Queensland Government

Premier of Queensland and Minister for Trade

Please quote: 21824/KM10/ERP

- 6 FEB 2003

Mrs Kay Elson MP
Chair
House of Representatives
Standing Committee on Agriculture, Fisheries and Forestry
Parliament House
CANBERRA ACT 2600

Dear Mrs Elson

Thank you for your letter of 20 January 2003 concerning the House of Representatives Inquiry into Future Water Supplies for Australia's Rural Industries and Communities. I have enclosed a copy of the Queensland Government Submission to this Inquiry.

I have no objection to Mr Peter Beavers, Department of Natural Resources and Mines, or Dr Roger Stone, Queensland Centre for Climate Applications, Department of Primary Industries, appearing before the Committee's public hearing in Brisbane to provide technical advice to the Inquiry.

In response to your request for a contact officer, Mr Adrian Jeffreys, Department of the Premier and Cabinet, has been nominated. He can be contacted on (07) 3224 6478 or at Adrian.Jeffreys@premiers.qld.gov.au.

I have taken the liberty of forwarding a copy of your correspondence to the Honourable Stephen Robertson MP, Minister for Natural Resources and Minister for Mines, and the Honourable Henry Palaszczuk, Minister for Primary Industries and Rural Communities.

Yours sincerely

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QUEENSLAND SUBMISSION TO HOUSE OF REPRESENTATIVES INQUIRY INTO FUTURE WATER SUPPLIES FOR AUSTRALIA'S RURAL INDUSTRIES AND COMMUNITIES

Executive Summary

The primary responsibility for ensuring the adequate and sustainable supply of water in rural and regional Queensland rests with the Queensland State Government. Local Governments in Queensland also play a significant role by supplying water for urban and industrial purposes.

The Commonwealth has a role in the resolution of water issues and needs to be involved in the development of national policy frameworks in collaboration the States and communities concerned.

Queensland's view is that the key national policy activities have proved to be powerful and effective tools when there is multilateral support. This means they must recognise the different issues and conditions inherent in each state and the complexity and time needed to bring the desired water reforms to successful implementation.

Where necessary, the Commonwealth can play an important role as a facilitator of co-ordinated inter-jurisdictional action with and by the states towards efficient and sustainable water supply in rural and regional Australia. Provision of funding support is crucial in this role and should continue at current or increased levels.

The Commonwealth's contribution to the facilitation of water infrastructure projects such as the Aboriginal and Torres Strait Islander (ATSI) water supply and sewerage infrastructure has been highly successful. It is recommended that the Commonwealth consider expanding the ATSI Water supply and sewerage infrastructure funding program to include all ATSI communities.

A significant commitment is required from the Commonwealth to align all regional program expenditure relating to sustainable natural resource management in ways that: build upon the health of the emerging regional arrangements being established for NAP and NHT2; and are aligned with the strategic investment priorities of regional NRM plans.

A key issue for Queensland is for the Commonwealth to recognise the differences between Queensland and the southern states. Commonwealth policy focuses heavily on addressing over-allocation. Over-allocation is not currently an issue in the majority of Queensland river basins, and is not likely to become an issue in the future due to the implementation of water planning arrangements. The Commonwealth must recognise the need for tailored policy to meet regional circumstances.

There is a role for the Commonwealth to facilitate in the collation and coordination of scientific research of climate science and forecasting to bring together the studies and work of Commonwealth, state and local agencies so that the best knowledge can be utilised by all.

1. The Role of the Commonwealth in ensuring adequate and sustainable supply in rural and regional Australia

1.1 Government Roles

The Commonwealth Government in its May 2001 response to *Time Running Out: Shaping Regional Australia's Future*, indicated that the Federal Government, as well as the states territories and local government, "has an interest in the development and sustainable management of water resources, because of equity, natural resource management and national resource allocation issues."

Under the Australian Constitution (Section 100), the Commonwealth is prevented from interfering with the rights of the States in relation to the use of water. Consequently, primary responsibility for ensuring the adequate and sustainable supply of water in rural and regional Queensland rests with the Queensland State Government. Local Governments in Queensland also play a significant role by supplying water for urban and industrial purposes.

The Queensland Government's view is that the Commonwealth's responsibility lies chiefly in the area of facilitating coordinated responses to resource issues of national significance.

1.2 Water Supply Roles in Queensland

In recent times implementation of the National Competition Policy and Council of Australian Governments (CoAG) Water Reforms has resulted in new institutional frameworks that separate policy, regulation and service provision. In response, Queensland has established new legislation (*Water Act 2000*) to support the establishment of comprehensive systems for the allocation and management of water, water trading and regulation of water service providers and infrastructure. Further, Queensland has established commercial water entities in local government and water corporations (South East Queensland Water Corporation and SunWater), a number of private sector providers have emerged, and pricing regimes have improved. These reforms have resulted in agencies being more focussed and professional in their business, whether it is water service provision or water management. Few if any other jurisdictions have moved as far as Queensland in this area.

Following the reforms over the last three to four years, the role of the Queensland Government in water planning and management has evolved to one which:

a) Ensures the sustainable allocation and management of the State's water resources;
b) Regulates infrastructure and services so that environmental impacts are managed, public health and safety is protected and continuity of service is ensured; and
c) Facilitates the provision of strategic infrastructure of State significance.

In essence, the State Government's main interest is to ensure that sustainable management of water, balancing environmental and consumptive needs for water and promoting competition to encourage movement of water to higher value uses. In addition, the State wants to ensure that the economy is not inhibited by inefficient use of water or the lack of continuity of services (i.e. service disruption). The State also provides transparent subsidies and grants for some water infrastructure and therefore wants to ensure its contributions are used wisely.

In Queensland we now have a diverse range of organisations that provide water services, including:

- Local governments which have continued to provide traditional services;
- Newly established commercial bulk and retail water entities within the larger local governments;
- Water corporations such as the South East Queensland Water Corporation (previously a statutory authority) which provides bulk water supplies from Wivenhoe, Somerset and North Pine Dams mainly to local government but also to industry and rural water users;
- Government owned business enterprises such as SunWater which was previously the State Government entity which developed and operated strategic State water infrastructure supporting irrigation communities, some industry and smaller urban communities;
- Urban and rural water boards, and
- Various private sector providers supporting tourism, mining, power and now emerging for irrigation and bulk water supplies (e.g. SUDAW Developments as proponent for Nathan Dam).

