

HYDROLOGICAL SERVICES

As a result of the extension of the Bureau's water information role under the *Water Act 2007*, a major transformation of Hydrological Services began during the reporting period. The new role is backed by funding of \$450 million over ten years through the Government's Improving Water Information Program, which sits within a wider \$12.9 billion Government strategy to address the threat of future water scarcity in Australia.

The Bureau's new water information responsibilities include: compiling and publishing a National Water Account; providing regular water availability forecasts; producing reports on the use, condition and availability of water resources; and enhancing understanding of Australia's water resources.

The pre-existing components of Hydrological Services – the hydrometeorological advisory service, flood warning services and water resources assessment – are being integrated into this broadened water information output.

These existing services depend on the information collected through the Bureau's national meteorological observation networks, as well as a special-purpose network of rainfall and river level stations operated by the Bureau in cooperation with State and local government agencies. To meet its increased water information responsibilities, the Bureau is establishing new systems to receive water data from over 250 agencies and organisations in all States and Territories of Australia. The water data being collated cover all the elements of surface and groundwater budgets and some aspects of water quality, along with information on water resource management and trade, such as entitlements and allocations.

PLANNED OUTCOME 2007-08

<p>Outcome</p>	<p>(1) Enhanced community safety and well-being through preparation of meteorological and related products and information and the effective use of meteorological and related services by the general public and other major social, environmental and economic sectors.</p> <p>(2) Enhanced water planning and management through effective use of water information.</p>
<p>Objective</p>	<p>To provide an effective national source of hydrological and hydrometeorological data and advice and to meet the needs of the general public, emergency services and other specialised users for effective, reliable flood warning services.</p>
<p>Effectiveness indicators</p>	<p>The extent to which:</p> <ul style="list-style-type: none"> • hydrological services contribute to: <ul style="list-style-type: none"> - minimising loss of life and property and community disruption; - minimising economic and other costs of disaster preparedness; - the safety, comfort, convenience and general welfare and economic benefit of the public and major community groups; - government and community planning; - the management of the environment, including natural resources; and - the economy and efficiency of primary and secondary industry; • forecasts, warnings, information and advice are accurate and timely; • user needs are identified and satisfied and new services and products are developed as opportunities arise and within available resources; • the public, major user groups and specialised users receive, understand and make optimum use of the services and express satisfaction with the services; • water planners and managers have access to water information that is accurate, timely, reliable and fit-for-purpose; • water information standards satisfy the requirements of water planners and managers; and • strategic investigations enhance understanding of Australia's water resources.

OUTPUTS 2007-08

Hydrological Services is one of the Bureau's eight Major Outputs and contributes towards Output Group 1.3 - Meteorological and Related Services and Products, and Output Group 1.5 - Water Information. Products and services currently include: a comprehensive national flood warning service for coastal and inland rivers in collaboration with relevant State and local government agencies; advice to public and private sector organisations on the use of hydro-meteorological information in design, construction and other applications; and publications, reports and datasets on Australia's surface water resources and their utilisation, and on the links between weather, climate and surface water.

The establishment of the Bureau's new water information systems will lead to the generation of a significantly greater range of water information products and services for use by governments, industry and the community, based on the collection of new data.

OUTPUT PERFORMANCE 2007-08

Output performance is measured against a number of quality, quantity and price targets. The results achieved for 2007-08 are provided below along with a commentary on significant variations.

