**John Williams Scientific Services Pty Ltd**

# Document of Discovery

*To inform the management of groundwater in the Burdekin River Irrigation Area*

**November 2007**

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## 1.0 Introduction

This ***Document of Discovery*** has been produced by the consultant team for Canegrowers Pty Ltd as stage 1 of the SRDC funded project titled:

***"Management of groundwater in the Burdekin River Irrigation Area (BRIA)"***.

This first report attempts to provide a stock take of current natural resource management in the Burdekin River Irrigation Area (BRIA). This document makes observations and puts forward initial recommendations. The information to inform this work was gathered through a literature review and interviews with the key stakeholders. The discovery nature of this report has meant that it has been titled the ***'Document of Discovery'***.

This document was validated, refined and improved through a workshop and follow-up process with stakeholders during August and September 2007. Following the workshop the input from a number of stakeholders has now been incorporated in this report which concludes stage 1 of this project. This report is an attempt to set out the points of view and understandings of each stakeholder or cluster of stakeholders who have a commitment and interest to building more sustainable management of irrigation and groundwater in the BRIA.

In stage 2 of the project the consultant team will build on the foundation set down in the ***'Document of Discovery'*** and will seek to work further with stakeholders to find an agreed way forward to begin to solve the groundwater and surface water management problems confronting the BRIA in an integrated manner. In this way it is hoped that the project can build a blue print document which can take all parties to a more sustainable future for the BRIA. This blue print document, if agreement and vision for a way forward can be found, will be the basis of the stage 2 and final report for this project. The blueprint in this final report will then form the basis of discussion, consideration and action by the three sponsors of the project namely Canegrowers, SunWater and Department of Natural Resources and Water.

The Document of Discovery uses the *Standard for Quality Natural Resource Management* [1] (the Standard) as a framework to organise and evaluate the information. The Standard is made up of seven components:

- Collection and use of knowledge
- Determination of scale

[1] Natural Resources Commission (2005) *Standard for Quality Natural Resource Management,* Natural Resources Commission, NSW (2005). Available at www.nrc.nsw.gov.au

- Opportunities for collaboration
- Community engagement
- Risk management
- Monitoring and evaluation
- Information management

It should be noted that in this report the irrigation area will generally be referred to as the BRIA. The consultant team recognise that the area is also referred to as the Burdekin Haughton Water Supply Scheme (BHWSS). This BHWSS is used in one section of this report where previous work by others has been included. The BHWSS brings together what is often referred to as the BRIA and the Haughton River irrigation area, The North and South Burdekin Water Boards along with the BHWSS all have groundwater management issues which must be addressed. The consultant team and the workshop participants recognised that solutions to groundwater must be integrated across all four irrigation areas that make up the lower Burdekin valley. While the focus is on the BHWSS a whole of lower Burdekin valley is seen as the hydrogeological systems that must be managed by the industry, community and government.

## 1.1 Observations

The primary observation from the work undertaken is that the BRIA stakeholders have not worked together in the past to deliver coordinated quality natural resource management. As a result the problems around sustainable means to manage surface and groundwater continue to occur. The most significant and immediate of these is the rising groundwater table which is having a negative impact on sugar cane productivity. It is unlikely this or any of the natural resource problems occurring in the BRIA will improve if stakeholders continue to operate as they have in the past.

Observations for each component of the standard are made below. These observations focus on the groundwater problem as this is the project focus:

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| **Knowledge** | There is a vast amount of knowledge about the BRIA held by the key stakeholders. Interviews with stakeholders have indicated that this knowledge tends to stay within the groups who generate it either because there is no forum for it to be shared, it is not in a form that can be easily used or it is withheld by choice. |
| **Scale** | The scale of the groundwater problems within the BRIA has not been adequately assessed and estimates of current and future costs made. This is a key contributor to the continuation of the problem and the lack of a coordinated response by stakeholders. |
| **Collaboration** | Collaboration to date has been poor. A number of attempts have been undertaken to get a collaborative approach to resolving the groundwater problems of the BRIA. These collaborations have, for a range of reasons, generally failed to address the key problem. |
| **Community engagement** | There is currently no mechanism to allow the community to become engaged in decisions on management of the natural resources in the BRIA. These decisions have implications for nearby sites with a high community value. |
| **Risk management** | A robust collaborative approach to the management of risks within the BRIA is not being undertaken by the key stakeholders. This lack of coordination in risk management means that the risks are not being managed. |
| **Monitoring and evaluation** | Some monitoring is currently being undertaken by stakeholders across the BRIA. This information is not being evaluated in a systematic way or made available for all stakeholders to use in |

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| | decision making. Consequently there is no means of determining the current state of the groundwater and any trends. |
| **Information management** | There is currently no coordinated information management approach between the stakeholders within either the BRIA or the Lower Burdekin in general. Consequently information is not available to decision makers. |

## 1.2 Recommendations

The primary recommendation is that the key stakeholders in the BRIA need to develop a framework that they are all willing to commit to and will lead to the coordinated management of natural resource issues in the BRIA and possibly the whole Lower Burdekin. Once this framework is agreed a blueprint for action should be developed.

Recommendations for each of the components of the Standard are made below. These recommendations focus on the groundwater problem as this is the project focus:

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| **Knowledge** | Stakeholders need to find a way to ensure best available knowledge is accessible and used to inform decisions at all levels.<br><br>Stakeholders need to find a way to prioritise knowledge needs and identify ways to get this work undertaken. |
| **Scale** | Stakeholders need to find a way to use best available knowledge to agree to the scale of the problem, the appropriate scale of response and the scale of each of their roles in this response. |
| **Collaboration** | Stakeholders need to find a way to effectively collaborate to manage the problems within the BRIA. The existing plans and strategies which apply to the BRIA are all frameworks for collaboration. Effective collaboration will attempt to align with the aims, goals and targets of these plans and strategies and where appropriate use the plans and strategies as frameworks to formalise collaborative arrangements. |
| **Community engagement** | Stakeholders must find a way to engage the community in the process of managing the problems of the BRIA. |
| **Risk management** | Stakeholders must find a way to identify and manage risks in a coordinated way across the BRIA. |

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| **Monitoring and evaluation** | Stakeholders must find a way to implement robust monitoring and evaluation at the appropriate scale to inform decision making in the BRIA. |
| **Information management** | Stakeholders must find a way to manage information and ensure it is readily available to inform decisions at all levels. |

## 1.3 How is this report structured?

The next chapter provides further background to this project and the natural resource issues within the BRIA as well as some background to the Standard. The chapters that follow document the information gathered and its evaluation under each of the seven components of the Standard:

- Collection and use of knowledge (Chapter 3)
- Determination of scale (Chapter 4)
- Opportunities for collaboration (Chapter 5)
- Community engagement (Chapter 6)
- Risk management (Chapter 7)
- Monitoring and evaluation (Chapter 8)
- Information management (Chapter 9)

## 2.0 Background

This project was initiated by Canegrowers Pty Ltd in response to concerns about the rising groundwater table being raised by members. Canegrowers worked with senior managers in SunWater and the Department of Natural Resources and Water (DNRW) to sponsor and develop the project proposal and the documentation which was subsequently submitted to Sugar Research and Development Corporation (SRDC) for funding support. Part of the conditions for funding from SRDC was that Canegrowers, SunWater and DNRW commit to a high level engagement in negotiation and a willingness to take recommendations in the final blueprint to their respective CEO level of authority for consideration and action. The consultant team has found to date a high level of engagement in the project by all three project sponsors and this augers well for the future of this project and the region.

### 2.1 History of land use and the development of ground water problems in the BRIA as part of the Burdekin Haughton Water Supply Scheme

Our reading of the history of the BRIA suggests to us that government and industry were in a situation like a young family who struggle to buy their first home. The young family can't

quite afford a three bedroom home with an ensuite for the parent's bedroom. So like most of us the young family go for what they can afford and build a three bedroom home with a single family bathroom. As time passes the two children become teenagers, and Dad can't get in the bathroom to get a shave and Mum's make-up goes missing! So the family decides it is time to renovate and put in the ensuite they initially could not afford.