1.3 Water Supply Planning for Sustainable Supplies

Before any consideration is given to allocating additional water supplies, efforts must be made to:

a) Facilitate a move to **high value and best use of water** through improved specification and security of existing water entitlements and providing for water trading;
b) Encourage **efficient use of water** (reduce, reuse, recycle),

This strategy seeks to improve overall productivity and efficiency before developing new water sources. Queensland is progressing this strategy in a number of state programs such the Rural Water Use Efficiency Initiatives, Queensland Water Recycling Strategy and through its water reforms under the *Water Act 2000*.

Under this approach, less emphasis is given to the establishment of new water supplies and infrastructure. However, a number of strategic dam sites have been preserved for future development in Queensland and a number of existing dams are planned to be raised to meet future growth requirements, both in urban and rural areas. These will need to be progressed under the new legislation framework. Some specific and current examples include:

- The current work of the private sector entity SUDAW Developments associated with the proposed Nathan Dam;
- The State-owned Burnett Water Pty Ltd to progress water infrastructure in the Burnett catchment;
- Lenthalls Dam, which supplies water to Hervey Bay, is proposed to be raised by Wide Bay Water in the near future subject to obtaining necessary statutory approvals and land purchases;
- Borumba Dam could also be raised within the next ten to twenty years to meet urban and rural supply requirements in the Mary River catchment and Sunshine Coast areas; and
- In southeast Queensland, there is strong competition for available supplies. Many local government areas are currently reliant on or have potential future reliance on water supplied from the Wivenhoe Dam–Somerset Dam system and other potential major storages such as Glendower and Wyaralong Dams. These sites are being protected for the future through land purchases.Regional coordination of service delivery is essential if the long-term provision of an equitable, cost-effective and sustainable water supply system is to be achieved.

All planning for these proposals must ensure that any future developments meet expectations in terms of environmental outcomes, and other CoAG requirements such as economic viability.

1.4 Facilitation and Coordination at a National Level

Queensland's view is that the Commonwealth should maintain this role as a facilitator of co-ordinated action with and by the states towards efficient and sustainable water supply in rural and regional Australia. Funding support is crucial in this role (at current or increased levels) for these initiatives. Examples of programs where the Commonwealth is supporting funding with the States are:

- Facilitation of Inter-jurisdictional Cooperation eg GABSI
- IGA on the Lake Eyre Basin
- ATSI infrastructure
- Sugar Infrastructure Incentive Program (SIIP)
- Bilateral agreements – NAP, NHT 1 and 2
- National Water Quality Management Strategy

The water reforms being undertaken by Australian governments have been very complex and timetables have been optimistic. It is important that sufficient time is given before assessing the full effects of the reform program.

Queensland's view is that the key national policy activities have proved to be powerful and effective frameworks to provide for sustainable water supplies, but challenging in terms of timeframes. The different issues and conditions inherent in each state and the complexity and time needed to bring the desired water reforms to successful implementation means that the states will not be able to complete all the reforms at the same time.

The Commonwealth needs to maintain flexibility in its approach so that it can accommodate a number of state-specific needs:

- State-based initiatives should be considered when the Commonwealth is determining funding priorities and other support;
- Negotiation of bilateral agreements should be based on the Commonwealth adopting a strategic perspective, recognising that detailed implementation and operational aspects are a matter for the State Government; and
- Regular review of barriers and obstacles to effective implementation of water supply initiatives, e.g. timing of approvals under EPBC Act and adequate consultation on and consistency in funding approvals.

Where necessary, the Commonwealth can play an important role as facilitator of co-ordinated inter-jurisdictional action with and by the states towards efficient and sustainable water supply in rural and regional Australia. Provision of funding support is crucial in this role and should continue at current or increased levels

In the development of its programs, the Commonwealth needs to consult with the States in order to ensure consistency with existing State and regional programs, and to take funding pressures and specific State issues into consideration. The Commonwealth should only announce programs after States have agreed to all details including any funding arrangements. Unilateral announcements are not acceptable.

1.5 Conclusions

The primary responsibility for ensuring the adequate and sustainable supply of water in rural and regional Queensland rests with the Queensland State Government. Local Governments in Queensland also play a significant role by supplying water for urban and industrial purposes.]

The Commonwealth has a role in the resolution of strategic water issues and needs to be involved in the development of national policy frameworks in collaboration the States and communities concerned.

Queensland's view is that the key national policy activities have proved to be powerful and effective tools when there is multilateral support. This means they must recognise the different issues and conditions inherent in each state and the complexity and time needed to bring the desired water reforms to successful implementation .

Despite the widespread benefits of the national water reform agenda, its implementation has brought new challenges. The recent institutional changes has resulted in new relationships being established between the State and local government agencies, water service providers, water users and the community and these agencies are still coming to grips with and adjusting to their new roles in water. While the separation of water service provision and regulation has provided clarity of purpose of agencies, there are increased complexities of coordination required especially at the regional level.

Where necessary, the Commonwealth can play an important role as a facilitator of co-ordinated interjurisdictional action with and by the states towards efficient and sustainable water supply in rural and regional Australia. Provision of matching of funding support is crucial in this role.

2. Commonwealth policies and programs, in rural and regional Australia that could underpin stability of storage and supply of water for domestic consumption and other purposes

The Commonwealth currently has a number of valuable policies and programs that contribute to water supply stability in rural and regional Queensland.

2.1 Provision of Aboriginal and Torres Strait Islander Community Water Supply and Sewerage Infrastructure

To date, the major input from the Commonwealth to the provision of Aboriginal and Torres Strait Islander (ATSI) Community Water Supply and Sewerage Infrastructure has been capital infrastructure support for the Torres Strait area through the Torres Strait Regional Authority.

For the Torres Strait Island Water Upgrade Projects undertaken in the 1990's, the Commonwealth and the State provided $10.5M each. For the Major Infrastructure Projects, MIP1 and MIP2 beginning in 1998 and 2001 respectively, the Commonwealth and the State have each provided $15M for MIP1 and $15M for MIP2. MIP1 included significant water services infrastructure. MIP2 funding is largely for sewerage, waste disposal and housing subdivisions.