Quality	Target	Actual
Percentage of users surveyed are 'satisfied' or 'very satisfied' with hydrological data, information, advisory and flood warning services	85%	Approx 75% (see Note 1)
Percentage of partner agencies satisfied that the Bureau inputs to the operation of the total flood warning system are effective and meet agreed service levels	90%	>90% (see Note 2)
National water information standards (including data quality, metadata and data transfer) defined to the satisfaction of an appropriate expert group		System implementation in progress
Establishment of a national water data archive		System implementation in progress
Percentage of regular data downloads successfully completed within preset quality control standards	95%	System implementation in progress
Percentage of users surveyed that are 'satisfied' or 'very satisfied' with water information products	90%	System implementation in progress
Percentage of commissioned investigations completed in accordance with specified terms and conditions	100%	100%

Quantity (cont.)	Target	Actual
Number of hydrological data, information, advisory and flood warning services issued	2 million	2.6 million
Number of Internet accesses to automated hydrological service delivery systems	2 million	6.8 million
Number of national water information standards issued	3	System implementation in progress
Number of States and Territories in which water data provision arrangements are in place	3	8
Percentage increase in access to water information from the Bureau's website	10%	> 40%
Number of new water information products developed	4	2
Number of strategic investigations commissioned	3	3
Price		
Flood Warning Service	\$5.241m	-
Hydrometeorological Advice	\$2.082m	-
Water Information	\$14.743m	-
Water Data Service		\$3.052m
Water Monitoring Service		\$1.852m
Water Prediction Services		\$6.082m

ADMINISTERED ITEMS

Quality	Target	Actual
The coverage of water observation networks	Increase in coverage relative to the previous year	Upgrades to 11 networks funded
Quantity		
Number of State and Territory governments which have agreed to investment programs for the modernisation and extension of water observation networks	3	8
Price		
Water Information	\$10.000m	\$8.043m

Notes

- (1) Results from the systematic survey that was undertaken in July and August in Victoria following flooding in Gippsland.
- (2) Estimate based on combination of informal feedback at post-flood debriefing meetings and the survey undertaken in Victoria in July and August. Further post-event performance analysis of major flood episodes is planned.

COMMENTS ON OUTPUT PERFORMANCE

Several of the targets above relate to functions and systems that were in the process of development or implementation in this first year of the Bureau's expanded water information role, and hence no actual performance results are yet available. These include definition of national water information standards, establishment of a national water data archive, percentage of data downloads within quality-control standards, and satisfaction level of users of new water information products.

Arrangements for water data provision were in place in all States and Territories, rather than the target of three, with the commencement at the end of June of the Water Act Regulations, which require water data owners across Australia to provide the Bureau with prescribed information within a set timeframe. Similarly, all State and Territory governments agreed to investment programs for the modernisation and extension of water observation networks in light of their obligations under the Regulations.

The popularity of new products released during the year, along with the unusual occurrence of flooding in Central Queensland, led to targets for the number of hydrological service products issued and accessed via the internet being significantly exceeded.

The Bureau completed a restructure of the Hydrological Services Major Output at the beginning of the year to recognise its new functions and responsibilities in this area. This resulted in the former outputs through which Hydrological Services were delivered - Flood Warning Service, Hydrometeorological Advice, and Water Information - being replaced by three new outputs. Output prices are therefore reported against each of these new outputs.

The discrepancy between the total of the price targets and the total of the actual prices was a result of the rephasing of \$5 million to the 2016-17 financial year, in conjunction with lower than expected staff numbers due to the significant time required to recruit and select the large number of staff needed to fulfil the Bureau's new water-related responsibilities. In regard to administered funding, which was allocated on the basis of proposals from State and Territory agencies, the difference between target and actual prices was a result of insufficient project proposals of the required quality being received, which also in part due to time constraints related to the establishment of the Bureau's new functions.

ACHIEVING THE OUTCOME

During 2007-08 Hydrological Services was delivered through three individual outputs - the Water Data Service, Water Monitoring Service, and Water Prediction Services. The developments related to each of the outputs, and their contribution to the outcome, are addressed below.

OVERVIEW OF 2007-08

2007-08 was the critical start-up year for the Bureau's new water information responsibilities which centre on the development and maintenance of an integrated national water data system that is freely accessible to the public.

A major development during the period was the implementation at the end of June of the Regulations supporting the *Water Act 2007*, which require over 250 water agencies and organisations around Australia to deliver certain water data to the Bureau within specified timeframes. It is these data which will enable the Bureau to begin collation and publication

of water information at a national level.