The BRIA family of government and industry are maybe like that family…it has reached the time where both need to invest in management options as well as infrastructure both on farm and off farm that initially was needed but could not be afforded!

Important to improving our understanding and development of a mind map for what may be happening in an irrigation area is an accurate description of the development history of the region. Dr Cuan Petheram[9] and his colleagues in CSIRO have brought together such a history for the Burdekin Haughton Water Supply Scheme (BHWSS) and we have extracted their text in this report.

"Development of the Burdekin Delta

The Lower Burdekin was first settled in 1861 and the first sugar cane was grown in the Delta in 1879. Irrigation first commenced in 1885 when surface water from lagoons on the Pioneer Estate was used to irrigate cane. When the amount of cane grown on Pioneer Estate became limited by surface water supplies, the spear system for extracting groundwater was introduced to the Lower Burdekin by John Drysdale in 1887. By the mid 1890's over 2000 ha of the Delta was being irrigated using both surface and groundwater. In 1965/66 the North and South Burdekin water boards commenced pumping water from the Burdekin River and today the amount of land under irrigation in the Delta stands at over 35,000 ha.

Development of the left bank of the BHWSS.

Irrigated agriculture didn't arrive in the BHWSS until midway through the twentieth century. In July 1949 the first 10 of 40 irrigated tobacco farms opened at Clare under the solider resettlement scheme. Prior to development of these farms the BHWSS had only been used for extensive grazing. The tobacco farms were irrigated using river water which was supplied by a network of channels and two river pumping stations. It has been hypothesised that these old supply channels may have lost a considerable quantity of water through leakage (Lukacs pers. comm. 2004). In 1964, with the collapse of tobacco farming in the area these farms converted to sugar cane. The area under irrigation in the BHWSS at this time was 2319 ha. In 1965 irrigated agriculture commenced in Mona Park following subdivision of the land which was part of the Haughton Sugar Mill. Rather than pumping river water, irrigation

water was sourced from groundwater, where each 26.3 ha Lot was allocated 95 ML (i.e. 3.6ML/ha).

Mona Park was the first area to extract 'substantial' quantities of groundwater for agriculture in the BHWSS. At the time other users of groundwater in the BHWSS were limited to the Burdekin Agricultural College (which started using limited amounts of groundwater in the 1970s) and a small number of users in the settlements of Jardine (0.25 ML/ha allocation), Northcote (0.25 ML/ha allocation) and Clare (very limited development). Today Mona Park still has the greatest density of production bores in the BHWSS.

By 1970 the area under irrigation in the BHWSS had grown to 5365 ha (Figure 7) and by 1978 it was 5789 ha (annual volumes of water diverted from the Burdekin River to the BHWSS increased to 47 048 ML and 58 383 ML in 1970 and 1978, respectively). In 1979 the Clare Weir (8000 ML) was completed (storage commenced in 1978). In 1985 flap gates were installed which increased the capacity of the weir to approximately 15 500 ML. The Clare Weir was to provide a pumping pool for irrigation water for the proposed Burdekin Haughton Water Supply Scheme (BHWSS).

The BHWSS was realised in 1987 with the completion of the Burdekin Falls dam and the Haughton and Barratta main channels. These two channels supply water to customers between the Burdekin and Haughton rivers and the former supplements the Haughton River and Giru groundwater areas. Farms in the Jardine and Northcote regions did not receive water from the BHWSS for several years after Mona Park was connected (about 1988). Anecdotal information suggests that farmers in Mona Park used in excess of their surface water allocations for the first few years until the Jardine and Northcote regions were connected by supply channels.

In 1988/89 control of groundwater in the BHWSS reverted from the Department to NRMW. At the time of development it was estimated that across the scheme 12.5% of water applied for irrigation would return to the groundwater system. Hence, in an attempt to pre-empt any potential rise in the watertable, a conjunctive use policy was introduced in 1989 where most farmers were permitted to extract 1 part groundwater for every 8 parts of surface water applied, referred to as a nominal allocation. However, in practise, only about half the irrigated farms in the BHWSS are able to exploit commercial quantities of groundwater. Northcote and Jardine were given nominal allocations based upon estimates of the sustainable yield of the system. Nominal allocations for Clare were arbitrary."

It is critical at this point in the story to acknowledge the important conclusions from the work of Roger Shaw[2] and Ahern et al. [3,4] in the Department of Primary Industries who had researched the hydrology and soils of the BRIA during the 1980's prior to the BHWSS being

implemented. In his paper in 1989 Roger Shaw[2] concluded "The observed salinity and hydrology behaviour on permeable soils in the BRIA together with the predicted Dd (deep drainage) figures, indicate that problems of shallow watertables and salinity will undoubtedly occur in the irrigation area. Water application management and technology on these more permeable soils will probably be insufficient to adequately manage the rise in groundwater levels and other measures such as conjunctive use and drainage of groundwater pumping may be required. It is strongly recommended that some additional validation of Dd estimates and additional data on the groundwater system behaviour be obtained."

In effect what appears to have happened as researched by the CSIRO team (Cuan Petheram[9]) is that the "department of NRM&E has attempted to adaptively managed the groundwater levels in the BHWSS through announced allocations, allowing farmers to pump a percentage greater or less than their nominal allocation. Announced allocations are a function of usage and groundwater and surface trends, and vary on a monthly basis and between districts. There appears to be little documentation on how announced allocations have varied in time and space.

In the Mona Park district, which was a groundwater district prior to the BHWSS, nominal allocations vary between farmers. This is because some farmers (i.e. 6 lots) did not take up the initial offer of surface water supply, while some others were only given the option of being supplied in part. Because of water quality constraints, a number of these farmers have since requested full allocations of surface water but have been refused by SunWater on the grounds of lack of supply channel capacity.

During the 2000 wet season in an attempt to address the issue of rising watertables unlimited groundwater use allocations were announced. However, in reality only a limited number of farmers were able to capitalise on the increase in groundwater allocation because of groundwater system limitations (i.e. quantity and quality) and in some circumstances because production bore infrastructure was no longer in place. In 2004 'Water Permits' were introduced on a trial basis, whereby if a farmer exceeded their allocation they could go into the department and get given a permit."

## 2.2 Who are the stakeholders in the BRIA and what are their roles?

The consultant team has identified the following key stakeholders:

- Landholders/irrigators in the BRIA and Lower Burdekin in general
- NRW
- SunWater
- BDTNRM/BBIFMAC
- Water Boards
- Canegrowers
- CSIRO/BSES and other knowledge providers
- Environmental groups
- Community

## 2.3 Standard for quality natural resource management

During the collection of information in the literature review and the interviews the consultant team realised there was a need for a framework to evaluate this information and make the review more manageable. The consultant team decided to use the Standard for Quality Natural Resource Management (the Standard). This was due to the team's prior knowledge of the standard and experience working with it as well as its apparent appropriateness for this project which became evident to the team as the project unfolded.

The Standard was prepared by the Natural Resources Commission (NRC) for the New South Wales Government. The Standard addresses quality practice in natural resource management and is designed to apply to natural resource management at all scales including at the state, regional or catchment, local and property levels.

In the development of the Standard, the NRC consulted widely with NSW Catchment Management Authorities, state and Australian Government natural resource management agencies, stakeholders in natural resource management including land managers and environmental interest groups, research organisations and consultants working in natural resource management.

The Standard can be used in a range of applications but its primary role is to give confidence to the public, government, other interested parties and to natural resource managers themselves that investment in natural resource management is cost effective, protects and improves high value natural resource assets and maximises benefits through actions which contribute to integrated outcomes at all scales. The standard does this by providing a framework to evaluate and develop processes to deliver best practice natural resource management.