Provision of capital support is an important and significant role that the Commonwealth should continue to fulfil, and should consider expanding the role to include all ATSI communities within the context of the Cape York Plan and the Ten Year Plan.

2.2 Sugar Industry Infrastructure Package (SIIP)

In April 1992 the Commonwealth established the Sugar Industry Task Force. As a result of the recommendations of the Sugar Task Force, industry and the Commonwealth and Queensland Governments developed a package of measures, designed to address the changes and challenges confronting the Australian sugar industry. The package addressed industry expansion, tariffs, industry ownership of bulk raw sugar terminals and price pooling arrangements amongst other matters.

In February 1993 the Commonwealth approved a package of incentives designed to ensure the future growth of the Australian sugar industry. Amongst these incentives was a commitment of government funding of $38 million to support infrastructure projects associated with further development of the Queensland sugar industry. This commitment involved a Commonwealth contribution of $19 million, matched by the Queensland Government, under the Sugar Industry Infrastructure Program, $45 million from the sugar industry and an additional Queensland Government contribution of $34 million. The Commonwealth directed a further $1 million to a similar program for the NSW sugar industry.

The projects approved under the Program were designed to enhance the economic performance of the sugar industry by providing funding for infrastructure projects in order to promote investment and growth in the sugar industry. The Program was designed to provide increased water availability, water management and provision of cane transport infrastructure.

Implementation of the Program in Queensland has been managed by NR&M. The Department of Agriculture, Fisheries and Forestry is responsible for administration, at the Commonwealth level, of the Program. This includes the provision of funds to the Department of Natural Resources and Mines and general monitoring, approval and oversight of the projects.

Environmental approval of projects under the Program is required from both Environment Australia (Commonwealth) and Environmental Protection Agency (State) before the Department of Agriculture, Fisheries and Forestry approves funding.

During the environment approval process for projects under the Program the Commonwealth engaged in proactive problem solving and played a major role in reviewing environmental issues associated with a number of the projects that impacted on the Great Barrier Reef Marine Park.

While programs of this nature may be useful, they must focus on ensuring that any works are undertaken in a sustainable development context.

As indicated above, the Sugar Industry Infrastructure Package was developed to enhance the economic performance of the sugar industry. The usefulness of programs with such objectives is reflected in a key premise underpinning the analysis contained in the Queensland Government's State Infrastructure Plan – Strategic Directions. That is; "infrastructure investments will continue to play a particularly critical role in ensuring the long-term strategic development of regional and rural areas with relatively small population bases and undeveloped infrastructure networks".

The Queensland situation differs somewhat from other States in that while water infrastructure development cannot be sustained in areas where the water resource is over-allocated or under stress, there are some catchments within Queensland where development could possibly proceed in the short-term without raising significant environmental risks. In line with CoAG agreements, any further Government programs involving financial contributions to such water infrastructure projects would need to involve transparent community service obligation payments and meet the tests of economic viability and ecological sustainability.

2.3 NAP and NHT

The National Action Plan for Salinity and Water Quality (NAP) and the Natural Heritage Trust (NHT) are major Commonwealth and State program initiatives, which impact on rural and regional Australia. The key aspect of these initiatives that distinguish them from previous Commonwealth initiatives is that the investments are to be made in accord with setting and achieving of "Targets".

On the assumption that Queensland and the Commonwealth will sign a NHT2 Bilateral Agreement, fourteen regional organisations listed in the table below will be established and will be required to undertake development of "regional natural resource management plans, including setting of targets" which will be accredited by Commonwealth and State. The planning process will identify key assets in each catchment/region that warrant protection. For each asset, its threats will be identified, and targets will be set according to need for removing, preventing, diverting or ameliorating, the identified threats.

For example, an asset in a region or catchment could be a town, the water supply, an irrigation area or a wetland. Its threats could be from salinity, poor water quality, drainage, timber clearing etc. The Regional Plan will identify actions, with targets to be achieved in protecting the asset from its threat/s.

Torres Strait	Cape York
Northern Gulf	Southern Gulf
Wet Tropics	Burdekin Dry Tropics
Mackay Whitsunday	Fitzroy Basin
Desert Uplands	Lake Eyre
Burnett Mary	South East/Moreton
Queensland Murray Darling	

Guidance to the Regional Bodies requires that priority consideration be given to:

- Areas threatened by rising/saline water table;
- Extent of native vegetation;
- Surface water salinity;
- Sediment and suspended solids;
- Nutrients;
- River health;
- Water allocation.

It is critical that State and Commonwealth government program expenditure is aligned as far as possible to the core investment direction intended to be established through regional NRM bodies. In addition, the planning and decision making infrastructure established to implement NAP and NHT 2 needs to be built upon, to deliver significant Commonwealth programs associated with natural resource management, assuming that further Commonwealth programs will be delivered this way.

The Commonwealth must acknowledge the significant on-going commitment by states to deliver natural resource management outcomes and take a more pragmatic view to funding of these programs by recognizing the in-kind effort of states.

2.4 Conclusions

There are many valuable existing policies and programs in the regional and local level and at a State level. The Commonwealth needs to ensure it consults in the development and implementation of its policies to ensure the objectives of its programs are consistent with other activities, thereby maximising the outcomes.

The Commonwealth's contribution to the facilitation of water infrastructure projects such as ATSI community water supply and sewerage infrastructure has been highly successful. It is recommended that the Commonwealth consider expanding this to include all ATSI communities

A significant commitment is required from the Commonwealth to align all regional program expenditure relating to sustainable natural resource management in ways that: build upon the health of the emerging regional arrangements being established for NAP and NHT2; and are aligned with the strategic investment priorities of regional NRM plans.

3. The Effect of Commonwealth policies and programs, on current and future water use in rural Australia

3.1 Implementing CoAG Water Resource Policy

The Council of Australian Governments (CoAG) Water Resource Policy has possibly been the most significant influence on policies and programs relating to water use. Key elements of the policy are:

- Water pricing based on recovery of costs and removal or reduction of subsidies, with transparency of any cross-subsidies;
- Separate institutional roles of service provider and regulator;
- A comprehensive system of water allocations or entitlements backed by separation of water entitlements from land title and clear specification of entitlements in terms of ownership, volume, reliability, transferability and if appropriate, quality;
- Formal determination of water allocations or entitlements including, allocations for the environment as a legitimate user of water;
- An integrated catchment management approach to water resource management; and
- Ecological sustainability of new water schemes.