A second very significant development was the signing of an agreement with the CSIRO to jointly invest over a five-year period in the Water Information Research and Development Alliance (WIRADA), that will establish the largest program of water information research in the southern hemisphere. The CSIRO and the Bureau will together contribute \$50 million to water information research and development through WIRADA, which will deliver a significant part of the research and development output needed by the Bureau in support of its new water information role, as well as its pre-existing role in flood warning and forecasting.

One of the priorities for the year was to facilitate the active participation of State and Territory stakeholders in the operation of the Bureau's national water information functions. The Bureau organised a series of water industry information seminars, holding one in each Australian State and Territory between November and February, to inform the relevant agencies and organisations about its new role. These were attended by over 1000 stakeholders. In addition, the Jurisdictional Reference Group on Water Information (JRGWI), which includes representatives of the lead water agencies in each State and Territory, was established and convened its inaugural meeting in January. The JRGWI, which will meet up to three times a year and held its second meeting in May.

The Bureau continued its participation in the activities of the WMO Commission for Hydrology, with one of its senior managers holding the role of President. Through this involvement, the Bureau contributes to the international exchange of knowledge and expertise, thereby enhancing the effectiveness of the hydrological services it provides to the Australian community. In 2007-08 Australia, through the Bureau, continued to have significant involvement in WMO activities which included revision of the WMO Guide to Hydrological Practices, compila-



Bureau staff and representatives from the water industry presented an overview of the Bureau's new water information role in a series of national workshops aimed to facilitate the active participation of State and Territory stakeholders in the operation of the Bureau's national water information functions. These workshops were attended by over 1000 stakeholders.

tion of manuals on streamflow gauging, low flow estimation and flood forecasting, and the development of a Quality Management Framework for hydrological observations.

Despite continuing dry conditions in some parts of the country, the number of flood warnings issued in 2007-08 was greater than in recent years. It began with major flooding in the Derwent and the Forth Rivers in Tasmania during August, and moderate flooding in the South Esk and Huon Rivers. Intense rainfall in the Sunshine Coast area of Queensland later in the month led to flash flooding in most coastal streams, with levels approaching or exceeding previous record levels in some cases.

In December, there were floods in the headwater areas of the Murray-Darling Basin, with major floods along the Warrego River in New South Wales leading to the first significant inflows to the Darling River for 12 months. Heavy rainfall in northern NSW and southern Queensland during the early part of January led to flooding in rivers including the Richmond (the highest since 1954), Wilsons, Bellinger and Tweed in New South Wales, as well as the Condamine and Logan/Albert river systems in Queensland. Flash flooding in the upper reaches of catchments in Queensland caused significant damage to farming, bridges and low level crossings, with many people trapped in cars.

Flooding continued in Queensland from January to March, a period during which the Queensland Flood Warning Centre issued over 500 flood warnings containing about 330 river height predictions for over 50 locations. Many towns and regional centres were severely affected with the areas around Emerald on the Nogoa River and Charleville on the Warrego River being among the more notable (Figure 30). Flood warnings from the Bureau for Charleville provided authorities with sufficient lead-time to construct a temporary levee to protect the town.

WATER DATA SERVICE

The Bureau's water information role contributes to enhanced water planning and supports the sustainable development and management of Australia's water resources, consistent with national water reform under the National Water Initiative. The Bureau's Water Data Service will contribute to these objectives through the identification, cataloguing and discovery of all the potential sources of information relevant to Australian water resources, the collation of this information in an Australian Water Resources Information System (AWRIS), and the provision of free public access to this information through AWRIS. This task also includes the setting of standards for and quality control of water data, the establishment and continuing revision of the Water Act Regulations, and management of the funds available under the Modernisation and Extension of Hydrologic Monitoring Systems Programme for the upgrade of Australia's water monitoring networks.

