sites<br>Gap 16: Inadequate spatial mapping of groundwater network.<br><br>***Gap Resolution***<br>*Resolved for the sites addressed by this project, but only addresses 10% of groundwater and 60% of surface water sites. (50% of time series groundwater sites).* | 150,000 | **Purpose:**<br>This project is a continuation of the previously funded project NSW 1.07. It aims to improve the locational information and accuracy of groundwater bores and surface water gauging stations.<br><br>Currently 40% of the states surface water catchment monitoring stations are not surveyed to AHD, and 200 groundwater bores need review and possibly resurvey.<br><br>**Outcome:**<br><br>Over several funding periods the following will completed:<br>PHASE ONE (completed round 3)<br>· Survey and locations (includes elevation) of 410 streamflow sites connected to AHD<br>· 150 c-type benchmarks for groundwater bores, and AHD connection for 400 surface water and 200 groundwater sites.<br>PHASE TWO (completed this round)<br>· Established approximately 150 'C' type benchmarks across the state in accordance with the NSW Department of Lands specifications<br>PHASE THREE (completed next round)<br>A follow up phase of surveying these newly established benchmarks, groundwater bores and surface water gauging stations to the Australian Height Datum (AHD) and concurrently checking other locational data will be conducted. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Surface water quality data revitalisation and station detail recovery to improve data quality and accessibility | NSW01.18 | Gap 19: Insufficient water quality data in electronic format (data at risk)<br><br>Gap 32: Inadequate water data QA system<br><br>***Gap Resolution***<br>*The GAP has been closed for all NSW Office of Water historical water quality data.* | 225,000 | **Purpose:**<br>Undertake a surface water quality database revitalisation project to improve the quality certification of historical water quality data, associated station metadata, and its accessibility by department staff, state and federal agencies, local government, industry and the community.<br><br>**Outcome:**<br>Significant improvements in the stored data (including metadata)which has complemented the development the new water quality database by ensuring the quality of historic data to be imported. This project specifically has:<br>· Improved the standard of data stored by the NSW Office of Water<br>· Ensured the data is scientifically robust and easy to access by other agencies, industries and communities<br>· Improved the quality, consistency and completeness of the database<br>· Improved data management systems by developing consistent metadata coding for water quality data collection, analysis and storage, and have staff trained in their use, and<br>· Improved natural resource decision making and environmental reporting standards. |

| ROUND FOUR Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Remote Control Vessels | NSW01.09 | Gap 8: Height/flow calibrations not meeting accuracy requirements<br>Gap 2: Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution***<br>*The project was research based and has not closed any data management gaps. The project has contributed to determining the best and safest was to close the gap for flood monitoring data*. | 154,000 | **Purpose:**<br>To expand the use of ADCP current meters purchased under the\project 2008-2009 (NSW Office of Water ADCPs high and low flow assessment bids). This project involves the purchase of 3 remote controlled boats to be integrated with the Departments ADCP current meters to permit safer gauging of rivers.<br><br>**Outcome:**<br>Current methods require ADCP meters to be deployed attached to boats that increases the risk of incident to Hydrometric staff. This project has investigated a safer option for staff and involved the research, purchase, evaluation and development of documentation and reporting success of the use of ADPC remote control vessels. |
| Improvements to Hydro-meteorological monitoring network in the Murrumbidgee Catchment | NSW02.02 | Gap 1: In some catchments the surface water network coverage is not fully meeting water information requirements (see information drivers, section A)<br>Gap 5: Inadequate water mass balance information<br><br>***Gap Resolution***<br>*When the project is completed for 2010, the gap is 50% resolved for all the State Water met stations.* | 400,000 | **Purpose:**<br>To resolve identified gaps in the current hydro-meteorological network for efficient operation of the Murrumbidgee River. It is recommended that 20 new rain gage stations and 5 new hydrometric stations are required to the existing network. Further, the study also recommended upgrade of eight of the existing streamflow monitoring stations.<br><br>The project will be staged over two years. In the first year a mix of rain gauges and stream flow stations to be established. The installation of remainder of the stations identified in the preliminary study will be addressed during the second stage of the project in 2011-12.<br><br>**Outcome:**<br>Improved data availability and water balance computations in the Murrumbidgee catchment through:<br>· a network field audit that specified the location of monitoring sites and instrumentation needed<br>· establishment of 10 rain gauge stations and 3 streamflow monitoring stations in the Murrumbidgee Catchment<br>· the upgrade of 8 existing streamflow monitoring stations in the Murrumbidgee Catchment |

**Table 40: Gap Analysis M&E ROUND 3 — 2009/2010**

| ROUND THREE Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Collection and transfer of water level and storage data | NSW 16.1 | Gap 26 Surface water database system unable to export data in WDTF format<br><br>***Gap Resolution:***<br>*GAP: The GAP is RESOLVED for Cabonne Shire Council.* | 10,000 | **Purpose:**<br>Capture of daily water level data from telemetry information for Molong Creek and Borenore creek dams, convert this data to storage volume and then transfer all information to the Bureau without the need for staff intervention<br><br>**Outcome:**<br>The conversion and integration of captured information to ensure the required data is transferred, at a set time every day to the Bureau, without the need for staff intervention.<br><br>The dams to which this project relates are located within the Macquarie River catchment in the Murray Darling Basin. And therefore provides vital information for catchment plans and strategies |
| Upgrade of WQ and GW databases | NSW 1.05 | Gap 36: Core database unable to meet current and future data management and delivery needs.<br>Gap 28: Groundwater database unable to export data in WDTF format<br>Gap 30: Water quality database unable to export data in WDTF format<br>***Gap Resolution:***<br>*GAP: The GAPS are resolved for NSW Office of Water, but other water quality databases across NSW may not have the capacity to export data in WDTF.* | 500,000 | **Purpose:** To take advantage of projects previously sponsored by the Bureau to produce system specifications for water quality (WQ) and groundwater (GW) systems and replace the 15 year old Office of Water Oracle based GW and WQ database systems with modern commercial packages.<br><br>**Outcome:**<br>· Provide WQ database system for multiple state agencies (currently NSW Office of Water, State Water, some elements of DECCW and those CMAs actively gathering WQ data use the old system)<br>· Provide support for the ArcHydro framework for GW aquifer description<br>· Provide the infrastructure to track data edits and additions to allow transfers to be made to Bureau<br>· Provide data in WDTF format from the new database system<br>· Provide better data import and export tools to improve data quality and reduce re-work<br>· Provide data quality assurance<br>*Continued…* |

| ROUND THREE Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| | | | | **Comments**:<br>· Not yet completed.<br>· State Water was consulted at onset of program and NSW Office of Water has incorporated their requirements into the specifications. The Database will be made available to them if they want to use it.<br>· Ultimately may bring water quality from across NSW (CMAs currently provide their data to QLD). Replaces TRITON and GDS. Ultimately publish to web for use by Council's etc.<br><br>**Issues**:<br>· Multiple databases in NSW dealing with water quality. DECCW, DPI, CMAs (to QLD), NSW Office of Water, State Water<br>· Lack of clarity/policy on collection and use of water quality data in NSW.<br>· Link to project 1.20 and CMA project |
| Engineering database Bureau exports | NSW 19.2 | Gap 26 Surface water database system unable to export data in WDTF format<br>***Gap Resolution:***<br>*GAP 26: upon completion of the project, the gap will be resolved for HWC* | 50,000 | **Purpose:**<br>To ensure that HWC meets its Bureau water information (WDTF) obligations, and in such a way that requires minimal or no need for HWC staff involvement.<br><br>**Outcome:**<br>Collating data into WDTF to reduce manual manipulation of data.<br>· Sent milestone report to Bureau<br><br>**Comments**:<br>· Not yet completed.<br>· Do not have IT platform to run the program<br>· Likely to complete in April<br>· Been in contact with the Bureau |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Modernisation of NSW Office of Water Hydrometric Network – Stage 3 | NSW 1.01 | Gap 2 Streamflow data not meeting all accuracy requirements<br>Gap 4: Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>*GAP 2: NSW Office of Water used this project to address 50% of the NSW network, and this was achieved. Ultimately the remaining 50% will need to be addressed through an asset management system.*<br>*GAP 4: This has been resolved through external contributions (HNE) to this project*<br><br>. | 457,000 | **Purpose:** Provide a modern hydrometric monitoring network that ensures<br>· higher levels of accuracy of hydrometric data<br>· Increased currency of data<br>· Improved collection methods and data transfer systems<br><br>**Outcome:**<br>· In excess of 360 water level monitoring sites upgraded with improved water level sensing systems<br>· 60 shelters (some elevated) removed or upgraded to comply with OHS requirements<br><br>**External:**<br>· Approx 46 % of telemetry network upgraded with IP comms (with a further 39% to be completed by the end of 2010)<br>· Network increased by 15-20%<br><br>**Comments**<br>· Improved communications has significantly reduced data capture system operating costs with the data transfer times from existing PSTN (dial up) connections (Max=294 secs Min=33.5 with average being 94secs) being reduced for IP compliant devices. (Max= 236secs, Min=6.87sec with average being 39secs). This represents an average 41.5% increase in data transfer rates from the remote monitoring sites<br>· With the introduction of new water level sensing equipment a collective of 17 years of data, since installations commenced, has seen less than 0.2% loss of data.<br>· The introduction of new water level measurement technologies (gasless systems) has also removed the need for a large amount of peripheral equipment required to operate older gas purge orientated systems. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Menindee Lakes upgrades | NSW 1.04 | Gap 2 Streamflow data not meeting all accuracy requirements<br>***Gap Resolution***<br>*GAP 2: The project addressed the Critical sites of the Lakes system, representing 60% of network. The remaining 40% could be addressed in future funding rounds.* | 152,000 | **Purpose:**<br>Upgrade key sites in the Menindee Lakes Network, to improve:<br>· Data accuracy<br>· Data currency (upgrade sites to telemetry) to provide higher efficiency in operations and availability of data for use.<br>Sites are to be upgraded from current technology (2 existing instrumented sites not included in this project) to current technology, and non-instrumented sites are to be upgraded to full instrumentation and telemetry. This will include major storage level recorders, and several connector works sites.<br><br>A new automated meteorological site will be implemented to increase timeliness of data.<br><br>The implementation of these works will provide higher accuracy data in a more timely fashion providing better operational data for the efficient use of the storages.<br><br>Physical Outcomes:<br>· Upgraded level sensing sites<br>· Automated Meteorological Site<br>The project will improve the currency and relevance of data in the corporate databases which will ensure better informed management decisions.<br><br>**Outcome:** Upgrade to the monitoring of flows in and out of the Menindee Lakes in New South Wales<br>· Improved accuracy and timelines of information for critical sites for the Menindee lakes.<br>· 8 sites updated, one of which is a weather station. |