The framework recognises the importance of a consistent approach to water reform throughout Australia while allowing each state and territory the flexibility to adopt an individual approach to implementation that suits the specific circumstances within each jurisdiction. The National Competition Policy (NCP) agreements signed in April 1995 incorporated the CoAG Water Reform Framework.

The Queensland Government has made significant progress in implementing these reforms, notably:

- *Water Act 2000* provides a process to establish tradable water allocations separate to land and provide security of entitlements and water for the environment;
- Institutional reform, i.e. the establishment of SunWater as a water business, separate to the Department of Natural Resources and Mines;
- Institutional separation of the State's regulatory, environmental and service delivery functions.
- Water Resource Plans provide the water allocation and management framework for individual catchments;
- The establishment of the Water Allocation Registry; and
- Rural water pricing.

3.2 Conclusions

The Council of Australian Governments (CoAG) Water Resource Policy has been the most significant influence on policies and programs relating to water use and in promoting sustainable allocation and best use of water. Queensland is implementing these water reforms through a number of initiatives including tradability of water entitlements to the highest and best value use, pricing reforms to ensure that a more appropriate value is attached to water, and water resource plans that ensures a greater security of entitlement than in previous licensing regimes.

4. Commonwealth policies and programs that could address and balance the competing demands on water resources

4.1 CoAG Water Reform Framework

Primary among the mechanisms linking Commonwealth and State water management objectives is the *CoAG Water Reform Framework 1994.* Other mechanisms include the Natural Resources Management Ministerial Council, the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality.

One of the key objectives of the CoAG Water Reform Framework has been to bring about better environment and water quality protection.

A key issue for Queensland is for the Commonwealth to recognise the differences between Queensland and the southern states. Commonwealth policy focuses heavily on addressing over-allocation, which is a key issue in southern states. Over-allocation is not an issue in the majority of Queensland river basins. There are many rivers, particularly those in North Queensland, that are near pristine in terms of streamflows. The Commonwealth must recognise the need for tailored policy to meet the regional circumstances.

4.2 Regional planning

Commonwealth emphasis on an integrated regional approach, as related initiatives such as the Natural Heritage Trust, is reflected in Queensland's approach. For example, Queensland is currently negotiating with the South East Queensland Regional Organisation of Councils to develop a regional water supply strategy. This work is important to not only address some of the region's water supply issues but also to support the development of a water resource plan under the *Water Act 2000* in a way which addresses the competing demands for available regional water resources.

4.3 Water for Ecosystems

The State has participated actively with Commonwealth Agencies in the development of the ANZECC/ARMCANZ statement of *'National Principles on Water for Ecosystems'*. These principles are embodied in the *Water Act 2000* and the subordinate Water Resource Plans. Water Resource Plans have been completed in 3 river basins in Queenlsnad and are at various stages of development across the State. They address and balance the competing demands for water in a process that legally recognises water for ecosystems and provides a process to evaluate water for ecosystems based on the best scientific information available.

4.4 The *National Action Plan for Salinity and Water Quality(NAP).*

The State and the Commonwealth have signed a bilateral agreement for the implementation of the Intergovernmental Agreement on a *National Action Plan for Salinity and Water Quality (NAP).* Through the NAP, communities and governments will work together to prevent, stabilise or reverse dryland salinity and to improve water quality in Queensland.

Additionally, in the implementation of the NAP, a suite of aspired 'National Outcomes and a Minimum Set of Regional Targets' has been agreed between the State and the Commonwealth. This includes the outcome that, *"surface and groundwater is securely allocated for sustainable production purposes and to support human uses and the environment, within the sustainable capacity of the water resource".*

4.5 Conclusion

The CoAG framework is the major national policy initiative, which can address and balance the competing demands on water resources. Other mechanisms include

- The National Action Plan for Salinity and Water Quality,
- The Natural Resource Management Ministerial Council
- National Heritage Trust, and
- ANZECC/ARMCANZ

A key issue for Queensland is for the Commonwealth to recognise the differences between Queensland and the southern states. Commonwealth policy focuses heavily on addressing over-allocation, which is a key issue in southern states. Over-allocation is not an issue in the majority of Queensland river basins. The Commonwealth must recognise the need for tailored policy to meet the regional circumstances.

5. The adequacy of scientific research on the approaches for adaptation to climate variability and better weather prediction, including the reliability of forecasting systems and capacity to provide specialist forecasts.

5.1 Overview of Scientific Research

The few modelling studies that have been conducted demonstrate the complexity of scientific research on linking climate change with current water management. Nevertheless they suggest that use of climate forecasting information would be beneficial. These findings are further supported by the increasing industry adoption as experience with climate forecasts increases and improved access develops.

These studies indicate that, despite the recent progress in climate science, much more scientific research will be required to adequately address the future issues of current and future climate change. The application of recent research findings to water management suggests that further improvements in reliability and targeting of climate forecasts can be achieved.

The following key points summarise findings that are most relevant to sustainable water use in rural & regional Australia outlined in the attached Appendices 1 to 3.

5.2 Current Situation

- Australian water authorities at present take a very conservative approach to managing water resources systems. Most authorities assume that the water resources available for the coming months consist only of the present stored water, less evaporative and distribution losses, plus the minimum historically observed inflows
- Human (anthropogenic) effects over the last hundred years on the climate system include land cover change, pollution, increasing greenhouse gas concentrations and stratospheric ozone depletion and hence future (and current) climate changes are expected..
- Abawi *et al.* (2001) conducted surveys of irrigators of upper Condamine, Border Rivers, Namoi & Gwydir catchments to assess climate knowledge and information needs. From 174 responses, the key findings were:

  a) two-thirds of irrigators had access to computers;
  b) growers had good knowledge relating to climate forecasts with about 30% using SOI in farm decisions;
  c) the mass media, the Bureau of Meteorology and QDPI's FaxBack were important sources of seasonal climate outlook information;
  d) there was demand for an information system which provides forecasts on water supply ahead of the irrigation season.

- Current types of climate forecasting systems may not necessarily provide sufficient lead-time (months, years) in forecasting for certain decision to be made effectively (e.g. especially through early to mid-autumn) or have the capacity to forecast climate change impacts.