Its aim is to support flexible and innovative regional planning, investment and decision-making while ensuring consistency, rigor and accountability in natural resource management.

The Standard comprises 7 components. These are: Collection and use of knowledge; Determination of scale; Opportunities for collaboration; Community engagement; Risk management; Monitoring and evaluation; and Information management.
Each component of the Standard specifies a mandatory required outcome which defines the optimal quality of a natural resource management practice.

**Collection and use of knowledge** - use of the best available knowledge to inform decisions in a structured and transparent manner.

**Determination of scale** - management of natural resource issues at the optimal spatial, temporal and institutional scale to maximise effective contribution to broader goals, deliver integrated outcomes and prevent or minimise adverse consequences.

**Opportunities for collaboration** - collaboration with other parties to maximise gains, share or minimise costs or deliver multiple benefits is explored and pursued wherever possible.

**Community engagement** - implementation of strategies sufficient to meaningfully engage the participation of the community in the planning, implementation and review of natural resource management strategies and the achievement of identified goals and targets.

**Risk management** - consideration and management of all identifiable risks and impacts to maximise efficiency and effectiveness, ensure success and avoid, minimise or control adverse impacts.

**Monitoring and evaluation** - quantification and demonstration of progress towards goals and targets by means of regular monitoring, measuring, evaluation and reporting of organisational and project performance and the use of the results to guide improved practice.

**Information management** - management of information in a manner that meets user needs and satisfies formal security, accountability and transparency requirements.

## 3.0 Collection and use of knowledge

There are vast amounts of knowledge about the Lower Burdekin and the BRIA area. This knowledge ranges from the scientific to the observational/historical knowledge of landholders. This section will consider current knowledge on the BRIA, its level of use by decision makers and identify some obvious knowledge gaps that require filling.

### 3.1 Existing Knowledge

#### 3.1.1 Published scientific knowledge

The consultant team undertook a literature review to evaluate the scientific knowledge that was available. Below is a selection of the knowledge that was felt to be of high importance to the BRIA.

- Shaw (1998) used deep drainage, irrigation and aquifer transmissivity information to estimate impacts of irrigation on BRIA soils. The paper makes the conclusion that 'Water application management and technology on the more permeable soils will probably be insufficient to adequately manage the rise in groundwater levels and other

measures such as conjunctive use and drainage of groundwater pumping may be required'.[2]

- Ahern *et al* (1988) published two papers which took information from soil analyses of 254 sites and the use of a model to predict deep drainage under dryland conditions. The reports also provide information on the effects of varying the soil exchangeable percentage on deep drainage. The papers provide a detailed soil classification which provides a better basis for planning at a farm level as well as deep drainage predictions at both the soil type and individual site levels.[3,4]

- McClurg *et al* (1986) published a paper which considered the physical and chemical properties of the major saline/sodic soil types of the Lower Burdekin area. The paper assigns the soil types to 8 groups which are described and their soil classification, location and approximate area are given.[5]

- Ahern *et al* (1989) published two papers which were developed in recognition of the need for detailed information on soil salinity as soil and water table salinity has been historically the major cause of reduced yields and even failure of irrigation schemes. These papers provide basic and derived measures of salinity and sodicity for individual soil profile classes.[6,7]

- Papers published by Petheram *et al* (2004)[8] and (2006)[9] were the only papers found relating to the BRIA aquifer; a large amount of work done on the delta aquifer was also reviewed but has not been included here. The papers focused on the Mona Park area and conclude that the large groundwater level variation seen in Mona Park in

[2] Shaw, R. (1989) *Predicted deep drainage loss under dryland and irrigated managements for Burdekin soils*. Soil Conservation Branch. In: Rayment, G. E. and Eldershaw, V. J. (ed.) Soils of the Burdekin River Irrigation Area. Workshop proceedings, Ayr, August 1998.

[3] Ahern C. R., Shaw, R. J. And Eldershaw, V. J. (1988) *Predicted deep drainage loss for Burdekin soils – Part A: Interpretation by landscape units and agronomic groups*. Bulletin QB88004. Queensland Dept. of Primary Industries, Queensland.

[4] Ahern C. R., Shaw, R. J. And Eldershaw, V. J. (1988) *Predicted deep drainage loss for Burdekin soils – Part B: Soil types and individual sites.* Bulletin QB88005. Queensland Dept. Of Primary Industries, Queensland

[5] McClurg, J.I., Ahern, C.R. and Donnollan, T.E. (1986) *Characteristics of inherently saline and sodic soils of the Lower Burdekin*. Landscape, soil and water salinity: Burdekin Regional Salinity Workshop, Ayr. Queensland Dept of Primary Industries, Conference and workshop series (Queensland Department of Primary Industries), QDPI QC86003 12pp

[6] Ahern, C. R., Weinand, M. M. G. and Eldershaw, V. J. (1989) *Salinity of Burdekin soil profile classes II – Duplex and miscellaneous soils*. Bulletin QB89003. Queensland Dept of Primary Industries, Qld

[7] Ahern, C. R., and Weinand, M. M. G. (1989) *Salinity of Burdekin soil profile classes I – Cracking clays*. Bulletin QB89002. Queensland Dept of Primary Industries, Qld

[8] Petheram C, Charlsworth PB, Bristow (2004 a&b) *Managing on-farm and regional water and salt balances in Mona Park*, Milestone 1 & 2. CSIRO Land and Water, Client Report

[9] Petheram C, Charlesworth PB, Bristow KL (2006) *Managing on-farm and regional water and salt balances in Mona Park*. CSIRO Land and Water Science Report 23/06

2000 was a result of the groundwater system changing behaviour from an unconfined aquifer to that of a semi-confined aquifer.

- To date the project has found limited information about the biodiversity of the BRIA. The appendices of a Sinclair Knight report *Environmental Review of the Burdekin River Irrigation Area*[10] contain two reports by Pearson *et al* titled *Ecosystem review working paper*[11] and *Identification of impacts on ecosystems working paper*[12]. These documents attempt to compile and review existing information on ecosystems in the BRIA and identify the possible impacts of the irrigation scheme on the terrestrial, freshwater and marine ecosystems as well as identifying other impacts and assessing the importance of these impacts.

The papers reviewed provide a large amount of the knowledge required to sustainably manage the BRIA. Discussions with landholders indicated that this knowledge has not been used in their decision making. It is not clear to what extent this knowledge has been used to inform decision making by other stakeholders. The consultant team believe that this is a result of the knowledge being very technical and difficult to access by those not trained in the relevant discipline.

A number of other key pieces of scientific knowledge were identified at the Document of Discovery Workshop. These included reports on deep drainage, permanent beds and rice and soybeans done by DPI in the early days of the BRIA project.

Of more importance was the response of growers when asked about their level of use of information in these reports. Growers stated that they did not read the reports and used BSES to translate the information, the Water Efficiency, Water Check Program in 1994 – 1996 had also been helpful. This response reiterated the concern of the project team that scientific knowledge is generally not in a form that can be used by growers.

### 3.1.2 PPK Report

In November 2001 the Department of Natural Resources and Mines (NR&M) engaged the consultants PPK Environment and Infrastructure Pty Ltd to prepare a groundwater

[10] Sinclair Knight and Partners Pty Ltd (1993) *Review of Agricultural Production Irrigation, Hydrology and Land use*. Burdekin River Irrigation Area Environmental Review (1993). Volume 2 (Appendices). Department of Primary Industries

[11] Pearson R. G., Thomas M., Lukacs G., Nolen J., Clayton P. and Butler B. (1993*) Ecosystem Review Working Paper Task 2*. In Sinclair Knight & Partners Pty Ltd, Environmental Review of the Burdekin River Irrigation Area, Volume 2 (Appendices) 1993. Department of Primary Industries, June 1993.