| ROUND THREE Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Development of a web tool for manual data entry | NSW 2.6 | Gap 4: Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>*GAP 4: When tool complete, gap closed for State Water. All data can be entered by web.* | 40,000 | **Purpose** :<br>To develop, test and implement a web based manual data entry tool, which will facilitate entering the data on storage levels, releases, diversions, stream levels from non-automated sites.<br>· The manually entered data from remote sites through the web-tool will be stored in 'Koncentrator' and routed through to corporate hydrological database managed by NSW Office of Water for onward transmission to the Bureau.<br>· The newly developed tool would replace the existing Manual Data Entry (MaDE) spreadsheets that are currently used for the purpose. The MaDE spreadsheets are less robust with multi stage manual processing, high risk to system security and also to the data integrity. The web-tool is aimed to provide a more secure way of entering the manual data in a timely fashion with reduced manual data entry errors.<br>**Outcome**:<br>· Not yet completed<br>· Instead of faxing data, use spreadsheet to upload to web immediately.<br>· Increased efficiency and timeliness. Framework for other applications to use same technology (e.g.. Meter reading). |
| Provision of real-time IP telemetry solutions – stage 1 | NSW 5.2 | Gap 4 Data capture and transfer not meeting time requirements<br>GAP 31 Lack of telemetry system full redundancy, Theme 4<br>***Gap Resolution***<br>*GAP 4: When tool complete, gap closed for DECCW for remote sites.*<br>*GAP 31: When upgrade completed, DECCW will have resolved the gap for remote sites.* | 174,000 | **Purpose:**<br>DECCW manages a network of r 237 water level gauges and 72 pluviometers in the NSW Coastal Zone. Data is currently transferred from these remote sites via a dial up internal modem system to MHLs database and data management system.<br>· The Project Objective is to upgrade the telemetry system for all the water level and pluviometers to an Internet Protocol (IP) telemetry solution. It is proposed to stage the project over 2 years with two separate applications.<br>**Outcome**: This capital upgrade will improve data transfer reliability, compared with existing dial-up systems, and provide a fallover system for communications to these remote sites. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Remote communication upgrade of river drain sites | NSW 8.4 | Gap 2 Streamflow data not meeting all accuracy requirements<br>Gap 7 Surface water sites no longer meet OHS and accuracy requirements<br>***Gap Resolution***<br>*GAP 7: Once the project is completed, the gap will have been resolved for the four priority sites identified for this project. There are no more sites to focus on within this organisation.* | 53,000 | **Purpose:**<br>· Drainage and irrigation escape water can leave the MIA at four licensed sites along the Murrumbidgee River. Water that leaves the MIA is currently measured at these sites using out-of-date technology. The information is stored in data-loggers which are manually downloaded every quarter. This information is essential for the calculation of a water balance for the MIA.<br>· The upgrade of these sites will allow for accurate data to be transferred to the Bureau on a near real-time basis which will provide improved operational data, contingency planning and management to ensure efficient distribution of high quality water as well as accurate water balance calculations<br>**Outcome**: Once completed, this project will allow near-real-time data transfer from the sites to MI and on to the Bureau.<br>**Issues**: This project is delayed due to difficulty in sourcing equipment. |
| Base & link radio upgrade to Narrandera Regular | NSW 8.5 | Gap 4:Data capture and transfer not meeting time requirements.<br>Gap 7 Surface water sites no longer meet OHS and accuracy requirements<br>***Gap Resolution***<br>*GAP 7: Once the project is completed, the gap will have been resolved for the site and there are no more sites to focus on for this organisation.* | 47,000 | **Purpose:**<br>· The objective of this project is to improve the communication system between the Narrandera Regulator and MI's office.<br>· MI's SCADA team trailed an ADSL system to retrofit the existing outdated system but found the use of this type of system left MI reliant on external providers. This is considered too high a risk for this site considering MI's operating requirements as well as the reporting requirements for the Bureau. This project will create a reliable communication link by upgrading the site to our existing SCADA system configuration, consisting of TRIO Base and link radios and associated hardware<br>**Outcome:** Project has been completed.<br>**Issues:** CITECT is to develop software which allows data from a data historian to be exported to the Bureau. As I understand it, this is a Bureau project that is not yet completed**.** |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Install pressure measurements gauges u/s of valves for storage discharge curves in light of HEPS operations | NSW 2.8 | *Gap 8 Height/flow calibrations do not meet accuracy requirements*<br><br>***Gap Resolution***<br>*GAP 8: Accurate storage discharge and height-flow data monitored at 13 State Water major storages will be transferred to the Bureau and NSW Office of Water in a timely and formatted manner. This represents all major storages with HEPS facility in NSW.* | 156,000 | **Purpose:**<br>The key objective of this project is to provide accurate storage discharge and height-flow data monitored at State Water major storages with Hydroelectric power stations (HEPS) and transfer to the Bureau of Meteorology and Department of Water & Energy in a timely and formatted manner.<br><br>· The project consists of installing pressure measurement systems on 13 of the major storages under State Water control.<br>· The proposed systems will provide more accurate, timely and effective information for the monitoring of storage discharges especially from HEPS facility and river flows enhancing management of water resources around the state and providing an automated process to deliver the data to the Bureau of Meteorology. The implementation of pressure measurement systems will facilitate this requirement to the Bureau.<br><br>**Outcome**: Accurate storage discharge and height-flow data monitored at 13 State Water major storages will be transferred to the Bureau and NSW Office of Water in a timely and formatted manner |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Groundwater Monitoring Bore Rehabilitation Program | NSW 1.12 | Gap 12 Lack of adequate asset management and replacement for groundwater bores<br>Gap 31: Insufficient redundancy in telemetry systems<br><br>***Gap Resolution***<br>*GAP 12: There are over 5,000 bores and this project will address around 1% of all bores, but 20% of the priority bores*<br><br>*GAP 31:In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A)* | 300,000 | **Purpose:**<br>The NSW Office of Water manages a network of some 8000 groundwater monitoring bores located across the state. The majority of these bores are west of the great divide and well within the Murray Darling Basin. These bores are monitored either manually or electronically for standing water level, at regular intervals. This project aims to improve the accuracy of acquired groundwater data by upgrading the existing infrastructure, through the purchase of new assessment and testing equipment, and using this equipment in a bore rehabilitation program to improve bore infrastructure and aquifer knowledge. In addition, sensors will be installed in selected bores as a means of expanding the extent of electronic monitoring within the network ensuring a more efficient means of data acquisition<br>**Outcome**:<br>· De-silting, replace screens, upgrade logging equipment.<br>· Potential more M&E bid.<br>· Data made available to internal and external clients for use, for example in the development of water sharing plans, research and other water management decisions such as water trading. The accuracy of the acquired data is directly dependent upon the quality of the monitoring infrastructure. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Procurement and installation of automated weather stations in 8 SW storages | NSW 2.1 | Gap 34 Insufficient number of hydro-meteorological stations at critical sites, e.g., storages.<br>***Gap Resolution**:*<br>*GAP 34: 50% of storage stations addressed. Future bids will address remaining 50%.* | 222,000 | **Purpose:** *Continuation of 2008/09 NSW 2.1. New stations*<br>To provide accurate meteorological data monitored at State Water major storages and transfer to the Bureau of Meteorology in a timely, formatted and efficient manner.<br>· The project consists of installing Automatic Weather Stations (AWS) on 8 of the major storages under State Water control.<br>· The proposed systems will provide more accurate, timely and effective information for the management of storages enhancing management of water resources around the state and providing an automated process to deliver the meteorological data to the Bureau of Meteorology. The implementation of automated weather stations will facilitate the water information transfer to the Bureau meeting the requirement specified under *Water Regulations 2008*.<br>**Outcome:**<br>· Still ongoing.<br>· Water balance through improved measurement of evapotranspiration.<br>· By installing the automated weather stations under this project, more accurate and consistent data can be provided at major storage sites where currently manual readings are required to be made by site staff. The improved data transfer methods detailed in the current project phases will enhance the knowledge of meteorological data within the Bureau of Meteorology in real-time formats |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Investigation, R&D report, procurement and installation of automated weather stations in remaining two storages | NSW 2.2 | Gap 34 Insufficient number of hydro-meteorological stations at critical sites, e.g., storages.<br>***Gap Resolution**:*<br>*GAP 34: 50% of automatic weather stations addressed. Future bids will address remaining 50%.* | 55,000 | **Purpose:**<br>The key objective of this project is to provide accurate meteorological data monitored at State Water major storages and transfer to the Bureau of Meteorology in a timely, efficient and formatted manner.<br>· The project consists of installing Automatic Weather Stations (AWS) on 2 of the major storages under State Water control.<br>· The proposed systems will provide more accurate, timely and effective information for the management of storages enhancing management of water resources around the state and providing an automated process to deliver the meteorological data to the Bureau of Meteorology. The implementation of automated weather stations will facilitate the water information transfer to the Bureau meeting the requirement specified under *Water Regulations 2008*.<br>**Outcome:**<br>· 2 stations installed. Improved timeliness, accuracy and quality of data.<br>· Water balance through improved measurement of evapotranspiration.<br>· Provide accurate and reliable meteorological data at improved frequency to agencies such as the Bureau, NSW Office of Water, MDBA, SW and others. This would help these agencies to develop more sophisticated programs and models and obtain more reliable outcomes to test other thesis, theories, plans and models that they would like to implement under WSPs and MDBPs.<br>· Support the data sharing requirements for meteorological information between the Bureau, SW, MDBA and the NSW Office of Water, which would lead to more efficient use of water resource information. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving the accuracy of Forests NSW hydro-meteorological monitoring network | NSW 7.1 | Gap 33: Insufficient collection of meteorological data in electronic format<br>***Gap Resolution**:*<br>*GAP 33: Resolved for NSW NSW I&I. All stations ratings are being improved.* | 41,100 | **Purpose:**<br>To improve water balance estimates across the Forests NSW stream gauging network by improving station ratings.<br>· purchase ultra-sonic Doppler units for continuous velocity measurement<br>· purchase a total station which will be used for accurate surveys of gauging stations to be utilised in a project to better model flows that exceed the present rating curves<br><br>**Outcome:**<br>The funding received by NSW I&I has been of enormous benefit. Across the department much of its water monitoring equipment was outdated and in urgent need of replacement. The M&E funding has injected much-needed capital into these projects and undoubtedly increased the reliability of data collected, extended the working life of the stations involved and improved the department's capability to transfer data to the Bureau, as required under the Water Regulations |
| Improving water measurements in Central west NSW | NSW 7.3 | Gap 20: Inadequate number of water quality sensors in the surface water network<br><br>Gap 17b: Inadequate water quality monitoring network for surface water physical/chemical parameters<br><br>Gap 2: Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution**: These gaps are resolved for NSW I&I for the Central West study.* | 90,000 | **Purpose:**<br>To fill the data and information gap in water quality (salinity and turbidity) and water quantity at the intermediate catchment scale in the central west.<br><br>**Outcome:**<br>This project has monitored streamflow at the intermediate scale (i.e. between the first order and the main river valley subcatchment) and resulted in:<br>· a nested scale of data from the headwater catchment to the main river valley,<br>· improving the understanding of water quantity and quality in relation to landscape, landuse, and climate.<br>· improved understanding for development of public policy for the management and sharing of water |