5.3 Problems and Issues

- A major limitation of studies, in terms of the future management, is the lack of understanding of recent trends and in particular the inability of current science to untangle the effects of inter-decadal variability, climate change, global warming, other anthropogenic effects, and background variability.
- Building on the success of governments' previous R&D funding, further investment will be required to:
  a) identify those key decision-points in rural and other industry where climate forecasting would have impact. Provision of climate forecasting per se is not enough.
  b) link climate forecasting R&D with rural industries and communities.
  c) address key issues at the catchment scale or which address issues to do with water quality.
- NR&M and QDPI , and the National Climate Variability Program have made considerable investments in the application of climate science in Queensland over the last twenty years. Bolstering of any further funding of climate science activities is likely to have a synergistic effect on efforts already made in agriculture and pastoralism.

5.4 Where to in the Future

- surveys indicate that a reasonable proportion of growers are already receptive to the use of climate information, including climate forecast information, giving a base to further support extension and communication of this information;
- developing Decision Support Systems that enable water users and water managers to better manage water resources given improved information on supply and risk; and
- developing extension programs to improve the adoption of better risk management strategies.
- The issue of the impact of climate change on rural industries and, especially the linking of climate change models with seasonal climate forecasting systems, needs to be addressed
- There is a need for an integrated system that links climate forecasting systems to those key decision points in rural industry or policy

5.5 Conclusions

The above key points and details in the appendices indicate high climate variability continues to occur on annual and inter-decadal time scales. Global warming and other anthropogenic changes are likely to contribute to increased climate variability placing even greater pressure on rural industries to better estimate available water resources and their utilisation. Climate science has provided some understanding and forecasting capability. It is also clear that rural industries are now more receptive than ever to receive and use sophisticated climate data in their operations. Further investment in climate research and its application will improve existing skill and provide the basis for adaptation to a future uncertain climate.

As outlined in this submission, there is a role for the Commonwealth to facilitate in this area to bring together the studies and work of Commonwealth, state and local agencies so that the best knowledge can be utilised by all.

Appendix 1

Natural Resource Sciences, Natural Resources and Mines, Indooroopilly 4068, Dr Greg McKeon and Ken Brook (Editors).

Key findings:

1) The following review of preliminary case studies in Queensland shows that considerable benefits in improving water use efficiency of Australia's scarce resources are likely to be achieved by integrating new climate science with management of water allocation and irrigation;
2) Integration with a range of other technological and managerial improvements (reduced evaporation and drainage losses) should lead to substantial production and environmental benefits;
3) surveys indicate that a reasonable proportion of growers are already receptive to the use of climate information, including climate forecast information, giving a base to further support extension and communication of this information;
4) water allocation policy in terms of risk management and environmental flow requirements will have to be further developed;
5) statistical relationships developed from historical rainfall and sea surface temperatures have identified variability in the climate system on inter-decadal time scales and their inclusion in operational climate forecasting systems should be supported;
6) both inter-decadal variability and possible climate change/global warming trends are becoming major considerations in risk analysis and are posing major issues for policy development. Continued research investment will be required to resolve these emerging issues by providing objective assessment and monitoring of climate, water, agronomic and environmental factors.
7) such risk analysis would allow both government and community negotiation to proceed on the basis of objective information and continued (and in some cases increased) funding support will provide a community benefit through greater prosperity and more sustainable water resource management.

Introduction

In this submission, we (1) briefly review new understanding of the causes of variability in Queensland rainfall; (2) highlight uncertainties in understanding recent decline in rainfall in south-east Queensland; (3) speculate on implications of global warming; (4) support further resourcing of focused scientific study including further development of Global Climate Modelling; and (5) briefly discuss the potential for use of short term weather predictions and weather modification technology.

In Australia water has long been recognised as a scarce resource subject to the high year-to-year variability of rainfall (Chiew *et al.* 2000). Not surprisingly Chiew *et al.* 2000 stated:

> Australian water authorities at present take a very conservative approach to managing water resources systems. Most authorities assume that the water resources available for the coming months consist only of the present stored water, less evaporative and distribution losses, plus the minimum historically observed inflows. The conservative approach is adopted mainly because of concerns about water shortfalls (Long and McMahon, 1996).

Recent climate research has begun to reveal some of the causes of the high year-to-year and interdecadal variability in the historical record, and current and possible future trends.

(A) Review of current understanding of climate science with particular reference to Queensland's rainfall and streamflow

1. The natural climate system is made up of 'oscillations' that cause variability in rainfall on timescales of daily to thousands of years (Table 1).
2. Human (anthropogenic) effects on the climate system include land cover change, pollution, increasing greenhouse gas concentrations and stratospheric ozone depletion.
3. Compared to the timescale of the natural and anthropogenic effects, the length of instrumental record (about 110 years) is relatively short. Both the instrumental record and reconstruction of paleo-records back to the 1700s suggest that the main period of agricultural and infrastructure development, that has occurred since World War II, has not included the wet or dry extremes that occurred in the 1800s or early in the 20th century (e.g. 1902 drought, Lough 1991).
4. Analysis of historical rainfall records indicates that year-to-year variability in Queensland rainfall is linked to variability in the Pacific Ocean sea surface temperatures and the resultant feedbacks on the atmosphere. Two major drivers of rainfall (and consequent streamflow) have been identified; these are the El Niño-Southern Oscillation (ENSO) and more recently the Inter-decadal Pacific Oscillation (IPO) (Power *et al.* 1999). The identification of the IPO is the result of recent scientific analysis and hence is still the subject of some scientific debate. ENSO and IPO appear to interact: for example, the combination of a La Niña and negative IPO have been associated with high summer rainfall in large areas of Queensland (early 1890s, 1916/17, mid 1950s, early 1970s, 1998/2000).
5. The fact that variability exists on inter-decadal time scales in the Pacific Ocean suggests that relatively short trends in rainfall (increase/decrease over 5 to 10 years) cannot be easily attributed to other trends such as tree clearing, woodland thickening, pollution or global warming.