[12] Pearson R. G., Thomas M., Lukacs G., Nolen J., Clayton P. and Butler B. (1993) *Identification of impacts on ecosystems working paper Task 4*. In Sinclair Knight & Partners Pty Ltd, Environmental Review of the Burdekin River Irrigation Area, Volume 2 (Appendices) 1993. Department of Primary Industries, June 1993

Management Strategy for the Burdekin Haughton Water Supply Scheme (BHWSS)[13]. The strategy identified issues influencing rising groundwater salinity and water tables, opportunities to remedy the problems and the action plans for implementation. The report also stressed that 'the issue is already with us and the time to act is now'.

The strategy developed by PPK was not implemented. It is unclear why this was the case. It may have been a result of a lack of 'buy in' by key stakeholders or the lack of a suitable framework for stakeholders to implement their actions as part of the overall strategy.

The workshop highlighted that this report had not been widely released. It was unclear why this was the case however it was agreed that now that it was available it was best to utilise the information in the document and move forward.

### 3.1.3 Knowledge from Landholder interviews

Interviews have been undertaken with a number of landholders including representatives of the BRIA Irrigators Committee, Upper Haughton Irrigators, DAVCO Farming and other irrigators across the BRIA including people with knowledge of the SBWB and NBWB issues and management structures.

One key message from the interviews was that landholders want sustainable irrigation in the BRIA and are willing to take action to achieve this as long as it is part of a broader plan which includes all stakeholders.

A second key message from the interviews is that landholders (and other stakeholders) feel that unless the BRIA area is managed as a whole of water approach improvement cannot happen.

Landholders feel that:

- There are water quality issues in the BRIA which are similar to the south and north Burdekin water areas.
- There are fundamental differences in the management techniques needed in any of these areas.
- At present the BRIA has no one authority with the will or the power to deal with the three issues of surface water, groundwater and water quality.

[13] PPK Environment and Infrastructure (2001), *The Proposed Groundwater Management Strategy for the Burdekin Haughton Water Supply Scheme, Information Paper,* Department of Natural Resources and Mines (2001)

- At present each problem is dealt with individually.
- Perceived financial loss or gain by each group impedes a solution. Overall financial loss to the area is inevitable unless sensible management is used very quickly.
- Landholders also want to know where groundwater and salt are coming from.

The interviews identified the following knowledge:

### Knowledge of physical system

- Landholders were aware of the rising groundwater and had observed impacts on crop health and growth.
- Landholders know which areas of their land are 'problem areas' and which are not; in Mona Park it has been observed that 100 mm of rainfall will result in a 1 m rise in the groundwater.
- Some landholders believe there is a natural bleed valve in the Mona Park area which allows groundwater to drain from the area once it reaches a level of approximately 3-4m from ground level.
- Landholders believe the Clare Weir had a significant impact on groundwater levels in the BRIA and that this was reflected in changes to groundwater quality of wells near the weir at the time of its installation. Landholders believe this would not be evident now as the aquifer has reached a level that no longer is impacted by the Clare Weir.
- Landholders believe that channel leakage is a significant contributor to groundwater problems in the BRIA.
- Landholders agree that deep drainage has an impact on the groundwater although it is generally believed this is not significant. Detailed values for this have not been measured across the BRIA.
- Landholders believe there is a shallow rock shelf that extends across the BRIA from the Haughton River and across Barratta Creek and that this has significant impacts on groundwater flow including causing a wedge in the Haughton area which has very little groundwater.
- Some landholders believe that SunWater channel capacity is not adequate and its inability to deliver water when required means that inefficient irrigation practices are undertaken.

- Landholders currently still use high volumes of gypsum to maintain permeability in their soils. However, this is changing to a gypsum lime mix. It is not totally clear why this works but it has been found to give positive outcomes on some farms.
- Some landholders believe there is a rock ledge on the northern bank of the Burdekin River near the Clare Weir and that this shelf is overtopped by water from behind the weir, this freshwater lens forces saline groundwater which would normally drain to the river to flow into the BRIA.
- Landholders believe the GW was effectively managed by the Irrigators and the department before the Water Act 2000 came into force (Act probably came into force around 2003).
- Some landholders believe deep drainage is a significant source. Work is currently being done to determine the level of deep drainage on some properties.
- Landholders would like to know if water (groundwater or surface water) can be trucked across boundaries.
- Some landholders have found that the application of gypsum is not effective.
- Landholders believe that ponding in drainage is causing greater inflow from channels.

### Knowledge of institutional system

- Some landholders believe that Land and Water Management Plans (LWMPs) are simply water licences and once approved will have little relevance to their on farm activities.
- Other landholders recognise the benefits of LWMPs as a farm management tool but believe they should be developed at a basic level initially and then improved on over time to ensure their relevance and functionality.
- At the workshop landholders stated that they need to get LWMPs but that they should be allowed to get them done and approved and then make amendments after that, at the moment they feel it is impossible to get them approved.
- Landholders believe they could better manage groundwater levels if they were permitted to pump at rates greater than the 1 Ml/ha currently permitted. It is felt this rule is not appropriate to apply across the state and the permit process to use more groundwater is confusing and difficult.
- Some growers feel that the original 1 in 8 groundwater pumping rule was a good start but that it should then be adjusted over time.

- Some landholders believe that NRW should legislate that they take more than 1 in 8 groundwater.
- Some landholders believe that SunWater's current pricing includes a charge to recoup the interest on the shortfall between the current value of the asset and the original money recouped from the sale of the lots (which they believe was significantly less than the cost of setting up the scheme).
- Landholders are concerned that the aim of SunWater is to sell water but they have no responsibility for the management of the groundwater and that Treasury is ensuring government income is maintained by preventing farmers from extracting more than 1 Ml/ha so they are forced to buy water from SunWater.
- Landholders believe the pricing structure of SunWater means there is disincentive to use groundwater; farmers who are using groundwater are actually losing money by using groundwater – running costs for groundwater is $5/Ml more than the Part B charge.
- Some landholders believe the SunWater Part A and Part B pricing structure is fundamentally wrong and does not promote efficiency.
- Landholders have the opinion that SunWater does not maintain drains so this is a disincentive to use drain water.
- Some landholders are concerned that it is not always clear who out of NRW and SunWater is responsible for cleaning drains.
- Landholders are concerned that Burdekin Dry Tropics NRM is a deep green organisation.
- Some landholders believe that all bore information, both private and public, should be recorded in a public database for use by all.
- Landholders would like to be consulted about future decisions about groundwater pumping allocations.

### 3.1.4 NRW knowledge

Natural Resources and Water (NRW) currently collects data from bores across the BRIA. This data is held in a central database. This data is currently only analysed on an ad-hoc basis but is publicly available on request.

NRW also holds bore logs for all bores across the BRIA. These logs are not currently publically available. Discussions with key stakeholders have indicated some of these logs may provide valuable information for modelling and understanding the BRIA aquifer if they were reviewed as they were logged by non-technical drilling staff.

NRW is currently developing a model to model the aquifer within the BRIA. This model is not currently available as NRW are working to get the model done properly. NRW believe an acceptable model will be available by the end of 2008.

NRW currently has a surface water model for the whole Burdekin area. A flood model is currently being developed, control points have been measured.

NRW has also undertaken a considerable amount of work in the development of its Burdekin Basin Water Resources Plan. This information has not been reviewed as part of this project but is important knowledge to inform future decision making[14]. NRW believe that the outcome of the Water Resource Plan should be helpful in setting better pumping rates.

NRW also hold the soils mapping for the BRIA. This mapping information has been added to by the Burdekin Dry Tropics NRM and is discussed below.

### 3.1.5 SunWater knowledge

SunWater is currently going through an exercise to quantify the volume of current water leakage. SunWater does not currently have all the leakage information.

SunWater currently have an Interim Resource Operating Licence with NRW, this is available on the website. SunWater do currently have data on what water is available for customers, this data is provided to NRW. The majority of the data is publically available.