| ROUND THREE Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Extent ALERT system to water level data, rainfall data and real-time flood data monitoring – stage 2, installation | NSW 14.2 | Gap 33 Insufficient collection of Meteorological data in electronic format<br>***Gap Resolution**:*<br>*GAP 33: Resolved for Shoalhaven Council. All gauges have been upgraded.* | 19,000 | **Purpose:**<br>To install rainfall gauges and water level gauges that were purchased in stage 1 of the project.<br><br>**Outcome**:<br>· Upgrade sensors for 7 existing locations at Fossickers, Grassy Gully, Hampton Bridge, Hillview, Mountview, Shoalhaven Heads, Sussex Inlet, Island Point and Tallowa Dam. It is then proposed to install new rainfall stations at Currarong, Porters Creek Dam, Milton and Foxground as well as new water level stations at Currarong, Millards Creek and Broughton Creek.<br>· New rainfall and stream level recorders in various catchments of the Shoalhaven were integrated into the existing system established for the Shoalhaven local government area in order to expand coverage of the warning system across the city and provide emergency services with maximum response time.<br>· People will be better able to help themselves in the event of a flood. They will have more time to prepare and evacuate. It is therefore expected that overall damages will be reduced and recovery will occur more smoothly without the excessive need for counselling, health and welfare services or loss of income. |
| NSW groundwater modelling enhancement | NSW 1.13 | Gap 27 Inability to collate and efficiently deliver water accounting data<br><br>***Gap Resolution***<br>*GAP 27: Once the system is built, the gap will have been closed for available groundwater information. The gap may still have issues regarding the availability of groundwater quality data.* | 130,000 | **Purpose:**<br>To develop tools to improve the efficiency and effectiveness of the groundwater modelling and provide data for the expansion of groundwater models to other areas.<br><br>**Outcome:**<br>· Tools developed to provide input to Groundwater Models to enable timely updating of groundwater models with the ability to deliver required water accounting data.<br>· Tools in place to assist with the expansion of groundwater models to other areas of the state.<br><br>**Comments:**<br>Contractors have been engaged to develop the components and specifications have been developed. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Water consumption data extract and transfer | NSW 3.1 | Gap 27 Inability to collate and efficiently deliver water accounting data<br>***Gap Resolution***<br>*GAP 27: For category 7 data this gap is resolved for Sydney Water.* | 125,000 | **Purpose:**<br>Create a data extraction routine to export Consumption information from Sydney Water's enterprise data warehouse (DBMS) and transfer this information in XML format to the Bureau.<br><br>**Outcome**:<br>This will supply information categories 7h through 7L from the data delivery plan. |
| National Water Accounting systems | NSW 1.14 | Gap 27 Inability to collate and efficiently deliver water accounting data<br><br>***Gap Resolution***<br>*GAP 27: Once the system is built, the gap will have been closed for available data. The gap may still have issues regarding available good quality data.* | 150,000 | **Purpose:**<br>Develop reporting tools to enable the collation and efficient delivery of water accounting data from the Department's databases.<br><br>**Outcome:**<br>Web based reporting tools development delivering information across both the *Water Act 1912* (NSW) and *Water Management Act 2000* (NSW), continuous and annual accounting methodologies in the areas of allocation announcements, water usage, trade, and account management.<br><br>**Comments**<br>Currently a number of reports have been developed and are in testing phase. Test reports will deliver data in a form that can provide water accounting data more effectively and efficiently. This will help in providing information for a number of current reports and provide more informative information to users |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| National Water Accounting Resourcing | NSW 1.15 | Gap 27 Inability to collate and efficiently deliver water accounting data<br><br>***Gap Resolution***<br>*GAP 27: When the project is complete, the project will likely address 80% of the available groundwater and surface water data necessary for the National Water Account.* | 220,000 | **Purpose:**<br>To provide resources in specific skill sets to enable information to be prepared in a timely and efficient manner for the National Water Account.<br><br>**Outcome:** Contractors have been engaged in 3 specific areas to develop methods, provide information and data into the water accounting process. The specific areas are:<br>· GIS expertise – provision of a series of maps and linked data for the NSW River Basins required for National Water Account. Provision of updated Pinneena maps detailing NSW Gauging Stations.<br>· Contextual Statement writer – provision of contextual statements for the NSW River Basins required for National Water Account.<br>· Groundwater expertise – Developed and implemented methodologies for non modelled groundwater areas. This will enable a completed groundwater view to be put together for groundwater areas as input to the National Water Account.<br><br>**Comments:**<br>Significant progress has been made in all these areas. The proposed increase in the 2010/11 bid to extend it out to 30 June 2011 will allow the process to be completed for the entire State.<br><br>**Needs:**<br>Proposing an increase in bid from $110,000 to $220,000 for next year extending the end date from 31 December 2010 till 30 June 2011. This will enable work to be completed for all of NSW catchments in time for provision of information to the Bureau under the new National Water Account delivery plan. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Development of water information standards | NSW 1.06 | Gap 32 Inadequate water data quality assurance<br>***Gap Resolution***<br>*GAP 32: Scope is limited to continuously monitored surface water and groundwater (includes storages) quantity and quality. QLD project 1.3 is addressing discrete water monitoring information.* | 139,000 | **Purpose:**<br>· Define the standards for water monitoring to be followed within NSW<br>· Use the standards as the basis of defining best possible data as in the Bureau's Quality Codes<br>· Use the standards as the basis for all procedures, work instructions and training in NSW water monitoring activities<br>· Develop the standards using robust procedures acceptable to the Bureau which could be used as a template or kernel for developing national water standards<br>· Develop high-level procedures to implement the standards in NSW agencies<br>· Publish the standards on NSW Water Information until such time as they are adopted / superseded by national standards set by the Bureau<br>· Provide training to staff on the standards and procedures<br>**Outcome**:<br>Drafting standards for agencies in NSW, this will influence how they operate and feed into National Standards<br>· 7 standards now in draft – addresses 100% of bid<br>· This will create additional workload to modify processes for each agency to meet the standard.<br>· Can have implications for establishing a National standard. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Audit current work data | NSW 1.17 | Gap 32 Inadequate water data quality assurance<br>***Gap Resolution***<br>*GAP 32: Not advised* | 90,000 | **Purpose:**<br>NSW Office of Water (and State Water) has a corporate database that maintains all water licensing and usage data. This project would audit the existing works and use related data, assess quality assurance procedures and data quality and provide recommendations on an appropriate data quality standard.<br>· This will identify the current strengths and weakness in the data provided to clients such as the Bureau. This project will also improve the quality of data NSW Office of Water relies on when making natural resource management decisions.<br>· This project also aims to map a pathway to using GIS to accurately map and track works and use.<br>· This Project would complement a separate proposal for the Bureau to fund the automation of licensing and use data through the water licensing enhancement and the recovery of historic licensing and use data projects.<br>**Outcome**:<br>· Clean up of category 5 and 6 data. Identify strengths and weaknesses of data to client.<br>· Provide recommendations on a standard |
| Hydstra system enhancements | NSW 1.11 | Gap 26: Surface water database system unable to export data in WDTF format<br>***Gap Resolution***<br>*GAP 26: When complete the project will have addressed the WDTF gap for Hydstra TS. This importer can be accessed Nationally by all Hydstra users*. | 190,000 | **Purpose:**<br>· To provide a WDTF importer for Hydstra so that NSW Office of Water as the NSW state lead agency (and all other mainland lead and major water agencies) can access the data being supplied to the Bureau in WDTF.<br>· To work towards a national approach to Instrument management and to enhance the Hydstra Instrument database system to be able to deliver that national approach and to better link instrument performance and data quality.<br>· To provide a single generic tool to allow WDTF export from Excel spreadsheets and/or MS Access databases<br>**Outcome:**<br>· WDTF for all time series data (Hydstra) for use for all Hydstra users.<br>· In progress. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Pilot digital pen technology to improve metadata | NSW 3.4 | Gap 32 Inadequate water data quality assurance<br>Gap 4: Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>*GAP 32: The project identified a mechanism to address water data quality assurance. It has not resolved the gap but determined the mechanism to do so.*<br>*GAP 4:The project identified a mechanism to address transfer of water data. It has not resolved the gap but determined the mechanism to do so.* | 60,000 | **Purpose:**<br>· Facilitate and improve currency, accuracy and descriptive characteristics (quality tags) related to hydrometric time series water data by implementing a trial of the Destiny digital, wireless metadata management system by carrying out the following:<br>· Review, consolidate and re-draft some common hydrometric quality record forms used by SWC Hydrometric Services Group<br>· Check for adequacy and completeness for use with Destiny™ Digital Pen system and Hydstra™<br>· Reference relevant Water Monitoring Standards, field hydrographers and Kisters Pty Ltd on final draft of proposed minimum standards of field metadata to be recorded at water level, flow, rainfall and other generic environmental monitoring sites in order to properly record the history, characterise the site and assist in describing the recorded hydrometric data<br>· Prepare final pro-forma and form-view templates which meet agreed standards<br>· Field trial the pilot system using a sample of Destiny Wireless digital pens and standard forms to automatically transfer the metadata collected in the field directly to the office<br>· Establish programs in Hydstra and trial the automatic transfer and permanent storage of metadata from field to relevant Hydstra databases<br>**Outcome:**<br>· The project will deliver current, timely, accessible and complete digital metadata, automatically transferred from field to office for immediate use in characterising or assessing the quality of hydrometric and related water monitoring data being recorded.<br>· By successful application in linking to and/or populating key Hydstra databases it will assist in assessment of quality codes to be applied to data and as determined by the Bureau of Meteorology or users |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Enhancement of the NSW water supply and sewerage performance monitoring database to report the 15 indicators required by the Bureau for Category 7 reporting for NSW urban water utilities | NSW 1.20 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution***<br>*GAP 36: Closed this gap for category 7 data. Next project will address quality assurance of the data (Gap 32).* | 135,000 | **Purpose**:<br>· Enhance the NSW Performance Monitoring Database developed and managed by the NSW Office of Water to facilitate reporting of the 15 indicators required by the Bureau of Meteorology for Category 7 data by NSW urban water utilities.<br>· This will enable the 27 NSW water utilities listed in the *Water Regulations 2008* to input their Category 7 water data into the NSW Performance Monitoring Database and the NSW Office of Water will then transfer the data to the Bureau in the Water Data Transfer Format (WDTF) as per the requirement of the *Water Regulations 2008*.<br>· This will continue the present one stop shop for reporting of NSW water utility data (which is strongly supported by the NSW utilities and which is similar to the Queensland SWIM project) and will significantly facilitate reporting by NSW utilities.<br>**Outcome**:<br>· Compile Category 7 data.<br>· Facilitate reporting by NSW utilities<br>· Make Category 7 data available on web, and provide data in WDTF to Bureau.<br>· Enable collection of 15 indicators in Category 7 data for NSW. |