6. Analysis of temperature records for Queensland's pastoral/cropping zone from 1957 to 1998 indicate general increase in minimum temperature (0.24°C/decade) and to a lesser extent maximum temperature (0.10°C/decade).
7. Simulations in Global Climate Models (GCMs) suggest that mean temperatures in coastal Queensland are likely to increase at 0.3 to 1.7°C by 2030 and 0.8 to 5.2°C by 2070. Associated with the temperature increase is a likely increase in evaporative demand increasing the water requirement for agriculture and community use.
8. The most recent simulations of future rainfall available to Queensland are not regarded with great confidence as those GCMs have not included adequate representations of ENSO or IPO-like variability. A wide range exists in predictions between the different GCMs, e.g. for central coastal Queensland changes in rainfall range from –12% to +4% for 2030 and –36% to +12% for 2070. Nevertheless several GCMs consistently indicate potentially lower rainfall in some regions (the Burnett) of Queensland with global warming.
9. Experiments with GCMs have simulated increases in extreme rainfall events or rainfall intensities. In some cases, associated with increases in tropical cyclone-caused precipitation, rates have been 20 to 30% higher. Lower average rainfall and increasing rainfall intensity suggest higher variability could occur with important implications for future management of water resources. However, the infancy of the science of GCMs as discussed later is a major limitation to decision making.
10. Analysis of rainfall records from 1970 to 2001 indicates substantial decline in rainfall in coastal Queensland. The decline in rainfall from 1970 to 1997 is consistent with changes in the IPO. However, the continued below-average rainfall conditions of 1998 to 2001 would appear to be linked to synoptic changes in the Tasman Sea reducing wet season rainfall (including tropical cyclone numbers). A case study for a catchment in central Queensland is discussed later. These emerging trends which may be related to a number of climatic explanations, including the possibility of anthropogenic climate change, need to be urgently explored.

Table 1. Some natural components of variability in the global climate system at different time scales.

Variability	Time Scale	Popular Name
daily/weekly	day	"Weather"
Madden-Julian Oscillation	30-60 days	"40 day wave"
quasi-biennial	2 ½ years	-
inter-annual	3-7 years	"El Niño"
inter-decadal Pacific Oscillation	10-20 years	"PDO" or "IPO"
long term trends	30-50 years	"climate change" or

		"global warming"
Milankovitch orbital variations	10,000 years	"ice age"

In Queensland and other regions in eastern Australia this new scientific understanding would appear to suggest that there are management options for better agricultural production and environmental outcomes for the community (Appendix 1). Simulation models using historical rainfall and in some cases streamflow records have been used to evaluate how ENSO-based forecasts could have been used to forecast water availability and options to increase crop production. However, a major limitation of these studies, in terms of the future management, is the lack of understanding of recent trends and in particular the inability of science to untangle the effects of inter-decadal variability, climate change, global warming, other anthropogenic effects, and background variability.

A case study (K.A. Day personal communication) for Awoonga Dam catchment has highlighted the difficulty of explaining the much lower (23%) rainfall over the last 25 years (1978-2002) compared to the previous period of instrumental record (1891-1977). The lack of years with above-average rainfall between 1978 and 1997 is consistent with historical expectation based on the effect of ENSO under positive IPO conditions on Queensland rainfall. However, the continued below-average rainfall in the catchment (and more generally south-east Queensland) is not consistent with previous historical periods when both the IPO have been negative and La Niña years have occurred (1890s, 1916/17, 1950s, 1970s). Although synoptic conditions and rainfall change are not inconsistent with what may be expected to occur with global warming, other possibilities unrelated to global warming can not be ruled out. Thus the attribution and extrapolation of recent trends is not as yet possible.

The Awoonga Dam catchment study highlights (1) the limitation of studies solely based on long-term historical records to address current and future management issues; and (2) the need for a greater scientific research effort to be focussed on supporting emerging policy and management needs associated with climate variability and climate change. In the absence of scientific understanding policy decisions are likely to be made in ignorance of the major climate forces and therefore prove inappropriate to meet future needs.

The primary scientific tool required to address the current uncertainty regarding climate is the Global Climate Model (GCM). GCMs are three dimensional representations of both atmospheric and sometimes oceanic circulation. Feedback effects from the land, vegetation, oceans and polar ice fields are represented. These complex models typically have many lines of computer code, their demands for computer power are vast, and because of these demands they are run on supercomputers. These models represent some of the major features of the complex climate system and hence offer the opportunity to understand past variability and provide quantitative (i.e.

probabilistic) assessments for future planning. However, the discipline of climate modelling is still in its infancy and will require major resourcing in terms of scientific understanding of effects such as land cover change or decadal sea surface temperature variations; and supercomputing power.

Analyses of historical seasonal rainfall have improved the understanding of past variability from a statistical/empirical viewpoint with factors such as ENSO, IPO, and temporal trends accounting for typically 20-40% of the variability. GCMs are yet to reach the same level of explanation of year-to-year variability in seasonal rainfall which may not be surprising given the physical processes which are yet to be parameterised or included in the limits of spatial resolution in the simulations. Climate change and global warming pose some major challenges to the use of climate forecasts: (1) can we adapt a statistical/empirical approach to allow for climate changet?; (2) can GCMs be improved sufficiently to be useful in management decisions? Current national and international research is addressing these questions but appears fragmented and not focussed on users' needs.

(B) Weather modification/cloud seeding

Ryan and Sadler (1995) discuss cloud seeding experiments undertaken in Australia over 47 years. The research has shown that in some circumstances cloud seeding has modified clouds and induced them to produce rain. However, the low frequency of appropriate meteorological conditions make the prospects for success very limited. Tasmania appears to be the only region where cloud seeding is cost effective. Recent approaches have used hygroscopic flares which are ignited behind appropriately fitted aircraft. Claims of success have been made for this technology in South Africa (Terblanche 2002). The hygroscopic technology may have more applicability in warmer clouds in eastern and northern Australia than conventional seeding techniques. However, definitive area experiments have yet to be undertaken and presented. Other international developments have involved the use of numerical cloud models, satellites, radar, and various air-borne lidars and profilers which can yield physical insight into cloud processes. However, these instruments and suitable aircraft are not commonly available in Australia. Weather modification studies have to compete for research funding with more pressing and perhaps more useful climate variability and climate change research.

The issue of cloud seeding usually becomes topical each time part of regional Australia develops a severe drought perhaps reflecting the human need for action in the face of adversity. However, cloud seeding should definitely not be seen as a drought breaking technology when few suitable meteorological opportunities for seeding exist. Perhaps the new hygroscopic technology may have something to contribute but the history of cloud seeding suggests that it is high risk research and successes are rare (Ryan and Sadler 1995).