Major developments 2007-08

- The first round of funding grants to State and Territory agencies under the \$80 million Modernisation and Extension of Hydrologic Monitoring Systems Programme was completed. A total of \$8.8 million (GST-inclusive) was distributed, with government departments and agencies in all States and Territories receiving grants in the last quarter of the financial year.
- Pilot systems were developed to aggregate water data to be supplied by major agencies in each State or Territory as input into AWRIS, which will become a publicly accessible

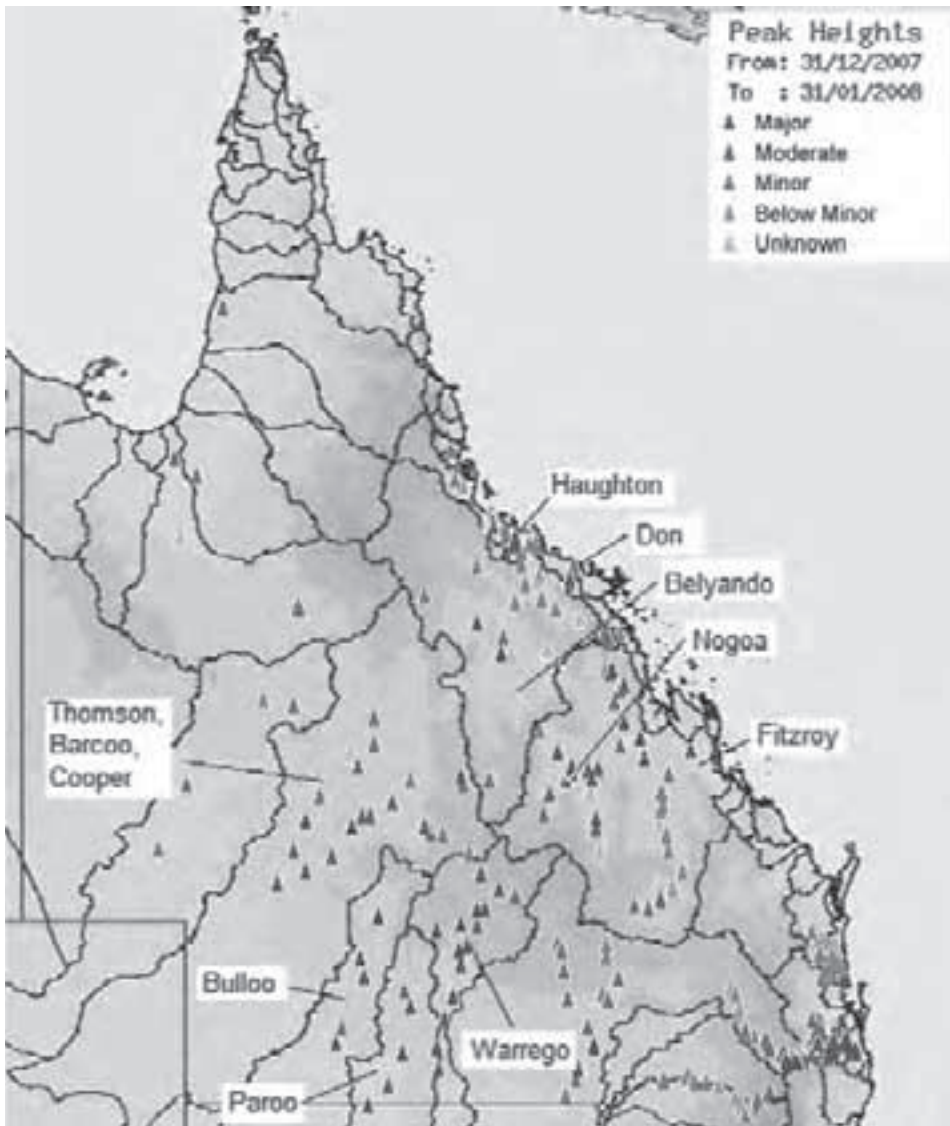


Figure 30. Map showing locations at which minor, moderate and major flood peaks were recorded in Queensland during January.

national database (Figure 31).