| Database and Content Management Upgrade | NSW 5.1 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution***<br>*GAP 36: Closed this gap for available data at DECCW/MHL.* | 306,000 | **Purpose**:<br>The project objectives are to<br>· Replace the database and content management system<br>· Reduce the risk of data provision failure<br>· Reduce the risk of redundant technology that is no longer supported<br>· Reduce the risk of irrecoverable system failure<br>**Outcome**:<br>The installation of software and upgrading of existing data management systems will improve the water data management within Manly Hydraulics Laboratory, including:<br>· Improved data security and reliability<br>· The processes for the transfer of data to the Bureau in the WDTP format<br>· Improving metadata<br>· Improved quality assurance procedures |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Water data management software | NSW 10.2 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution***<br>*GAP 36: Closed this gap for Essential Energy data delivery to the Bureau..* | 10,000 | **Purpose**:<br>The implementation of a new software application to provide a robust mechanism for the management of existing and new water information. Currently data is manually entered from a combination of manual and electronic sources. Analysis and distribution of data is limited.<br><br>**Outcome:**<br>Semi-automated and seamless data transfer to the Bureau of Meteorology. |
| Engineering database reporting system development | NSW 19.1 | Gap 36 Core database unable to meet current and future data management and delivery needs<br><br>***Gap Resolution***<br>*GAP 36: EDSR has resolved this Gap for Hunter Water.* | 43,000 | **Purpose**<br>To design, build, test and implement a software solution to capture, calculate and report water supply information.<br><br>The Engineering Database Reporting System (EDRS) will replace the Engineering Inquiry System (ENINQ) that currently resides on a VAX machine scheduled for decommissioning. EDRS main purpose is to provide water supply information for regulatory reporting and engineering modelling. It is a key component of HWCs water information data delivery plan<br>*Continued…* |
| | | | | **Outcome: '**Build completed'. Not in production.<br>· EDRS has improved metadata management, measurement calculation management, data quality, and access of water supply data necessary to meet regulatory reporting (for example, DECCW, NSW Office of Water, IPART, others<br>· Improved data quality as data validation and correction functionality is inherently designed within EDRS.<br>Data management and reporting capabilities have improved due to EDRS functionality to group measurements and assets, define measurement points and calculated measurements. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Enable data transfer from SCADA to the Bureau via WDTF | NSW 20.1 | Gap 36 Core database unable to meet current and future data management and delivery needs<br><br>***Gap Resolution***<br>*GAP 36: The gap is resolved for Port Macquarie Council.* | 140,000 | **Purpose**:<br>· Upgrade Council's older operational SCADA system which currently monitors and operates the water supply assets, from ELPRO SCADA 2000 (DOS based operating system) to Citect SCADA C (Windows based operating system) complete with Citect reporting functionality. Compile real-time and archive information in Water Data Transfer Format (WDTF) using the proposed reporting system.<br>· Investigate and, if required, develop file formatting processes for Council's other newer SCADA system which monitors and operates the sewerage system<br>· Additionally, Council proposes to initially transfer the last five years of existing archival information to avoid loss of strategic water and wastewater information<br>**Outcome**:<br>· Production of water data files in WDTF using two industry standard SCADA systems namely, Citect SCADA C and AZEDA 'WIZCON'. Both systems, when fully implemented, benefit all other LWUs and water industry bodies currently using this technology.<br>· Upgrade of Council system to a Windows based version which can accommodate an add-on report server which has the capacity to calculate derived data and create XML reports.<br>· Transfer of some of the historical data into new system to avoid data being overwritten. The current historical database has a rolling five-year storage. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Historic data recovery | NSW 1.02 | Gap 9 Water storage and surface water data not in electronic format<br>***Gap Resolution***<br>*GAP 9: Gap reduced by 6,000 station years of surface water data and 5,000 bores. This is around 40% of all category 1 and 2 raw data not in the system.* | 395,000 | **Purpose**:<br>· The primary objective of this project is to recover a large volume of surface water, groundwater and storages data, some of which is over 100 years old and at significant risk of imminent loss.<br>· The data is to be digitised, scanned or transcribed from paper records, put through a rigorous validation process and added to the existing archive, with metadata provided to the Bureau of Meteorology where it will be available for easy access.<br>· Further, the project will improve the currency and relevance of existing data in the corporate databases which will ensure better informed management decisions<br>**Outcome**:<br>· 6,000 station years of historic surface water data (3,600 years were processed in 2008-9) from gauge readers' cards, recorder charts, registers and files as well as stage:discharge ratings, cross-sections and manuscript data were digitised<br>· Paper information for up to 5,000 groundwater bores were processed. This includes details of works that were never registered, geophysical and geospatial data and groundwater water quality data.<br>· Digitisation of historical storage data from the state's seventeen major storages – an estimated 1.5 million data records exist in non-electronic form. This part of the project was undertaken as a prison inmate program through NSW Corrections Services.<br>· Improvements to the currency and relevance of existing data in the corporate databases (Hydstra, TRITON and GDS) which ensure better informed management decisions, especially in regard to flood modelling and forecasting and in climate change monitoring and management.<br>**Issues:** Still in progress. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Upgrade of storage level recorders on 20 major SW storages | NSW 2.3 Cont'd project from 08/09 | Gap 9 Water storage and surface water data not in electronic format<br>Gap 4 Data capture and transfer not meeting time requirements.<br>Gap 31 Insufficient redundancy in telemetry systems.<br>***Gap Resolution***<br>*Once project complete – gaps are closed for major storages.* | 491,000 | **Purpose:**<br>Provide accurate storage level data monitored at State Water major storages and transfer to the Bureau of Meteorology in a timely and formatted manner.<br><br>Provision of more accurate, timely and effective information for the management of storages enhancing management of water resources around the state and providing an automated process to deliver the storage level data to the Bureau of Meteorology.<br><br>**Outcome**:<br>· Still ongoing.<br>· Upgrading Storage Level Recorders (SLR) on 20 of the major storages under State Water control.<br>· Updated water level and storage capacity.<br>· Data provided in timelier manner via electronic transfer.<br>· Improved water accounting and water availability prediction. |
| Recovery of strategic water use data in Murrumbidgee Irrigation Area | NSW 8.6 | Gap 9 Water storage and surface water data not in electronic format<br>***Gap Resolution***<br>*GAP 9: Gap resolved for category 5d and 5e data for Murrumbidgee Irrigation.* | 25,000 | **Purpose:**<br>This project seeks to recover historic water use data of strategic value to the Bureau. It covers data requested under Item 5d and 5e of the Water Information Program. This data is currently not in a format which allows MI to provide it to the Bureau.<br><br>**Outcome**:<br>Extraction and conversion to WDTF of category 5d and 5e data for delivery to the Bureau. |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Connection of GW and SW sites to AHD | NSW 1.07 | Gap 6 Inadequate spatial location of surface water monitoring sites<br>Gap ten Insufficient quality attributes for data stored in Groundwater Database (GDS)<br>Gap 16 Inadequate groundwater spatial mapping<br>***Gap Resolution***<br>*Resolved for the sites addressed by this project, but only addresses 10% of groundwater and 60% of surface water sites. (50% of time series groundwater sites).* | 570,000 | **Purpose**:<br>To improve the location information and accuracy of groundwater bores and surface water gauging stations, by installing C type benchmarks and the surveying these benchmarks and selected groundwater bores and surface water gauging stations to AHD (Australian Height Datum). :<br>**Outcome:**<br>· Survey and locations (includes elevation) of 410 streamflow sites connected to AHD<br>· 150 c-type benchmarks for groundwater bores, and AHD connection for 400 surface water and 200 groundwater sites.<br>The survey information ensures:<br>· more accurate trend assessment such as interactions between groundwater and surface water/ better models<br>· better management decisions based upon more accurate data as all sites would be tied to a known datum.<br><br>These surveys and resultant more accurate data are now compliant with ISO19115 –Geospatial data and available on the web. |
| Bathymetric survey of four priority storages | NSW 2.5 | edge of capacity of river storages<br>***Gap Resolution***<br>*GAP 35: Funding for four storages so the Gap remains open for 50% of priority storages (river weir pools).*<br>*Next year submit for four more, plus also for other weir pools.*<br>*Included with 2008/09 projects – gap is 50% closed* | 170,000 | **Purpose:**<br>Survey 4 storage areas to develop more accurate capacity tables, reflecting a better relationship between heights and volumes, which would increase operational efficiency, particularly in times of low flow conditions in light of the current sustained drought over the past eight years.<br><br>**Outcome:**<br>The proposed Capacity Tables will<br>· Recalibrate height / volume relationships to develop more certainly of storage capacity.<br>· Provide more accurate and reliable relationship between height and volume of these storages enhancing more efficient management of water resources around the state.<br>· Ensure reliable information transfer to the Bureau of Meteorology on regular basis |