(C) Short term weather forecasting

In northern Australia large rainfall events can occur after irrigation causing substantial water loss through deep drainage and runoff. There is some potential to use forecasts from numerical weather models which can forecast temperature and rainfall up to seven days into the future. A desktop hindcast study (Timmers *et al.* 2001) showed that sown pastures could save 6% in irrigation, 22% in runoff and 32% in deep drainage. Cotton showed savings of 8%, 26% and 26% and sugar cane 10%, 15% and 23% respectively. Further research on the usefulness of short range weather forecasts for irrigation scheduling is needed. Increases in computing power are needed to provide better estimates of rainfall at finer scales than currently available.

(D) Water use efficiency

Gardner (personal communication) reports that much of the improvements in water use efficiency has traditionally come from increasing crop yield. With increasing pressure on water resources more consideration towards reducing water usage is now required. There is now considerable opportunity to block evaporation and seepage from water storages and distribution channels using sealed pipes and new generation polymer sheeting. Field design and water re-use systems are also important. Consideration of shorter furrow length and furrow shape can make marked savings in drainage for field crops. Integration of physical barriers and climate forecasting technology can make substantial steps towards increasing water use efficiency in field crops by minimising losses and optimising water use.

(E) Conclusion

This new understanding of the drivers of climate variability and change in eastern Australia suggests the management of natural resources such as water availability, should be re-evaluated. It is unlikely that the next 30-50 years will be a random sample of the last hundred years of experience. The design of flexible and responsive risk management systems that acknowledge high climate variability and likely climatic change can only occur by coupling climate science, resource monitoring and systems models in more focussed research and development groups.

Appendix 2

Review of studies on use of ENSO-based information in water management.

Chiew *et al.* (2000) stated that *'the inter-annual variability of runoff volumes and peak discharges in Australian rivers is greater than elsewhere in the world'.* Research over the last 30 years has shown that a proportion (e.g. 15-25%) of the year-to-year variability in rainfall and streamflow over eastern Australia was linked to the large scale coupled ocean – atmospheric phenomenon El Niño – Southern Oscillation (example references include Pittock 1975, McBride and Nicholls 1983, Allan 1985, Adamson *et al.* 1987, Clewett *et al.* 1990, Simpson *et al.* 1993, Allan *et al.* 1996, Stone *et al.* 1996, Chiew *et al.* 2000).

For example, Allan *et al.* (1996) examined a hundred years of natural inflows to Hume Reservoir (headwaters of River Murray) and found that inflows were 'almost a factor of two greater during strong La Niña, compared to strong El Niño episodes'. Similarly, Simpson *et al.* (1993) analysed estimates of natural discharge of the River Murray at the junction of NSW, Vic and SA from 1891 to 1985. They found the three lowest annual values occurred in El Niño years (1982, 1914, 1902). For 19 El Niño episodes, 11 had natural discharge in the lowest one-third of the whole series and only 2 episodes were in the highest one-third category. During La Niña episodes, more than half the years were in the highest one-third category.

Chiew *et al.* 2000 analysed the relationship between runoff and ENSO for a number of catchments in Eastern Australia. *'The results suggest that runoff in many areas in Australia over certain seasons can be forecast with some success using SOI [Southern Oscillation Index], SST [sea surface temperatures] or persistence in the runoff'.* However, they noted that *'although the correlations are significant, they are relatively low and forecasts derived from these data should be used with caution'.* Chiew *et al.* (2000) further observed that concerns about water shortfalls resulted in a very conservative approach being adopted by Australian water authorities in managing water resources systems. Nevertheless Chiew *et al.* (2000) suggested that seasonal streamflow forecasts could benefit *'the management of water resources and allow decisions on irrigation water allocation and environmental flows to be more realistically based'* once the benefits and risks had been '*properly assessed*'.

In a further simulation case study, Chiew *et al.* (1999) evaluated the use of ENSO information on (a) restriction rules for Benalla Water Supply; and (b) irrigation water allocation in Lachlan River Catchment. In the former study they found that *'restriction rules developed using ENSO information would reduce the impact of restrictions on the community'.* In the simulation case study on water allocation, Chiew *et al.* (1999) evaluated the impact on cropping area depending on combination of farmer and dam manager risk. With stated limitations, Chiew *et al.* (1999) found a net benefit in using forecasts to determine water allocation in this system although there are risks involved not only in terms of failed area of crop but also in terms of security and environmental flow requirements not being met.

Queensland Climate and Streamflow Studies

Abawi *et al.* (2001, Queensland Department of Natural Resources and Mines) have recently completed a major study evaluating the use of seasonal forecast information for Border Rivers catchment (northern Murray-Darling Basin). The objective was to improve water use efficiency in the wider sense of agronomic storage, conveyance, social and economic values. The report provides a detailed case study:

- evaluating the power of seasonal forecast indices for predicting water flows and evaluating likely benefits of the information system to irrigation users and managers;
- developing Decision Support Systems that enable water users and water managers to better manage water resources given improved information on supply and risk; and
- developing extension programs to improve the adoption of better risk management strategies.

The report documented significant relationships between 'natural' stream flow in spring and summer and SOI phases in previous late autumn and spring. This prediction of water availability during peak irrigation demand (October to January) was possible as early as May in each year. The QQM was run to simulate streamflow under natural and developed conditions for the perios 1890-1997 at different irrigation nodes within the catchment. The availability of off-allocation water, which represents a high proportion of total water used by growers, was strongly linked to phases of SOI. Comparison of SOI positive and negative phases showed a shift of 30% in planted crop area or a shift of 40% in farmer's risk for a fixed crop area.

Abawi *et al.* (2001) found that there was a strong relationships between the climate year-types (El Niño and La Niña) and (a) inflow to Glenlyon and Pindari dams, and (b) announced allocation prior to planting. This information would allow probabilistic forecasts of announced allocation to be made up to 4 months before planting time. An economic analysis (Abawi *et al.* 2001) was carried out with reasonable stated constraints of ignoring on-farm stored water from previous seasons and considering a maximum irrigable area. The results show that in a water limited environment the value of seasonal climate forecasts to irrigated cotton could be up to $192/ha with irrigators preference towards risk determining likely use of the information. To support quantitative assessment of how climate affects the many variables involved in irrigation decisions, decision support systems e.g. FLOWCAST have been developed by Abawi *et al.* (2001).