- A framework for the development of the Australian Hydrological Geospatial Fabric (the geofabric) was produced in conjunction with CSIRO and Geoscience Australia. When completed, the geofabric will link time-series data on surface run-off, flow diversions, groundwater levels, water held in storage, rural and urban water use, and water entitlements, allocations and trades to geographical or spatial data about hydrological features across Australia, including catchment boundaries, streams, aquifers, floodplains, storages and wetlands.

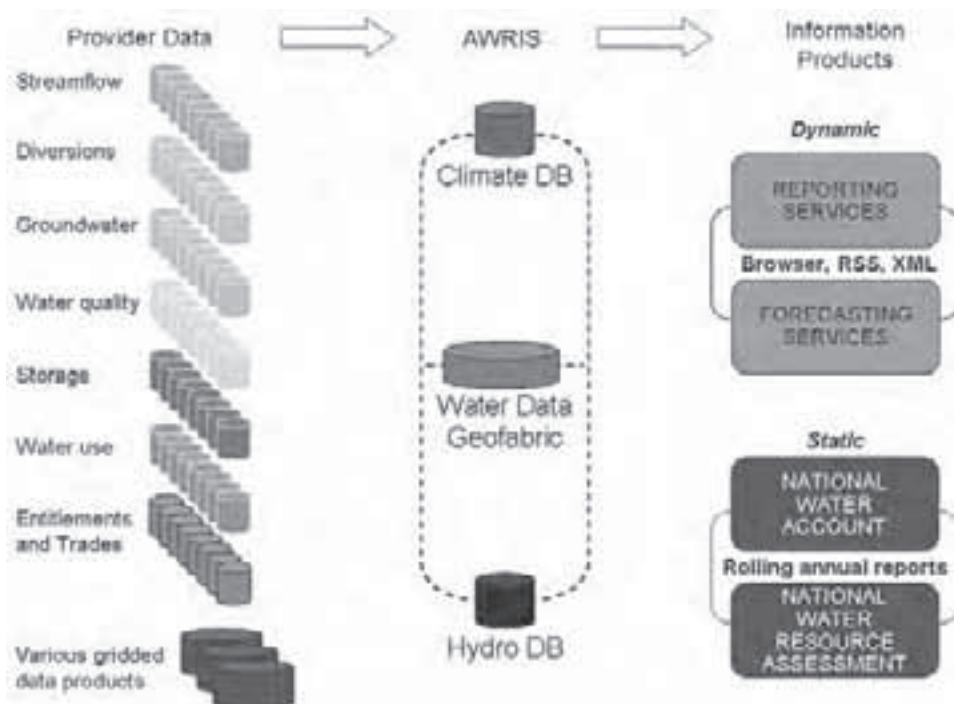


Figure 31. The Australian Water Resources Information System (AWRIS) will ingest, augment and arrange data from over 250 primary collection authorities across Australia, and provide these to the public through a suite of static and dynamic information products.

- Staff were recruited and computing infrastructure procured to enable the Bureau to meet its new responsibilities under the *Water Act 2007*, in particular the development of AWRIS, and the supply of water information and related spatial data required by the Act.

Contribution towards outcome

- The aim of the Modernisation and Extension of Hydrologic Monitoring Systems Programme is to improve the accuracy, currency and scope of the water data the Bureau will receive from agencies across Australia under the Regulations supporting the Water Act, which in turn will provide benefits to the governments, industries and communities which access the data.
- AWRIS will be the means by which the Bureau is able to offer a publicly accessible national database of up-to-date water information to assist understanding and management of Australia's water resources.
- The geofabric provides the design for a database of the information required for water resource assessment together with the relationships between its various elements, providing all the data needed to analyse the availability of water resources. When completed, it will be made freely available to the community and will be a shared national resource that will evolve through collaborative development as a key component of Australia's spatial data infrastructure.