| ROUND THREE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Strategic water information Coordination (NSW) | NSW 1.00 | Gap 21 Insufficient coordination of SWIMP activities at jurisdictional/lead agency level<br>***Gap Resolution***<br>*GAP 21: For 2009/10 Gap is closed.* | 335,000 | **Purpose:**<br>Improved coordination of NSW monitoring activities.<br><br>**Outcome**:<br>Employment of strategist who has coordinated NSW Office of Water activities and the development of a cross agency monitoring plan. |

**Table 41: Gap analysis M&E ROUND 2 — 2008/2009**

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Remodel, update and migrate water quality database | NSW 6.1<br>DECCW | Gap 30: Water quality database unable to export data in WDTF format<br><br>***Gap Resolution***:<br>*GAP 30: The data gap is resolved for DECCW with regard to water quality data. There is currently no integration with this project and the building of a water quality database by NSW Office of Water although it is feasible.* | 120,800 | **Purpose:**<br>DECCWs water quality data is currently stored as multiple electronic files in a variety of formats and is relatively difficult to access or transfer in a user requested format. Much of this data resides in an old Oracle database which has not been updated since 2003. This project aims to remodel, update and migrate the water quality database to a SQL server for later storage, access and provision of data.<br>**Outcome:**<br>· Comprehensive single point of truth DECCW water database<br>· Update of Water Quality database with all current projects<br>· Consistent storage of water data<br>· Appropriate quality assurance of stored water data<br>· Greater accessibility to water data<br>· Efficient transfer in a user requested (e.g. WDTF) format<br>· Assist the Bureau to fulfil its National roles, specifically in the areas of the provision of reliable water information to the public.<br>**Commen**t: the DECCW database is an SQL server database and the NSW Office of Water database is (I understand) to be based on the same platform, integration in the future should not be problematic |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| SCADA Data Historian for Data Transfer to the Bureau | NSW 8.2 | Gap 26 Surface water database system unable to export data in WDTF format<br><br>***Gap Resolution**:*<br>*GAP 26: The gap is resolved for Murrumbidgee Irrigation for available data.* | 79,000 | **Purpose:**<br>The upgrading of gauging systems to increase currency, accuracy, and cater for continuous flow monitoring will require MI to purchase a SCADA data historian as part of the project.<br>**Outcome:**<br>The data historian has enabled timely delivery of data to meet Bureau reporting requirements and provide the ability to collect and store data history which MI was unable to do. |
| Data Logger and Level Sensor Replacement-Installation | NSW<br>1. 01 | Gap 2 Streamflow data not meeting all accuracy requirements<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***:<br>*GAPS Resolved for this project.* | 480,000 | **Purpose**:<br>Improving accuracy and currency of existing streamflow measurement networks through the installation of the logger and sensor technology acquired through the 2007/08 Modernisation and extension of Hydrologic Monitoring Systems Program. This consists of 347 loggers, 247 sensors, and installation of 60 shelters and refurbishment of existing float well stations.<br>**Outcomes**:<br>The equipment was purchases in this round, will be installed in round 3. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Salinity Sensor Replacement (EC and Temperature) | NSW 1.03 | Gap 2 Streamflow data not meeting all accuracy requirements<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***:<br>*GAP 2: Resolved for the network installed in 1990.*<br>*GAP 4: Resolved for the network installed in 1990.* | 456,000 | **Purpose:**<br>Improving the accuracy of existing water quality (EC) networks.<br>The existing network of 190 Electrical Conductivity sensors are of the 1990 vintage with most generating temperate compensated output. Failure rates of this equipment are increasing with age.<br>**Outcomes:**<br>Replacing all existing sensors has ensured:<br>· All data collection is made to the same standard hence improving the consistency, reliability and accuracy of the datasets being delivered to the Bureau.<br>· The uncompensated output also allows post processing for site specific salinity conditions. |
| Groundwater Data Logger and Level Sensor Installation. | NSW 1.04 | Gap 12 Lack of adequate asset management and replacement for groundwater bores<br><br>***Gap Resolution****:*<br>*GAP 12: 75 bores were upgraded. This is a fraction of those requiring upgrading and represents less than 10% of the total number.* | 280,000 | **Purpose:**<br>Improving currency of existing groundwater monitoring networks.<br>The Department will purchase 25 OTT pump sensors and 25 Campbell loggers to bring a proportion of the network in contentious and highly saline groundwater areas to current sensing and logging technology<br>The Installation of SD1 12 STS water level sensors and loggers to measure time-series changes to water levels in groundwater monitoring bores and adjacent streams to advance the current understanding of surface water and groundwater interaction and the associated water resource impacts. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| | | | | **Outcomes:**<br>Replacement and upgrade of 75 older type sensors at NSW Office of Water groundwater monitoring sites to modern sensor and telemetry technology. The upgrade allows the stations to be configured with more accurate industry standard SDI-12 sensor technology and provide reliability and accuracy which has not been achievable in the past due to the highly saline nature of the water.<br>This has improved the speed of data acquisition and an associated increase in efficiency of data delivery. It has also reduced the amount of missing record and increased the potential availability of other water monitoring parameters.<br>Other benefits include:<br>· data from a larger proportion of the network is available real-time on the web.<br>· increased memory size reducing the chance of lost record.<br>· improved accuracy and reliability of measurement, increased availability of data and increased efficiency.<br>· the number of site visits per year by monitoring staff has been significantly reduced to just maintenance and calibration.<br>· Improved information or water accounting<br>Detailed water level monitoring has allowed quantification of the volumes involved when measuring time-series changes to water levels in groundwater monitoring bores and adjacent streams. This has assisted with water accounting. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Instrumentation upgrade for 92 Metropolitan rainfall and 33 Treatment plants<br>*Sydney Water Corp* | NSW 3.2 | Gap 2 Streamflow data not meeting all accuracy requirements<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***:<br>*GAP 2: Data loggers upgraded. Gap resolved for SWC.*<br>*GAP 4: Data loggers upgraded. Gap resolved for SWC.* | 330,000 | **Purpose:**<br>Replacement of aging dial-up loggers with 125 Halytech Spider Tm IP data loggers to meet reporting obligations from the Bureau.<br>**Outcomes**:<br>· A significant reduction en the number of logger failures in the hydrometric networks particularly with the elimination of modem-logger lock up problems formerly associated with older, dial-up loggers with external OEM modem<br>· With its easily programmable functionality the new logger has provided a simple and effective push data telemetry system with data being sent independently from each individual site via GPRS to an FTP server each day or up to each hour as required.<br>· The GPRS telemetry system provides a data delivery guarantee and has reduced the reliance on specialised, centralised, dial-up polling programs which require additional maintenance and subject to failure and late data deliveries<br>· Each site data logger transfers data automatically at pre-programmed times via GPRS and the Ethernet to and FTP server from where it is automatically processed to Hydstra or re-directed as raw data to elsewhere as required<br>· Threshold alarms can now be sent from logger to logger via SMS and this has allowed for additional controlling, activation of water samplers and a simple yet effective metropolitan catchment based high rainfall alarm system.<br>· The overall network reliability has improved (generally 100% recorded)<br>*Continued…* |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| | | | | · The new loggers have enable simple, automatic data send as well as dial-up access for configuring remote firmware upgrade or interrogation<br>· The overall reliability and high-level data capture has resulted in more timely, validated information being provided and in the future will be the standard logger used across various Sydney Water hydrometric networks. |
| Upgrade gauging stations<br>*Sydney Catchment Authority* | NSW 4.2 | Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution**:*<br>*GAP 4: The gap is resolved for the 65 priority monitoring sites. There are approx. 16 more to be upgraded under the SCA renewal program in 2010/11.* | 202,000 | **Purpose:** Prior to the commencement of this modernisation project, approximately 65 of the SCAs water level monitoring sites were fitted with Mace HM2000 data loggers. These are no longer supported by their manufacturer and were replaced..<br><br>**Outcome**: 27 of the Mace logger sites were upgraded in 2008/09. The sites involved are water level sites at SCA storages, inflow monitoring sites and licence reporting sites<br>When the data loggers were replaced, each site was fully upgraded.<br>· Replacement of the data logger<br>· Replacement of the site wiring to the standard of the newly installed sites<br>· Reprogramming of the data logger to provide consistency of logger configuration<br>· Replacement of modems (if installed)<br>· Upgrade of the telemetry to an IP based system where NextG coverage is available.<br>· Replacement of existing analogue sensors with SDI-12 digital sensors<br>· Replacement of all lightning protection.<br>· Documentation of the upgrade<br>· Delivery to the SCA of details of the installed equipment for inclusion in the SCAs MAXIMO database and reporting to the Bureau. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Standardise programming of Field Loggers | NSW 4.3 | Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution**:*<br>*GAP 4: The gap is closed for Sydney Catchment Authority.* | 77,000 | **Purpose:** The SCA has 77 telemetered water level monitoring sites. Many of these sites monitor parameters other than water level, such as temperature. Historically there were different types of data logger and the loggers were installed at different times by different contractors. As a result the data loggers did not store data in a consistent format. This caused difficulty when the information from the data loggers was downloaded to the SCAs computers. This project was to reprogram the loggers so that the data retrieved from the loggers is as consistent as possible.