SunWater are going to be required under their licence to show how they are going to operate the system including how trading will operate. SunWater believe there is a lot of work to be done on the issue of water trading with the Water Boards and Water Committees.

### 3.1.6 CSIRO knowledge

CSIRO through a number of recent projects carried out through the LBI has developed considerable knowledge and understanding of the delta irrigation and groundwater systems – results indicate that the 'recycling' process is not sustainable in the long term – salts are not being removed from the GW systems and nitrogen appears to be accumulating in the GW systems.

Carried out the first and most comprehensive analysis of the Mona Park region within the BHWSS – reported on extensively in sections above – data analysed to date suggests that the water table has risen to a point were the aquifer seems to change from an unconfined system to a confined system. It is not clear yet but there are indications that the water table may have reached a level where the 'bucket' is full so the water table may not rise much more, except

[14] Natural Resources, Mines and Water (2006) *Burdekin Basin draft water resources plan, economic and social assessment, stage 2 report,* Natural Resources, Mines and Water (2006). Available at http://www.nrw.qld.gov.au/wrp/pdf/burdekin/burdekin_eco_social_stage2.pdf

temporarily when conditions are very wet. Need further analysis of more recent data to verify this.

The NAIF project is negotiating to secure funding to provide an enhanced Lower Burdekin Knowledge Platform.

### 3.1.7 BSES knowledge

Issues relevant to the BRIA commenced with the research undertaken to measure the water requirements of sugarcane in the Burdekin[15] for maximising crop production; this was supplemented by subsequent research into crop water use under commercial growing conditions[16]. This basic information was used in the water resource allocation for the new developments of the BRIA, and has been extensively used in the development of irrigation scheduling/management for these and Delta farms. In developing these irrigation management tools, extensive further work relating crop growth to crop water use has been undertaken so that a range of methods and tools for best management of irrigation supplies have been developed and used through the WATERCHECK [17] and RWUE projects [18,19,20].

Sugarcane rooting depths/distributions, crop water extraction patterns and growth and PAWC of the soils of the BRIA were determined for the major soil types in 23 plant and ratoon crops at 25%, 50%, 75% and 100% canopy stages and during maturation of the crop[21,22]. Simultaneously with this study, neutron moisture meter calibration equations for soil water assessment were developed for the soils of the area [23,24]. Since the irrigation system for the

[15] Kingston, G., Ham G.J. (1975) *Water requirements and irrigation scheduling of sugar cane in Queensland – 1.Water requirements of sugar cane in Queensland*. Proc.42nd Conf. Qld Soc. Sugar Cane Technol. 55-67

[16] Ham, GJ (1985) Crop water use by sugarcane under commercial growing conditions. 5th Afro-Asian Conf. ICID, Townsville pp1-12

[17] Holden, JR; Hussey, B; Shannon, EL (1997) *Project BS127S (Water Check) Increased Adoption of Efficient Sustainable Irrigation Practices by Australian Canegrowers*. Final Report to SRDC(BSES Internal Report SD97017) @ www.srdc.gov.au

[18] Shannon, EL ( 1995 ) *Calibrating evaporation minipans*. BSES Bulletin

[19] Shannon, EL (1994) *Burdekin growers take their hats off to evaporation mini pans*. BSES Bulletin 48:17,19

[20] Shannon, EL; Holden, JR (1996) *The evaporation minipan: a simple Irrigation scheduling tool for the canegrower. Sugarcane: research towards efficient and sustainable production* – Sugar 2000 symposium 213-214

[21] Inman-Bamber, NG; Muchow, RC; Holden, JR; Robertson, MJ; Ham, GJ (1998) *Soil water extraction by sugar cane beyond the readily available limit* Proc.20th Conf. Aust. Soc. Sugar Cane Technol. 112-117

[22] Ham, GJ (1992-1995) *Efficient use of irrigation water for sugarcane: plant – water relationships*. Project BS62S, SRDC Annual Reports.

[23] McDougall, AJ; Raine, SR; Bakker, D (1996) *Neutron moisture meter calibration equations for soil water assessment in the sugar industry*. Proc.18th Conf. Aust. Soc. Sugar Cane Technol. 125-130

[24] Raine, SR; Bakker, D (1995) *Calibration equations for soil moisture measurement using the neutron moisture meter*. BSES Internal Report TE95006.

BRIA was to be furrow for the foreseeable future, furrow irrigation efficiency was an important issue examined through better design and management of irrigated cane fields[25,26,27,28] resulting in recommendations for optimum furrow lengths, slopes and furrow shapes for the range of BRIA soil types [29]. The SIRMOD model, modified for the long furrows of the BRIA, was used to complement furrow design studies[30], while alternate furrow irrigation was assessed as a method to improve irrigation efficiency[31,32]. Alternative irrigation systems for the Burdekin were evaluated for suitability/adaptability [33] and surge irrigation research showed that significant improvements to irrigation application and distribution efficiencies could be achieved[34].

Crop establishment in the long furrows of the heavy BRIA soils was addressed [35,36] resulting in a new method of planting and a change in early irrigation application. The effect of nitrogen placement on crop nutrition and production under furrow irrigated, trash blanket conditions showed the advantage of sub-surface placement, either split stool in the row or either side of the row[37]. The applicability of green cane trash blanket harvesting to the Burdekin was documented [38,39] and constraints to its general adoption identified[40]. The

[25] Raine, SR; Bakker, DM (1996) *SRDC Project BS90S- Increased productivity through better design and management of irrigated canefields*. Final Report to SRDC (BSES Internal Report SD 96008) @ www.srdc.gov.au

[26] Raine, SR; Bakker, D (1996*) Increased furrow irrigation efficiency through better design and management of cane fields*. Proc. 18th Conf. Aust. Soc. Sugar Cane Technol. 119-125

[27] Raine, SR (1995) *Water application under furrow irrigation of sugarcane*. Proc. 17th Conf. Aust. Soc. Sugar Cane Technol. 365-366 (Poster Paper)

[28] Holden, JR; Mallon, KM (1997) *Project BSE2 - Increasing Irrigation Efficiencies in the Australian Sugar Industry*. Final Report to LWRRDC (BSES Internal Report PR97006)

[29] Raine, SR; Shannon, EL (1996) *Improving the efficiency and profitability of furrow irrigation for sugarcane production. Sugarcane: research towards efficient and sustainable production* – Sugar 2000 symposium pp 211-212

[30] Raine, S; Walker, W. (1999) *SIRMOD: improving surface irrigation efficiencies*. Australian Sugarcane 2:6: 10-11

[31] Bakker, DM; Raine, SR; Robertson, MJ (1997) *A preliminary investigation of alternate furrow irrigation for sugar cane production*. Proc. 19th Conf. Aust. Soc. Sugar Cane Technol. 302-309

[32] Raine, S; Bakker, D; Robertson, M (1997) *Alternate furrow irrigation improves water use efficiency*. Australian Sugarcane 1:4:6-7

[33] Ham, GJ (1979) *Evaluating alternative irrigation systems for sugar cane in the Burdekin*. Proc.46th Conf. Qld Soc. Sugar Cane Technol. 55-67

[34] Ham, GJ (1991) *Surge irrigation can improve water distribution*. BSES Bulletin 36:20-21

[35] McMahon, GG; Ham, GJ (1994) *Ridge planting sugarcane on heavy clay soils in the Burdekin*. Proc.16th Conf. Aust. Soc. Sugar Cane Technol. 70-74

[36] McMahon, GG; Chapple, PA; Ham, GJ; Saunders, M; Brandon, R (1993) *Planting sugarcane on heavy clay soils in the Burdekin*. Proc. 15th Conf. Aust. Soc. Sugar Cane Technol. 305-311

[37] McMahon, GG; Ham, GJ; Brandon, RW (1994) *Effects of nitrogen placement on crop production under furrow irrigated, trash blanket conditions*. Proc. 16th Conf. Aust. Soc. Sugar Cane Technol. 55-62

[38] McMahon, GG; Ham, GJ (1996*) A review of green cane trash blanketing in the Burdekin*. Proc. 18th Conf. Aust. Soc. Sugar Cane Technol. 131-136

experiences of a large cane producer using green cane trash blanketing were recorded to outline the advantages and pitfalls of commercial use of this system [41].