- Recruitment of staff and procurement of computing infrastructure are critical activities in successful implementation of the Bureau's expanded water information role.

WATER MONITORING SERVICE

The Bureau's Water Monitoring Service includes the longstanding hydrometeorological advice service along with new functions the Bureau has assumed under the Water Act. The new functions include the analysis, interpretation and dissemination of water data and information, particularly in support of the Bureau's preparation and presentation of annual water resources assessments, and the production and publication of the National Water Account.

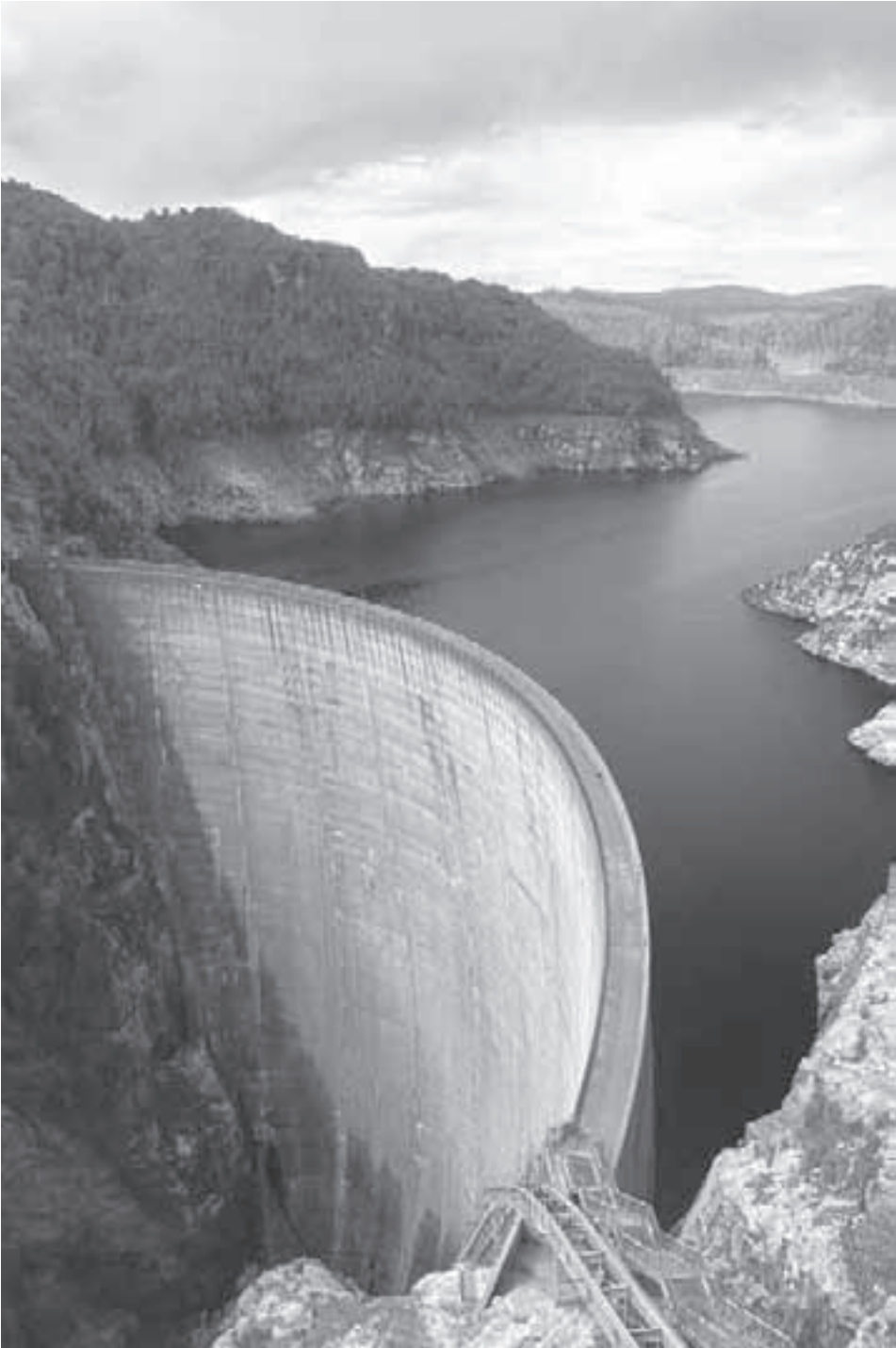
The existing specialised hydrometeorological advice service, provided to the scientific and engineering communities, contributes to the safe design of a wide range of hydrological and other civil infrastructure. Hydrometeorological advice and products include probable maximum precipitation (PMP) and rainfall intensity-frequency-duration (IFD) information, as well as a range of other statistical rainfall analyses. The Bureau also provides a focus for Australian input to, and dissemination of information from, the international hydrology and water resource programs of the World Meteorological Organization (WMO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Major developments 2007-08