<br><br>**Outcome:** The types of logger in service were catalogued and the data order in each examined.<br>There are three basic types of datalogger at water level sites:<br>· The Mace Hydromace2000 (many being replaced under Project 4.2)<br>· The Campbell Scientific CR10X/CR510 family<br>· The Campbell Scientific CR1000/CR800 family<br>Each of these loggers has its own native data format.<br>There are also significant differences in the complexity of the sites. Some simply monitor the water level, others monitor varying numbers of water quality parameters. Some sites also have one or more automatic water samplers.<br>A consistent data format was defined and adopted as the standard. As a result all sites with Campbell loggers (including those installed under Project 4.2) have been programmed to deliver data as per the adopted standard |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Replacement of rain gauges and data loggers | NSW 4.4 | Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution**:*<br>*GAP 4:The gap is closed for Sydney Catchment Authority at 45 rain gauge sites. The SCAs ongoing renewals program will replace other items as they age in the future to ensure the gap remains closed.* | 86,000 | **Purpose:** This project involved the replacement of the older data loggers and rain gauges at 45 SCA rain gauge sites. When either a rain gauge or data logger was replaced, the condition of all the wiring on site was be assessed and replaced as required. Modems (where applicable) were be replaced at the same time as the data loggers.<br>**Outcome:** The M&E funding was used to upgrade 45 rain gauges. At 11 sites, both the rain gauge and data logger were replaced, at 13, the rain gauge only was replaced and at 20 sites, the data logger was replaced.<br>Where coverage was available, NextG IP capable modems were installed.<br>**Strategic Benefits:** As a consequence of the SCAs projects funded under the Modernisation and Extension Program, the vast majority of sites have:<br>· new, modern data-loggers and modems<br>· new rain gauges<br>· upgraded, consistent physical configurations and wiring<br>· all relevant data recorded in the SCAs asset management database<br>**Important strategic benefits include**: Consistency of equipment and programming will improve the reliability and efficiency of data transfer to existing systems and facilitate conversion to new formats and systems in the future<br>enablement of IP capability, with resulting increases in communications reliability, flexibility and cost efficiencies<br>simpler, more efficient maintenance and upgrade processes<br>more timely and reliable data to both the SCA and Bureau during major inflow and flood events<br>in the long-term, more accurate and complete datasets for water resources assessment and planning |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Installation of Hydrometric Instrumentation | NSW 5.1 | Gap 2: Streamflow data not meeting all accuracy requirements.<br>Gap 4 Data capture and transfer not meeting time requirements<br>Gap 31 Insufficient redundancy in telemetry systems<br><br>***Gap Resolution**:*<br>*GAP 4: The gap has been closed for the upgraded sites.*<br>*GAP 31:The gap has been reduced for the upgraded sites. It is envisaged it will be closed by 2011 with additional upgrades.* | 602,000 | **Purpose:**<br>In the first round of funding approved in late 2007/08, $698,000 was allocated for the purchase of 250 Campbell CR800 data loggers and 92 pressure transducers to upgrade the DECCW Coastal Water Level Network. This application for funding addresses the installation of this instrumentation purchased in 2007/08.<br>The installation requires the following components<br>· Preparation and standardisation of instrumentation assembly<br>· Calibration of the pressure transducers<br>· On-site installation of the data loggers and pressure transducers<br>· Staff training in the use of the Campbell loggers<br>· Purchase of the telemetry software package (an Off The Shelf HydroTel system that supports the new data logger communication protocol)<br>· Integration of the new data loggers, transducers, instrument tracking system, and telemetry packages into the current MHL network<br>**Outcome:** Ageing data logging instrumentation was upgraded to current technology and has substantially improved the quality, reliability and accessibility of this extensive water level network. |
| Streamflow and storage gauging and telemetry upgrade | NSW 8.1<br>Murrumbidgee Irrigation | Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution**:*<br>*GAP 4: The gap is not closed for Murrumbidgee Irrigation. The upgrade is less than ten per cent complete.* | 30,000 | **Purpose:**<br>installation of stream gauging, storage gauging, and telemetry within the MIA system<br><br>**Outcome:**<br>Improved data capture and transfer for part of the MIA. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Investigate and develop detailed installation plans including costing for installation of 12 automated weather stations at Major storage sites | NSW 2.1 | Gap 34: Insufficient number of hydro-meteorological stations at critical sites.<br><br>***Gap Resolution**:*<br>*GAP 34: The gap is not closed but a strategy has been developed to address the issue.* | 38,000 | **Purpose**: Installation of automatic weather stations on main storages under State Water control<br>**Outcome**:. Site review and design for hydro-meteorological stations at critical sites.<br>**Issue**: Variation to the project due to changed budget |
| NSW DPI Weather stations a strategy for the future. | NSW 7.2 | Gap 34: Insufficient number of hydro-meteorological stations at critical sites.<br><br>***Gap Resolution**:*<br>*GAP 34: The gap is closed for NSW I&I.* | 238,500 | **Purpose**: funding was used to replace the data-loggers at six existing AWSs and to install complete AWSs at two new sites (Dareton and Narrabri). Telemetry has been upgraded at all eight sites to router rather than modem status. All eight sites will now be Bureau compatible although NSW I&I will continue to download data<br>**Outcome:** The funding received by NSW I&I has enabled the expansion of the department's AWS network. It has also brought the equipment used in those AWSs closer into line with that used by the Bureau resulting in an improvement in both data quality and metadata quality. It has significantly improved the department's capability to transfer data to the Bureau, as required under the *Water Regulations 2008* |
| Improved measurement and logging technology for Forests NSW streamflow monitoring network | NSW 7.1 | GAP 1: In some catchments the surface water network coverage is not fully meeting water information<br><br>***Gap Resolution**:*<br>*GAP 1: The gap is closed for NSW I&I.* | 146,000 | **Purpose**: Funding was used to upgrade and replace data-loggers, pressure transducers and optical shaft encoders in the WM network.<br>**Outcome**: The funding received by NSW I&I has been of enormous benefit. Across the department much of its water monitoring equipment was outdated and in urgent need of replacement. The M&E funding has injected much-needed capital into these projects and undoubtedly increased the reliability of data collected, extended the working life of the stations involved and improved the department's capability to transfer data to the Bureau, as required under the *Water Regulations 2008* |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Purchase equipment and telemetry for 5 Key Sites | NSW 7.3 | Gap 2 Streamflow data not meeting all accuracy requirements<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution**:*<br>*GAP 2: The gap is closed for NSW I&I.*<br>*GAP 4: The gap is closed for NSW I&I.* | 157,315 | **Purpose:** Funding was used to upgrade stream gauging, climate and groundwater stations with data-loggers, turbidity sensors, EC sensors, pyrometers, RH and temperature sensors, barometric pressure sensors, windspeed and direction sensors, solar radiation sensors and modems for telemetry<br>**Outcome:** The funding received by NSW I&I from the Bureau has allowed continuity of data of from representative first and second headwater catchments in NSW. The upgraded water monitoring equipment will ensure ongoing reliability of data by extended the working life of the stations involved. These will enable improved understanding of these water source catchments and additionally improve the department's capability to transfer data to the Bureau, as required under the *Water Regulations 2008.* |
| Database and data refinements | NSW1.05 | Gap 28: Groundwater database unable to export data in WDTF.<br><br>Streamflow data not meeting all accuracy requirements<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>50% gap resolution this year, but funded in subsequent years to close the gap. | 169,000 | **Purpose:** To engage a specialist Hydstra consultant to:<br>· develop Hydstra tools to be able to access data from other database systems in a form that is compatible with the Bureau HYXMLEXP process.<br>· use the range of tools available within Hydstra (HYGIENE, HYAUDIT, etc) to undertake audits of both data and databases<br>To make modifications to the groundwater level data so that it could be more easily and consistently sent..<br>Assistance with the analysis of the requirements for an upgrade to the to a Multi Agency Water Quality database..<br>**Outcome:**<br>· Improved accuracy of existing data and data transfers to the Bureau<br>· Clean up of the Department's Hydstra databases.<br>· A framework and tools that can be applied at other agencies looking to use data sources.<br>· A vision and scope document that is the basis for a competitive tender for the development of a new integrated water quality database system. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Update the ALERT network hardware to ensure the continual operation of all network components | NSW 21.1<br>SMCMS | Gap 31: Insufficient redundancy in telemetry systems<br><br>***Gap Resolution**:*<br>*GAP 31: The gap is resolved for the Sydney Metro CMA. 12 stations in the network have been upgraded.* | 90,000 | **Purpose:**<br>To seek funding to update the network hardware to ensure the continual operation of all components of the network. The network is aging and the CMA is unable to replace/refurbish the hardware. Without funding the CMA will continue with its program to hand over some of the network to Councils to maintain and to decommission the remainder of the network.<br>**Outcome:**<br>· The replacement of the existing data collection hardware, in particular the ALERT canisters, have brought the UPRCT network up to a consistent specification compared to the Bureau network in the immediate vicinity of the Trusts area of operation.<br>· The replacement ALERT canisters are ELPRO ERRTS Field Station Canister, 5 Watt Transmitter and are similar to Bureau equipment to overcome the problem of rainfall calibration data being displayed on the Bureau website. Data transmission will incorporate the enhanced IFLOWS format, which has more advanced error checking than the current UPRCT system.<br>· Each station has a solar panel supplement power to the batteries.<br>· The number of rainfall stations within the UPRCT is required for the hydrologic modelling to provide redundancy in the system. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Data systems harmonisation and integration | NSW 2.4 | Gap 36 Core database unable to meet current and future data management and delivery needs<br><br>***Gap Resolution**:*<br>*GAP 36: The gap is resolved for State Water datasets using Koncentrator (integrated different datasets)* | 40,000 | **Purpose**:<br>Develop a Koncentrator – a data management tool to harmonise discrete datasets from multiple sources<br>**Outcome:** Developed a data integration and management system.<br>The project collates data from within the SW into a unified format and forwards this data from a single point in SW to NSW Office of Water and Bureau. It is required because currently SW surface water data is not centralised but located in diverse formats across systems located in different regional locations of NSW. |