Given that ~35% of the BRIA was sodic soils, a review of farming on sodic soils in the sugar industry was conducted [42] and this was used as a template to guide further research into their use. The effects on sodicity and salinity on crop production were evaluated through measuring natural variation in the field and relating this to soil properties [43,44]. Field trials were conducted to assess the efficacy of the ameliorants available in the marketplace, techniques examined to maximise their effect together with detailing their chemical and physical properties and elemental composition [45,46]. A planned extension program was instituted to deliver results to growers[47] , while a computer program was developed to develop appropriate gypsum rates for application to sodic soils [48]. Additionally, a field guide for the diagnosis of sodic soils in the Australian sugar industry was developed[49].

The proximity of the Great Barrier Reef lagoon to this major cane growing area raised public perceptions of concern regarding its potential adverse effects. A study of the losses of nutrients and pesticides in surface drainage from irrigated sugarcane was carried out to assess the extent of any losses and identify contributing on-farm practices producing an adverse

[39] McMahon, GG (1995) *Green cane trash blanketing : A situation statement for the Burdekin district*. BSES Internal Report TE95008

[40] McMahon, GG; Holden, JR (1997) *Constraints to the adoption of Green Cane Trash blanketing in the Burdekin*. BSES Internal Report SD970003

[41] Shannon, EL (1999) Green cane in the Burdekin: The Rapisarda experience. Australian Sugarcane 2:6:6-7

[42] McMahon, GG; Ham, GJ; Cox, AZ (1997) *Project BS146S - Farming Sodic Soils – A Situation Statement and Future Direction.* Final report to SRDC (BSES Internal Report SD97004) @ www.srdc.gov.au

[43] Nelson, PN; Ham, GJ (2000) *Exploring the response of sugar cane to sodic and saline conditions through natural variation in the field.* Field Crops Research 66:245-255

[44] Nelson, P; Ham, GJ (1998) *Soil sodicity : Its influence on cane yield in the Burdekin*. Proc. 20th Conf. Aust. Soc. Sugar Cane Technol. pp 248-250

[45] Ham, GJ (2005). Project BSS197: *Products and mechanisms for the amelioration of sodic soils*. Final Report to SRDC (BSES Internal Report SD05006) @ www.srdc.gov.au

[46] Ham, GJ; McMahon, GG; Elliot, PJ; Smettem, KRJ (1995) *Cropping Sodic Soils in the Burdekin River Irrigation Area in 'Australian Sodic Soils : Distribution, properties and management'* – R Naidu, ME Sumner & P Rengasamy (eds.) CSIRO Publications, Melbourne, Australia 139-147

[47] McMahon, GG; Ham, GJ; McGuire, PJ (1996) *The BSES extension for sodic soils in the Burdekin*. Proc. 18th Conf. Aust. Soc. Sugar Cane Technol. 195-201

[48] Nelson, P; Fitzgerald, T (2000) *Gypsy : a computer program for recommending gypsum rates on sodic soils under sugarcane*. Proc. 22nd Conf. Aust. Soc. Sugar Cane Technol. pp 506 (Poster Paper)

[49] Nelson, PN (2000) *Field guide for the diagnosis of sodic soils in the Australian sugar industry – 'Diagnosis of sodicity and related problems of soil and water in the Australian sugar industry' for use with manual "Diagnosis and management of sodic soils under sugarcane"* Nelson et al (2000)

impact through any such losses[50]. A later study provided an assessment of the inflows/outflows to the Barratta Creek system, the main outflow to the reef lagoon for most of the BRIA development [51], showing at least the status quo had been maintained during the development period. A case study in the Burdekin of the movement of nitrogen and pesticides in deep drainage revealed the limited movement of pesticides down the soil profile[52] while appreciable nitrogen moved in deep drainage water, with the clear potential to reach the aquifer system. Changed practices were shown to have a positive effect on reducing nitrogen movement[53] . Fertiliser placement in the new farming system for sugarcane was shown to require particular attention to avoid appreciable losses in run-off and increased potential for environmental damage [54].

### 3.1.8 BBIFMAC knowledge

BBIFMAC is an incorporated community natural resource agency whose constituency possess a considerable collective knowledge of water management in the Lower Burdekin. BBIFMAC made a major contribution to the development of the BDTNRM's regional plan which details surface and ground water management issues.

Past deputy chair and chair of BBIFMAC's ground water subcommittee Les Searle has made a significant contribution to the area with his vast experience in water management in the Lower Burdekin.

BBIFMAC's project manager Tom McShane has been involved in groundwater/salinity issues since the early 1980's and now co-manages two important grower driven ground water related projects in the Lower Burdekin.

The upper Haughton project has installed twenty four piezometers to monitor short term changes in their local aquifers and to relate those fluctuations to recharge from various on ground activities. A contracted groundwater consultant provides the group with modelling skills which assist them in understanding the various interactions.

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[50] Ham, GJ (2006) *Nutrients and pesticides in surface drainage water from irrigated sugarcane*. Final Report to SRDC (BSES Internal Report SD06007) @ www.srdc.gov.au

[51] Ham, GJ (2007) *Water Quality of the Inflows/Outflows of the Barratta Creek System*. Proc. 29th Conf. Aust. Soc. Sugar Cane Technol., Cairns

[52] Klok, J.; Ham, G (2004) *A pilot study into pesticides and the Burdekin delta aquifer system*. Proc. 26th Conf. Aust. Soc. Sugar Cane Technol

[53] Klok, J.; Ham, G (2004) *Management of furrow irrigation to improve water use efficiency and sustain the groundwater resource – A case study in the Burdekin Delta.* Final Report to the Rural Water Use Efficiency Initiative. (BSES Internal Report PR04005)

[54] Ham, GJ (2007) *Farming system changes and fertiliser loss in an irrigated sugarcane area – the Burdekin*. Proc. 29th Conf. Aust. Soc. Sugar Cane Technol., Cairns

In the other project alternative irrigation systems (OHLP & drip) are being monitored at field scale to assess their performance as compared with the conventional furrow irrigation systems. Lysimeters to monitor and trap deep drainage water are being used to provide this vital component of the water balance.

### 3.1.9 DAVCO Farming

DAVCO Farming has recently received federal funding of up to $670,000 under the Regional and Community Projects component of the Sugar Industry Reform Package to undertake a project to gain further knowledge about the use of saline groundwater for irrigation and the optimal application rates for saline groundwater. The project will extract groundwater from two areas under immediate threat of groundwater impacting crop production and re-use the water under close control and monitoring. Expected outcomes include the demonstration of the beneficial use of elevated salinity water to improve water penetration on sodic soils and the development of irrigation guidelines that will equip the district's farmers with tested, practical methods to sustainably manage groundwater levels. Additional project aims include developing a more complete understanding of the quantity and quality of deep drainage under the BRIA, as distinct from the more permeable delta soils, providing management regimes that achieve appropriate deep drainage and reducing the need for imported salt in the form of gypsum as a soil ameliorant.

The physical components of the project will include bores and saline water distribution infrastructure, six nests of lysimeters under differing soils and treatments, six sites with multiple soil moisture sensors, electromagnetic surveying ground-truthed through soil samples, and water metering on and off field. Stalk elongation measurement and yield measurement will be used to evaluate crop performance. Further modelling and analysis will be carried out to establish long-term sustainability of the irrigation practices in the context of the regional flows of the BRIA aquifer. Analysis and modelling will be carried out under the supervision of the Project Manager, Gary Ham, formerly of BSES Burdekin.