Abawi *et al.* (2001) conducted surveys of irrigators of upper Condamine, Border Rivers, Namoi & Gwydir catchments to assess climate knowledge and information needs. From 174 responses, the key findings were:

e) two-thirds of irrigators had access to computers;
f) growers had good knowledge relating to climate forecasts with about 30% using SOI in farm decisions;
g) the mass media, the Bureau of Meterology, and QDPI's FaxBack were an important sources of seasonal climate outlook information;
h) there was demand for an information system which provides forecasts on water supply ahead of the irrigation season.

Abawi *et al.* (2001) supported the further development of information systems for the management of environmental flows and the analysis of different water allocation scenarios.

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Appendix 3

Current scientific activity in climate forecasting, including 'targeted' and 'integrated' forecast systems.

The Department of Primary Industries (DPI), through its Agency for Food and Fibre Sciences (AFFS) Queensland Centre for Climate Applications (QCCA) undertakes the following climate research:

- Strategic climate research - long-lead forecasting research, climate change research, development of mathematical models.
- Applied climate research - especially focussed on delivering climate forecast systems appropriate for rural industries in Australia.
    - Applied climate research and forecast delivery that develops and provides climate forecast systems that can be *integrated* into cropping, pasture, and other system simulation models. This program area also provides the following:
        - Regular (i.e. at least monthly) climate forecasts for the general public as well as through dedicated web systems and e-mail systems.
        - Regular media commentary and output (e.g. The Queensland Country Life, The Rural Weekly, ABC TV news and weather) regarding potential for excessively dry or wet seasons on a rolling three-month basis.
        - Consultancy work for various Australian and international bodies (e.g. Western Australian Government for the Gascoyne Murchison region, Papua New Guinea Government for drought preparedness).
        - Climate forecast skill testing and similar research that assesses relative climate forecast 'reliability' and 'skill'.
- Climate applications research that develops and provides tailored, *targeted,* climate forecast information for rural industries in Australia and world-wide. Additionally, this program does R&D into the following: (dpi)
    - Landscape systems, including catchment management systems (including streamflow forecast) and rangelands systems,
    - Cropping systems modelling and crop yield forecasting. This R&D area provides crop yield forecast to state and federal authorities (e.g. ABARE), agribusiness (e.g. grain trading organisations) as well as to growers. This work is carried out in conjunction with The Agricultural Production Systems Research Unit (APSRU) in Toowoomba.
    - Targeted climate forecast systems for fisheries and aquaculture. This R&D effort is directed as management issues in fish catch assessments and improved management of fish stocks and others.
- Provision of certain decision-support systems through computer packages and provision of or input into 'internet sites'. These include '*Australian Rainman*, '*Streamflow*' *Whopper Cropper, Droughtplan*, 'The Long Paddock (through Qld Dept of Natural Resources and Mines) and The QCCA Internet page. (dpi)

Adequacy of current R&D effort

The climate forecast systems QCCA and its associated organisations use for rainfall, temperature, frost, hail, and integrated yield and other forecasting have been thoroughly tested and published in international peer-reviewed scientific journals (e.g. *Nature*).

The currently employed standard climate forecast systems have been tested in 'hindcast' mode and, what is called, independent verification in real time. These forecast systems have been shown to perform considerably better than by 'chance' and greatly exceed the information through 'climatology' – the use of long-term climate records as the sole basis for assessing rainfall potential for the coming season/s.

Although the 'QCCA forecast system' can claim to forecast most high or low rainfall events (over a season) in terms of probability values it is not 'perfect'. While, in some seasons, the system may indicate just 10% or 20% (or 80% to 90%) probability of exceeding median rainfall for a shire or region, representing relatively high forecast 'skill', this means that in 10% or 20% of years that forecast system would not provide appropriate information.

Current types of climate forecasting systems may not necessarily provide sufficient lead-time (months, years) in forecasting for certain decision to be made effectively (e.g. especially through early to mid-autumn). There remains considerable R&D work to be done that will provide increased lead-time in climate forecasting systems which would better equip rural industry to plan for the seasons or years ahead. It has been assessed that rural industry makes profit in just 30% of years. Climate forecasting should enable rural industry to reduce their exposure to risk in the potentially 'bad' years and to increase their profitability in the potentially 'good' years. It is believed economic sustainability is linked to resource sustainability.

Not all droughts are related to El Niño/Southern Oscillation events. Additional work needs to be carried out which will investigate means of integrating other climate forecasting systems that use sea-surface temperatures and other mechanisms. (The issue of climate change affecting the value of incorporating sea-surface temperature systems in climate forecasting has not been addressed yet).

The issue of the impact of climate change on rural industries and, especially the linking of climate change models with seasonal climate forecasting systems, needs to be addressed.

Adequacy of provision of information to policy, rural, and other industry

It is believed the main reason climate forecasting and climate applications research has received some success (in terms of rural industry uptake) in Queensland and northern NSW is that one of Australia's leading R, D, &E agencies in this field is physically located in a large rural centre – Toowoomba - rather than being located in a major capital city.

Key scientific staff from QCCA and APSRU regularly make presentations and address rural lobby groups, farmer organisations, and industry bodies (e.g. Grainco, Qld Sugar Corporation, Selected Seeds, 'Agforce', many cotton industry groups, many beef industry, irrigation focus groups, Landcare, insurance industry, small business groups, school groups, and government (e.g State Parliament, Local Government).

Not enough R&D has been provided so far that identifies those key decision-points in rural and other industry where climate forecasting would have impact. Provision of climate forecasting per se is not enough. There has to be developed a complete integrated system that links climate forecasting systems to those key decision points in rural industry or policy. Interestingly, Australia leads the way world-wide in this type of research and development. However, it use in Australia appears to be mostly confined to north-east Australia, at this stage.

Not enough R&D has been provided that links climate forecasting R&D with rural industries other than broad-acre cropping and pastoral industries. These industries include horticulture, fisheries and aquaculture, forestry, wine grape industry, mining industry, energy industry.

Not enough R&D has been provided so far that address key issues at the catchment scale or which address issues to do with water quality.