- A new system was implemented to deliver, free of charge, IFD data sourced from the publication *Australian Rainfall and Runoff* through the Bureau's website. This online system improves public access to IFD data, making them freely available in both tabular and graphical format.
- The Bureau completed a two-year project, commenced in 2006-07, which investigated the potential effects of climate change on estimates of PMP. This project, which delivered a 200-page scientific report, was primarily funded by the Department of Climate Change (which encompasses the former Australian Greenhouse Office) and the Queensland Department of Natural Resources and Water.
- Through its participation in the eWater Cooperative Research Centre (CRC), the Bureau made a significant contribution to the Murray-Darling Basin Sustainable Yields Project, carried out by the CSIRO for the National Water Commission, through work characterising the current drought and an assessment of the uncertainty of water yield estimates.
- Bureau water accounting responsibilities under the Water Act were coordinated and aligned with those of the Australian Bureau of Statistics and the Water Accounting Development project sponsored under the National Water Initiative, and planning for the first publication by the Bureau of a National Water Account was undertaken.

Contribution towards outcome

- The free provision of the latest IFD data through the Bureau's website improves access to, and use of, this information by engineers working in the areas of water infrastructure design, planning and management.
- Investigations of the potential impact of climate change on estimates of PMP will inform design standards for large dams, thus assisting in adaptation measures necessitated by



The potential impact of climate change on estimates of Probable Maximum Precipitation is an important issue for managers of large dams, such as the Gordon Dam in Tasmania (pictured).

changes in climate, and reducing the risk to public safety and water security stemming from potential infrastructure failure.

- Participation in the eWater CRC research project enabled the Bureau to assist in this landmark study of water availability in the Murray-Darling Basin which was called for by the Prime Minister of Australia and the Premiers of Victoria, New South Wales, South Australia and Queensland at a water summit in 2006.
- The annual publication of a National Water Account is a key obligation on the Bureau of Meteorology under the *Water Act 2007*, aimed at improving public and investor confidence in information about the amount of water being traded, extracted for consumptive use, or recovered and managed for environmental and other public benefit outcomes.

WATER PREDICTION SERVICES

The Bureau has provided flood forecasts and warnings for many years and will continue to provide and enhance these services alongside a range of new prediction services that are being developed to meet the Bureau's new water information responsibilities. The new services will include the provision of short, medium and long-term river flow and water availability predictions, which will assist in water resource planning and management, and in the development of water policy.

The Bureau prepares and disseminates flood forecasts and warnings to the public through Flood Warning Centres in each of its Regional Offices, with overall coordination provided by the Flood Warning Program Office in the Bureau's Head Office. Regional service delivery depends on close cooperation with State and Territory water and emergency service authorities, local government agencies and other stakeholders. More detailed local interpretation of Bureau flood warning information is provided directly to the public by flood response agencies. Bureau inputs include early alerts to the possibility of flooding through a Flood Watch product, with site-specific forecasts of river height and the expected impact in terms of minor, moderate or major flooding in specific river basins. Where dedicated flood forecasting systems have not been installed, more generalised products are issued on a regional basis. The free exchange of data in real time among stakeholder agencies and the timely availability of warnings, data reports and flood information to the public are cornerstones of the flood warning service.