### 3.1.10 Burdekin Dry Tropics NRM

BDTNRM have recently completed a project to bring together all current soils information for the Lower Burdekin and translate this onto a single soils map. A focus of the project has also been to simplify the soils classifications. The aim of the project is to collate a large amount of existing soils information into an easy to use tool which can be used to guide decision making.

Burdekin Dry Tropics also undertook extensive community consultation in the development of their Burdekin Dry Tropics Natural Resource Management Plan[55]. This is another piece of knowledge that could inform decision making by key stakeholders.

BDTNRM is interested in improving knowledge in the area of social and economic impacts of NRM decisions. BDTNRM is also in a critical position as it has knowledge of the whole catchment and is responsible for ensuring that decisions made at a local level fit within a catchment wide NRM plan.

### 3.1.11 Water Board Knowledge

"Development of the Burdekin Delta"

The Lower Burdekin was first settled in 1861 and the first sugar cane was grown in the Delta in 1879. Irrigation first commenced in 1885 when surface water from lagoons on the Pioneer Estate was used to irrigate cane. When the amount of cane grown on Pioneer Estate became limited by surface water supplies, the spear system for extracting groundwater was introduced to the Lower Burdekin by John Drysdale in 1887. By the mid 1890's over 2000 ha of the delta was being irrigated using both surface and groundwater. The expansion of the sugar industry was in a very ad-hoc fashion, from 1890 to 1920. Sugar mills were built and dismantled in an unstable financial sugar market. Plantation and small farm enterprises had varied financial success. The Government of the day passed various Acts dealing with the sugar industry. Land size and ownership rules, labour condition rules, culminating in the Sugar Acquisition Act. All of these changes affected farming in the Burdekin Delta.

The biggest aquifer management change was the Inkerman Irrigation Area Act 1922. This Act established a Government owned power house, powerlines and wells in the Home Hill area. Financial stress of the whole Inkerman Irrigation Scheme saw it sold to the farmers in 1932.

The expansion of the sugar Industry by 1962 saw the situation where the aquifer in both the NBWB & SBWB areas was extremely low with sea water and other problems very seriously impacting on the production of sugar cane. Some areas were completely out of groundwater.

In 1965/66 the North and South Burdekin water boards commenced pumping water from the Burdekin River and today the amount of land under irrigation in the Delta stands at over 42,000 ha.

[55] Burdekin Dry Tropics Board (2005) *Burdekin Dry Tropics Natural Resource Management Plan (2005 – 2010),* Burdekin Dry Tropics NRM (2005)

## 3.2 Knowledge use

There is a vast amount of knowledge about the BRIA held by the key stakeholders. Interviews with stakeholders have indicated that this knowledge tends to stay within the groups who generate it either because there is no forum for it to be shared, it is not in a form that can be easily used or it is withheld by choice.

This approach to knowledge within the BRIA has meant that the best available knowledge has not been used in decision making at all levels. This ineffective use of knowledge means that poor decisions have been made in the past.

At the workshop it was raised that at times it is difficult to know which knowledge to trust and that at times knowledge has been used to create mischief. This response further highlights the need for knowledge to be made available, this way people will have a broader base to inform their decisions and potentially false information will be able to be challenged openly.

Stakeholders need to find a way to ensure best available knowledge is accessible and used to inform decisions at all levels.

## 3.3 Knowledge Gaps

Discussions with stakeholders have identified a number of key knowledge gaps. These are:

- The social, economic and environmental costs resulting from the problem of rising groundwater in the BRIA are not currently known. This includes costs resulting from lost production, the flow on costs to industries reliant on the sugar cane industry as well as environmental costs resulting from the impacts of raised groundwater. No predictions of future costs if nothing is done have been made. A study completed by Davco Farming as part of their recent bid was provided for the project team to review. This document provides some estimates of the economic costs of the current situation as well as estimates of the losses prevented by the proposed project.
- The aquifer(s) below the BRIA are not currently understood; aquifer size, boundaries and flows are not known and the influence of the BRIA aquifer(s) on the delta aquifer is not understood. This is in contrast to the delta aquifer which by comparison is relatively well understood.
- The relative contributions of deep drainage and channel leakage to the raised groundwater levels in the BRIA are not known.

- The effects of ongoing application of gypsum on soil structure and chemistry of the BRIA soils is not understood.

Stakeholders need to find a way to prioritise knowledge needs and identify ways to get this work undertaken.

## 4.0 Determination of scale

The scale of the groundwater problem within the BRIA has not been adequately assessed. This is a key contributor to the continuation of the problem and the lack of a coordinated response by stakeholders. This is illustrated in the following points:

- The scale of the financial, environmental and social costs of the rising groundwater in the BRIA has never been assessed. This lack of understanding of the costs both current and future has made it difficult for stakeholders to determine the appropriate scale of response.

- The scale of the aquifer has never been assessed. This lack of knowledge has meant that stakeholders cannot easily appreciate the scale of the problem and the scale of action that would be required to manage the problem.
- The scale of contribution of deep drainage and channel leakage to the rising groundwater has never been comprehensively assessed. This has meant that stakeholders have not been able to determine the scale of their own contribution to the problem and appreciate the scale of their role in addressing the problem.
- The time scale of the problem has not been adequately assessed, it is unclear increase in cost there will be over time if no action is taken or the timeframes required to manage the problem.

This lack of knowledge about the scale of the problem has meant that previous attempts to take action have failed as each stakeholder has reached a point where they are unable to justify the costs of action due to their uncertainty about the size, cost and complexity of the problem and their responsibility in managing it.

Notwithstanding this all stakeholders have used their own understanding of the problem to decide that the scale of the problem is of some significance. This is reflected in the willingness of all stakeholders to engage with this project. All stakeholders have expressed the view that there is a problem and they are willing to engage in a coordinated response to manage the problem.

The scale of this willingness has previously not been sufficient to move past the early stages of developing a solution. Subsequently a number of previous projects similar to this one have failed to achieve the required outcome. The success of this project will relate directly to the scale of willingness amongst stakeholders to take action.

Improving understanding of the scale of the problem, the scale of costs and the scale of contribution are critical to keep stakeholders engaged in the project and comfortable with the scale of their role in managing the problem.

Stakeholders need to find a way to use best available knowledge to agree to the scale of the problem, the appropriate scale of response and the scale of each of their roles in this response.

# 5.0 Opportunities for collaboration

## 5.1 Collaboration to date

Collaboration to date has been poor. A number of attempts have been undertaken to take a collaborative approach to resolving the problems of the BRIA. As discussed in the 'scale' section of this report these collaborations have, for a range of reasons, generally failed to address the key problem.

## 5.2 Frameworks for Collaboration

There appear to be a raft of plans and strategies that apply to the Lower Burdekin and the BRIA. These all have targets, goals or aims and operate at a range of institutional scales. These are outlined in the following section.

### 5.2.1 National Water Initiative (NWI)

The National Water Initiative (NWI) is a strategy developed by the Australian Government which aims to improve water management across the country. The Government has developed the strategy to attempt to improve the productivity and efficiency of water use, while maintaining healthy river and groundwater systems.

The strategy encompasses a wide range of water management issues and encourages the adoption of best-practice approaches to the management of water in Australia. If successful, the NWI will result in:

- expansion of permanent trade in water bringing about more profitable use of water and more cost-effective and flexible recovery of water to achieve environmental outcomes;
- more confidence for those investing in the water industry due to more secure water access entitlements, better and more compatible registry arrangements, better monitoring, reporting and accounting of water use, and improved public access to information;
- more sophisticated, transparent and comprehensive water planning that deals with key issues such as the major interception of water, the interaction between surface and groundwater systems, and the provision of water to meet specific environmental outcomes;

- a commitment to addressing over allocated systems as quickly as possible, in consultation with affected stakeholders, addressing significant adjustment issues where appropriate; and
- better and more efficient management of water in urban environments, for example through the increased use of recycled water and stormwater.