| Hydstra Upgrade to Version 9.06<br>*Sydney Water Corp* | NSW 3.1 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution**:*<br>*GAP 36: The gap is now resolved for Sydney Water. The core system has been upgraded and was an enabler of projects 3.3 and 3.5* | 162,000 | **Purpose:**<br>The upgrade to Hydstra V 9.06 is necessary to support the new Hydstra Kisters Task Server Module that SW is currently using.<br>**Outcome**: Upgrade of some source systems to write scheduled data extraction and send processes.<br>Storage, water quality and meteorological data are being extracted from a variety of sources, summarised and transmitted to the Bureau on a weekly basis without any human intervention. |
| Hydstra – Kisters Task Server Module (SVR) | NSW 3.3 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution**:*<br>*GAP 36: The gap is now resolved for Sydney Water .* | 81,500 | **Purpose:**<br>The existing Hydstra Kisters Task Server Module is installed on 12 servers at 6 locations. The upgrades will ensure all systems remain synchronised.<br>**Outcome**: Upgrade some of our source systems to write scheduled data extraction and send processes. Storage, water quality and meteorological data are being extracted from a variety of sources, summarised and transmitted to the Bureau on a weekly basis without any human intervention. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Data extraction from Enterprise Data Waterhouse (EDW) for IICATS telemetry data for the Bureau | NSW 3.5 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution**:*<br>*GAP 36: The gap is now resolved for Sydney Water.* | 25,000 | **Purpose:**<br>To set up a system that can format the data compiled in the Sydney Waters Enterprise Data for delivery to the Bureau.<br>**Outcome**: Upgrades to some of Sydney Waters source systems, write scheduled data extraction and send processes. Storage, water quality and meteorological data are now extracted from a variety of sources, summarised and transmitted to the Bureau on a weekly basis without any human intervention. |
| Data extraction from Enterprise Data Waterhouse (EDW) of LIMNOS data for the Bureau | NSW 3.6 | Gap 36 Core database unable to meet current and future data management and delivery needs<br>***Gap Resolution**:*<br>*GAP 36: The gap is now resolved for Sydney Water.* | 25,000 | **Purpose:**<br>To set up a system that can format the data compiled in the Sydney Waters Enterprise Data for delivery to the Bureau.<br>**Outcome**: Upgrades to some of Sydney Waters source systems, write scheduled data extraction and send processes. Storage, water quality and meteorological data are now extracted from a variety of sources, summarised and transmitted to the Bureau on a weekly basis without any human intervention. |
| Install flow monitoring equipment both upstream and downstream of Rylstone Dam. | NSW 28.2 | Gap 1: In some catchments the surface water network coverage is not fully meeting water information requirements.<br>***Gap Resolution**:*<br>*GAP 2: The gap is now resolved for Midwestern Council.* | 66,000 | **Purpose:** To install flow monitoring equipment both upstream and downstream of Rylstone Dam in order to meet current water supply licence conditions and to provide river flow data for the Cudgegong River upstream of Windamere Dam.<br>**Outcome:**<br>· The council is able to adhere to licence conditions and provide flow data to NSW Office of Water and the Bureau.<br>· Data will contribute to better water accounting and improved water modelling. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Investigate and prepare R & D Report including costing for the Major Storage Level Recorder instrumentation upgrade and prepare detailed construction plan. | NSW 2.3 | Gap 9 Water storage and surface water data not in electronic format<br>Gap 4 Data capture and transfer not meeting time requirements<br>Gap 31 Lack of telemetry redundancy<br>***Gap Resolution***:<br>*ALL GAPS: The gaps are not resolved, but pending effective implementation of the plan the gap should be resolved in 2009/10 funding round.* | 51,913 | **Purpose** : Upgrade of storage level recorders on 19 major SW storages . Scoping project for 09/10 implementation.<br>**Outcome:** An efficient plan for the upgrade of storage level recorders on 19 major SW storages. The plan will be implemented in the next round of funding.<br>Ultimately SW will improve both the speed of data delivery to the Bureau and the accuracy of the data. This will enable improved management of water resources in primary storages in NSW. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Increased reliability of water data level and flow data | NSW 1.02 | Gap 9 Water storage and surface water data not in electronic format<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution*:**<br>*GAP 9: The gap is BEING resolved for and current telemetered and then current non telemetered stations that are required by the Bureau.*<br><br>*GAP 4 : The gap is BEING resolved for and current telemetered and then current non telemetered stations that are required by the Bureau.* | 243,000 | **Purpose:**<br>· Improved management of datasets and their availability to the Bureau.<br>· Convert the unprocessed raw height and associated datasets from priority stations to digital format. Almost 30% of NSW Office of Waters historical height datasets (40,000 years) is not available in digital form and much of the metadata around the whole dataset is only available in paper format.<br>· Focus on water balance stations (WSP) and current telemetered and then current non telemetered stations that are required by the Bureau.<br>**Outcome**: **ongoing?**<br>The conversion of 11,000 years of unprocessed height data (estimated to consume 100 staff years) .to digital format has:<br>· Secured this data for the future,<br>· Ensured timely and complete extraction and use of the raw and processed datasets.<br>**Issues:**<br>The historical archive constitutes over 97% of the surface water information for NSW and forms the backbone of the Bureau modelling efforts in NSW and South Australia. The project is planned to cover the 4 years remaining of the MEHMS funding. That is 6 person years for the next 4 years will eliminate the backlog in data processing and converting analogue metadata to digital format (Hydstra) of priority stations. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Groundwater monitoring bores connected to AHD | NSW 1.07 | Gap 16: Inadequate spatial mapping of groundwater network<br><br>***Gap Resolution:***<br>*GAP 16:* NOT resolved. The project only surveys 250 high priority bores. This represents a fraction of the total bores in NSW, and less than 50% of priority bores in NSW. | 200,000 | **Purpose:**<br>· Accurately locate bores, including their elevation.<br>· Improve accuracy of groundwater data, and database<br>**Outcome:**<br>· 250 bores in high priority areas surveyed.<br>· Purchase of specialised camera-surveillance equipment that permit the assessment of the bore status increasing the reliability of level data and reducing the cost of bore maintenance.<br>· The establishment of stable reference points (c-type bench marks) that eliminate the need to resurvey the sites. |
| Bathymetric survey of eight priority storages | NSW 2.5 | Gap 35 Insufficient knowledge of capacity of river storages<br><br>***Gap Resolution****:*<br>*GAP 35: The gap is 60% resolved as only 6 out of ten priority storages have been surveyed.* | 197,918 | **Purpose:**<br>Bathymetric survey of priority storages to improve accuracy of data and timeliness of data delivery to the Bureau.<br>**Outcome:**<br>· Completed the bathymetric survey for 6 out of ten priority storages..<br>· SW will be improve both the speed of data delivery to the Bureau and the accuracy of the data. This will enable improved management of water resources in priority storages in NSW. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Differential GPS hardware system for geo-locating sites / assets for Bureau metadata | NSW 3.4 | Gap 18 In adequate spatial mapping of water quality network.<br><br>***Gap Resolution*** :<br>*GAP 18: Mapping of assets completed*. | 10,000 | **Purpose:** To develop the ability to locate sites accurately, including elevation.<br>**Outcome**:<br>· Easy to use Hemisphere R220 TM DGPS with sub-metre capability has provided improved metadata of water quality samples taken at drinking water catchment sites sampled by Sydney Water Field Services Team<br>· Sub-metre accuracy provides a means to locate specific sampling points and ad added assurance of repeatability<br>· Accurate geo-coding of hydrometric sites and in particular sensor location, morphology, assets or other features which may describe the information collected from sites. |
| Extend ALERT system for water level data, rainfall data and real time flood data monitoring. | NSW 14.1 | Gap 1: In some catchments the surface water network coverage is not fully meeting information requirements.<br>***Gap Resolution***<br>*Gap 1: Resolved for Shoalhaven Council.* | 70,000 | **Purpose:** Extend Alert system.<br>**Outcome**: Improved flood warning |
| Install remote level sensing devices to monitor water levels at two Broken Hill reservoirs<br><br>Essential Energy | NSW 10.1 | Gap 9 Water storage and surface water data not in electronic format<br>Gap 4 Data capture and transfer not meeting time requirements<br><br>***Gap Resolution***<br>Gaps 9 and 4 : Resolved for Essential Energy at Broken Hill Reservoir | 20,500 | **Purpose:** To install remote level sensing devices that will monitor water levels in the two of the three cells of Stephens Creek Reservoir and one of the two cells in Imperial Lake. Proposed to connect back to SCADA system in Broken Hill and set up automatic reporting to the Bureau.<br>**Outcome**: Improved water level data to assist with management, and an ability to efficiently provide 3a data to the Bureau. |