The Bureau, in close cooperation with communities and stakeholder agencies, plays a lead role in planning the flood warning service and the supporting data network. A significant contribution is also made by the Bureau in raising community awareness of flood risk and in measures to improve the effectiveness of the warning service.

Major developments 2007-08

- The Bureau's online flood warning information was improved through a web product displaying the most recently observed river height data for the past four to seven days as a time series. The time series plots are provided for each available gauging station and, where available, the flood class levels (minor, moderate or major) are also shown.
- The quality of quantitative rainfall estimates derived from weather radar data was enhanced by the development of a system to generate 30-minute rainfall totals from flood-

warning radio telemetry gauges and their use in calibrating the radar-based estimates.

- The systems used by the Bureau to support its flood warning function were improved through an upgrade to the Enviromon rainfall and river height data collection and processing system in the Bureau's Regional Offices. Among the enhancements to the system were the development of processes for automatic alerting at significant river height and rainfall values, and improved direct ingest and real-time forwarding of data. As part of this system development, more powerful computing infrastructure was implemented in the Bureau's offices in Western Australia, Victoria and the Northern Territory to host the upgraded software.
- The joint development of a trial web services system with the New South Wales State Emergency Service (SES) enabled the SES to automatically transfer to and display water level information in its GIS systems in support of day-to-day operations.
- A number of new and improved rainfall and river height observation networks and data relay systems were installed in support of flood warning services for the community. These included a new system for the Manning River valley (New South Wales), an upgrade of the system for the Thompson, Macalister and Avon Rivers (Victoria), a new flash flood system for Moolap Creek at Geelong near Melbourne, upgrades to radio telemetry networks in the East Gippsland and Barwon areas in Victoria, and new networks to improve access to water level information from flood control dams in the greater Adelaide area in South Australia.
- The Bureau contributed to State government public education and flood awareness programs (FloodSmart) in NSW and Victoria, and in association with the Victorian SES reviewed the effectiveness of its warning system during the 2007 flooding in Gippsland. The Bureau also worked in conjunction with Emergency Management Queensland to run a pre-season awareness campaign for floods and severe weather. About 600 representatives of local and State government and other agencies involved in Queensland's disaster management system attended the 11 workshops held across Queensland during September to November as part of the campaign. The effective integration of flood warning services into floodplain management continued through Bureau participation in the National Flood Risk Advisory Group, which provides expert advice on flood matters to the Australian Emergency Management Committee, Australia's peak consultative emergency management forum.

Contribution towards outcome

- The provision of graphical information showing changes to water levels over time assists emergency management agencies in using the data in their planning and response activities during floods. The graphical display also enhances the use of the information by recreational users, travellers and a range of other user groups, thus contributing to their safety.
- More accurate rainfall estimates from radar will improve the accuracy of flood forecasting services as well as water management and public weather applications.
- Enhancement of the Enviromon system, and upgrades to the computer hardware which hosts it, improves its utility and robustness, making it more effective and reliable in sup-

porting flood warning and severe weather services to the community.

- The delivery of flood information to the New South Wales SES through web services technology assists it in achieving its aim of capturing and using information to improve situational awareness, response management and reporting in emergency situations.
- New or improved rainfall and river height observation networks enable flood forecasts and warnings to be more accurate and timely, contributing to a greater level of mitigation of the risk from flooding.
- Working closely with emergency management and other stakeholder agencies involved in flood warning and flood risk management, including Commonwealth, State and Territory agencies, helps to maximise the effectiveness of the Bureau's flood warning services by enabling their better integration with overall disaster mitigation efforts. Public education and flood awareness campaigns help to maximise the effectiveness of the Bureau's flood warning services by improving the community response to warnings.