| ROUND TWO<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Installation of automated river level and flow gauging stations at existing manual gauge sites.<br>Tweed Shire | NSW 1.7 | Gap 4 Data capture and transfer not meeting time requirements<br>Gap 1: In some catchments the surface water network coverage is not fully meeting information requirements.<br>***Gap Resolution***<br>*Resolved* | 60,000 | **Purpose:** Installation of automated river level and flow gauging stations at existing manual gauge sites at the following two locations:<br>· Tweed River at Palmers Road upstream of Doon Doon Creek confluence<br>· Doon Doon Creek downstream of Clarrie Hall Dam and upstream of Tweed River confluence<br>**Outcome:** Improved accuracy and currency of data required by the Bureau. |
| Strategic water information Coordination (NSW) | NSW 1.00 | Gap 21 Insufficient coordination of SWIMP activities at jurisdictional/lead agency level<br>***Gap Resolution***<br>*GAP 21: Resolved for 2008/2009* | 335,000 | **Purpose:**<br>Improved coordination of NSW monitoring activities.<br><br>**Outcome**:<br>Employment of strategist who has coordinated NSW Office of Water activities and the development of a cross agency monitoring plan. |

**Table 42: Gap analysis M&E ROUND 1 — 2007/2008**

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving accuracy of existing data (1) – High Flow Doppler | NSW 1.1 | Gap 2 Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution:***<br>*GAP 2: The gap is not closed as the project is only for equipment purchase. See round 2.* | 610,000 | **Purpose:** Acquisition of portable acoustic Doppler current profiler/discharge measurement systems to improve the accuracy of the measurement of medium to high flows.<br><br>**Outcome:**<br>· This technology overcomes many of the OHS issues that are restricting the industries ability to collect high flow data.<br>· This technology has dramatically reduced the amount of time required to collect the data, resulting in more high flow gaugings being obtained and ultimately more accurate representation of the flow distribution at medium to high flows.<br>· Improved accuracy of the stage discharge relationship.<br><br>**Issues:**<br>This project is also requesting Differential Global Positioning Systems (DGPS) which are required to improve navigation accuracy when using the Doppler current meters and especially for use in moving stream bed conditions. This project does not include training and procedure development and implementation costs – funds to undertake this work will be sourced next year |

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving accuracy of existing data (2) – Low Flow Doppler | NSW 1.2 | Gap 2 Streamflow data not meeting all accuracy requirements<br><br>Gap 8: Height and Flow Calibrations not meeting accuracy requirements<br><br>***Gap Resolution:*** T<br>*The gaps are not closed as the project is only for equipment purchase. See round 2.* | 255,000 | **Purpose:**<br>The acquisition of low flow acoustic Dopplers to improve accuracy in the measurement of low flow conditions.<br>**Outcome:**<br>· Replacement of 20+ years old low flow measurement<br>· Higher accuracy at low flow,<br>· better interpretation of data, and data outputs are integrated with the Hydstra program.<br>**Issues:**<br>This bid does not include training and procedure development and implementation costs. Funds for these activities will be sourced next year. This technology is becoming the Water industry standard for low flow measurement. |
| Improving currency of existing networks (1) – Loggers | NSW 1.3 | Gap 4: Data capture and transfer not meeting time requirements<br><br>***Gap Resolution:***<br>*GAP 4: The gap is not closed as the project is only for equipment purchase. See round 2.* | 306,000 | **Purpose:**<br>Improve the currency of the existing network with the purchase of 200 old 4-20 mA level sensing systems with SDI 12 compatible/Monibus communication platform systems at NSW Office of Water, MDBC and State water funded stations. The 4-20 mA do not meet the current Australian standard accuracy levels of ±5mm.<br>**Outcome:**<br>Increased accuracy of the measurement of stream height and hence streamflow.<br>**Issues:**<br>This project is for procurement only and does not include installation, training and implementation costs. Funds for these activities will be sourced the following year. |

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving accuracy of existing networks | NSW 1.4 | Gap 2: Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution:***<br>*The gap is 50% closed and requires funding in future years.* | 306,000 | **Purpose:**<br>Replace old level sensing technology<br>**Outcome:**<br>Increased accuracy of the measurement of stream height and hence streamflow.<br>**Issues:**<br>Linked to other projects e.g. 1.1 and 1.2 |
| National Performance Report | NSW 1.5 | Gap 21: Insufficient coordination for SWIMP activities at jurisdictional / lead agency level<br><br>***Gap Resolution:***<br>*Gap resolved for this issue only, not for all data and issues.* | 54,500 | **Purpose:**<br>Assess NSW contribution for the national performance report.<br>**Outcome:**<br>Lesson the burden on participants by streamlining the data collection process. Reduce erroneous data. Accelerate the production of the NPR. Centralise data management (including historical data), providing greater reporting capacity. Effectively manage the data collection and compilation activities with transparency across all participants. Minimise cost through efficiency gains. |

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving accuracy of existing data (3) – Survey equipment | NSW 1.6 | Gap 16: Inadequate spatial mapping of groundwater network<br><br>Gap 6: Inadequate spatial location of surface water monitoring sites<br><br>***Gap Resolution:***<br>*The gaps are not closed as the project is only for equipment purchase. See round 2.* | 183,000 | **Purpose :**<br>Improving accuracy of existing data. Investment in EDM Height Traversing and the Precise Differential surveying equipment to undertake accurate and consistent survey work at surface and groundwater monitoring sites.<br>**Outcome:**<br>Will result in the connection of remote surface and groundwater stations to Australian Height Datum (AHD) to allow the comparison of all water level data to a common datum for many hydrology uses. Much of the existing surface water monitoring stations are not connected to AHD due to their remoteness makes this survey work using existing technology cost and time prohibitive. Groundwater monitoring networks are exponentially increasing and to assess the relative changes in aquifer level all sites need to be connected to AHD. Having this technology will facilitate this in a timely and cost-efficient manner.<br>**Issues:**<br>Currently this work can only be done by private contractors and with the limited number available they are expensive and near impossible to engage. This project is for the acquisition of the hardware only. Funding will be sourced for training costs in the following year. |
| Improving currency of existing networks (2) – Shelters | NSW 1.7 | Gap 4: Streamflow data not meeting all currency requirements<br><br>***Gap Resolution:***<br>*GAP 2: The gap is not closed as the project is only for equipment purchase.* | 306,000 | **Purpose :**<br>Replace some 100 1970s shelter structures. Much of the network is housed in infrastructure designed and implemented for the old analogue technology.<br>**Outcome:**<br>Improved currency of data<br>Once installed (next year) the upgrade program will bring the infrastructure at key water management stations funded by NSW Office of Water, MDBC, State Water and DBBRC to a standard to better house the newer electronic technology leading to longer life, reduced lost record and improved efficiency.<br>**Issues:**<br>Assumed to be managed over the next 2 years. |

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving accuracy of existing data (4) – Elevated structures | NSW 1.8 | Gap 2: Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution:***<br>*GAP 2: The gap is not closed as the project is only for equipment purchase.*<br><br>***Gap Resolution:*** | 366,000 | **Purpose:**<br>Refurbish/reconfigure of 60 float well monitoring stations to meet OHS specifications and/or change to pressure sensing technology to improve the reliability and accuracy of data recording.<br>**Outcome:**<br>Improved access to the float well infrastructure to maintain and desilt the wells resulting in improved data (usually at low flow conditions). Improved safety conditions as well as previously, ascending to the instrument shelter on top of the well structure (typically 2–5m high) was a safety concern.<br>**Issues:**<br>This project is for the initial acquisition of hardware and does not include installation costs. This is assumed to be managed over the next 3 years and additional funding will be sourced for these activities. |

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Improving accuracy of existing data new field recording technology. | NSW 2.4 | Gap 2: Streamflow data not meeting all accuracy requirements<br><br>***Gap Resolution:***<br>*GAP 2: The gap is not closed as the project is only for equipment purchase. See round 2.* | 125,000 | **Purpose:**<br>The purchase of PDAs and tough notebook computers to reduce the existing duplication of manual recording in the field to near real-time management through the use of appropriate software and hardware in the field. The acquisitions also ensure that the appropriate technology is used in extreme weather and harsh conditions such as during floods (will complement the acquisition of the portable Dopplers).<br>**Outcomes:**<br>· With the implementation of improved field procedures using the portable computer technology, there is more timely and accurate collection of a range of field data.<br>· The use of the Hydstra, HYVISIT program developed by NSW Office of Water, has provided a consistent state-wide approach to site visits, site maintenance and collection of a range of site performance and management data.<br>· No lost data.<br>**Issues:**<br>This bid reflects the hardware acquisition only. Funding will be sought for further software application developments, training and implementation in 08/09. |
| Improving coordination of monitoring activities | NSW 2.5 | Gap 21 Insufficient coordination of SWIMP activities at jurisdictional/lead agency level<br><br>***Gap Resolution:***<br>*GAP 21: The gap was resolved for the term of employment* | 40,000 | **Purpose:**<br>Improved coordination of NSW monitoring activities.<br><br>**Outcome**:<br>Employment of strategist who has coordinated NSW Office of Water activities and the development of a cross agency monitoring plan. |

| ROUND ONE<br>Project Name | Project Number | Gap in Data and Systems | Cost ($est.) | Contributions of project to the resolution of the gap. Quantify where possible. |
|---|---|---|---|---|
| Instruments approach – NSW coast zones gauging station | NSW 4.1 | Gap 2 Data capture and transfer not meeting time requirements<br>Gap 31 Lack of telemetry full redundancy.<br><br>***Gap Resolution**:* T<br>*GAP 4: The gap has been closed for the upgraded sites in 08/09*<br>*GAP 31: The gap has been reduced for the upgraded sites in 08/09. It is envisaged it will be closed by 2011 with additional upgrades.* | 698,000 | **Purpose: (same reporting as for project 5.1 in 08/09)**<br>In the first round of funding approved in late 2007/08, $698,000 was allocated for the purchase of 250 Campbell CR800 data loggers and 92 pressure transducers to upgrade the DECCW Coastal Water Level Network. This application for funding addresses the installation of this instrumentation purchased in 2007/08.<br>The installation requires the following components<br>· Preparation and standardisation of instrumentation assembly<br>· Calibration of the pressure transducers<br>· On-site installation of the data loggers and pressure transducers<br>· Staff training in the use of the Campbell loggers<br>· Purchase of the telemetry software package (an Off The Shelf HydroTel system that supports the new data logger communication protocol)<br>· Integration of the new data loggers, transducers, instrument tracking system, and telemetry packages into the current MHL network<br>**Outcome:** Ageing data logging instrumentation was upgraded to current technology and has substantially improved the quality, reliability and accessibility of this extensive water level network. |

## Appendix 5 – Contact details

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