The NWI was agreed to and signed at the 25 June 2004 meeting of the Council of Australian Governments (COAG). At this meeting, COAG noted the imperative of increasing the productivity and efficiency of water use and the health of river and groundwater systems in Australia[56].

Stakeholders within the Lower Burdekin should be collaborating to achieve the requirements of the NWI. The consultant team believes that collaboration to resolve the problems of the BRIA will contribute to the achievement of the NWI goals within the BRIA and Lower Burdekin in general.

### 5.2.2 BDTNRM

The Burdekin Dry Tropics NRM has developed a regional natural resource management (NRM) plan to sustainably manage the regional natural resources in conjunction with the Queensland and Australian Governments, the community, Traditional Owner groups, sub-regional groups and advisory committees of the region on behalf of the Burdekin catchment community. The BDTNRM aims to implement the plan with a range of stakeholders on behalf of the community.

Stakeholders within the lower Burdekin should be collaborating to achieve the targets within the BDTNRM natural resource management plan. The consultant team believes that collaboration between stakeholders to resolve the problems of the BRIA will contribute to the achievement of the natural resource management plan targets within the BRIA and Lower Burdekin in general.

Key targets that have been identified as relevant for the BRIA are listed below:

- By 2050; A sustainable landscape integrating conservation, primary production and community aspirations is achieved.
- By 2050; we have a community managing and undertaking sustainable practices in harmony with the landscape.
- By 2024; achieve a 10% improvement in soil health in extensive and intensive agricultural areas.

[56] Council of Australian Governments (2004) *Further information on the National Water Initiative, Attachment A,* June 2004. Available at http://www.coag.gov.au/meetings/250604/index.htm#water_initiative

- By 2050; the current distribution, composition and diversity of native plants and animals will have been improved by the increased adoption of economically and environmentally sustainable land management systems by land managers.
- By 2050; effectively manage impacts of pest plants and pest animals on environmental, economic, social and cultural values and prevent the spread of new pests into the region by having an informed and involved community.
- By 2050; wetland systems of high environmental value and importance to the community will be protected and cooperatively managed.
- By 2015; priority creeks, lagoons and wetlands maintain surface weed cover at 20% or less (acceptable levels for fish).
- By 2050; all water bodies have ambient water quality that allows for the maximisation of environmental productivity, diversity and ecological processes.
- By 2015; improve water quality (suspended sediments, nutrients, pesticides) at a sub-catchment and catchment level based on 2005 levels.
- By 2015; establish and implement an environmental flow.
- By 2024; the conservation of naturally occurring aquatic organisms and ecological values of 80% of priority, permanent natural waterholes will be ensured.
- By 2015, connectivity is re-established in 50% of freshwater wetlands and lagoons so they are able to support all native aquatic species expected for that system.
- By 2050; there will be healthy and self sustaining native vegetation communities along all waterways and wetlands.
- By 2050; there are secure and sustainable water flows of suitable quality for all to enjoy and utilise (domestic, industrial and agricultural).
- By 2020; water is used more efficiently through 50% adoption of a range of water use efficiency practices.
- By 2050; to have sustainable groundwater systems (quality and quantity) suitable for agricultural, industrial, environmental and domestic use.
- By 2012; the health and diversity of 75% of the mapped key groundwater dependent ecosystems (eg springs, wetlands, wonky holes) is stable.
- By 2015; the health and diversity of 25% of poor condition key groundwater dependent ecosystems (eg springs, wetlands, wonky holes) is improved to good condition.

- By 2050; to deliver sustainable environmental and production outcomes by having a successfully interactive groundwater and surface water strategy.
- By 2015; to achieve an optimal depth from the natural surface, for groundwater resources, dependent on topography and geology, which also prevents further sea water intrusion.
- By 2015; maintain groundwater quality at a level which sustains current use.

### 5.2.3 Water Resource Plan and Resource Operation Plan

The Burdekin Basin Water Resource Plan has recently been released. The document aims to provide a blueprint for future sustainability by establishing a framework to share water between human and environmental needs. A draft of this plan was released on 3 August 2006. NRW developed the plans through a detailed technical and scientific assessment as well as extensive community consultation. The aim of this work has been to determine the right balance between competing requirements for water.

The Burdekin Basin Water Resource Plan applies to the catchment's rivers, lakes, dams and springs and, ultimately, underground water and overland flow. The plan has been developed by assessing the size and nature of the resource so NRW can ensure that water allocation occurs within sustainable limits.

The environmental and consumptive objectives specified in the water resource plan are met through Resource Operations Plans. Also addressed is the management of water that may become available for future use.

Plans are published as subordinate legislation to the Water Act 2000. They detail the plan area, water to which the plan applies and what the plan aims to achieve including:

- outcomes for water use, such as the needs of towns, agriculture and industry;
- outcomes for the environment, including, for example, the needs of specific species and general river ecology;
- strategies to achieve water use efficiency and the best possible environmental outcome;
- environmental flow objectives – the flows necessary to sustain a healthy environment;
- water allocation security objectives – the performance water users can expect from their allocations; and

- monitoring and reporting requirements – to ensure that plans are working.[57]

A water resource plan may also provide for a water trading system to be established. In achieving this, a resource operations plan must ensure that environmental flows and water allocation security objectives, specified in a water resource plan, are protected. This is currently part of the Burdekin Basin plan.

The plan provides a framework for stakeholders to collaborate to effectively manage water within the Lower Burdekin. The consultant team believes that collaboration by stakeholders to resolve the problems of the BRIA will contribute to the achievement of the aims of the Burdekin Basin Water Resource Plan within the BRIA and Lower Burdekin in general.

### 5.2.4 Water Use Plan and Land and Water Management Plans

NRW's view is that a LWMP provides individual landholders with a practical property management tool to plan and review an irrigation enterprise, and identify and manage risks to land and water associated with irrigation practices. It can also be a way of recording and measuring continuous improvement and demonstrating to third parties that risks associated with the farming operation are being managed[58].

At the moment this view is not shared by landholders who view the plans as little more than a water licence.

The consultant team believe that if a regional view is taken and land and water management plans are guided by and approved in accordance with the regional objectives, then the plans could become a framework for collaboration between landholders and government at a farm scale.

NRW believes this regional view could be provided by a Water Use Plan. NRW proposes that a water use plan would be a statutory plan that specified the risk associated with using land and water resources. In doing so, it would identify outcomes that landholders were required to achieve to deal with degradation issues such as rising groundwater levels and salinisation.

It would also specify how individuals were to meet the objectives of the plan which:

- would set standards for water-use practices;
- might relate to the type of water use; and
- might relate to the preparation of individual Land and Water Management Plans.

[57] Natural Resources and Mines (2004) *Understanding Water Resource Planning* Natural Resources and Mines, Queensland Government (2004). Available at http://www.nrw.qld.gov.au/wrp/pdf/general/u_wrp.pdf

[58] Cowan, D. (2006) *Facts, Water Series Land and Water Management Plans* Land management and use, Natural Resources and Water, Queensland Government (2006)

Within a plan area, and depending on the level of risk, certain water users might be required to have a LWMP approved by the department. Others might need to conduct their enterprises according to standards nominated in the district plan.

Water users who were unable or unwilling to comply with the standards might need to have a LWMP approved, demonstrating that their preferred management practices would achieve the outcomes specified in the district plan.[59]

### 5.2.6 BBIFMAC Natural Resource Management Strategy

A large range of organisations and agencies are involved in the management of the Natural Resources in the Burdekin/Bowen Region, but there is no other independent, co-coordinating body that takes an overview and provides the leadership that BBIFMAC provides.

The sub regional Plan for the Burdekin/Bowen Region entitled "A Community Based Natural Resource Management Strategy for the Burdekin - Bowen Floodplain Sub-Region" published in September 2000 and revised in 2005 set out the priorities for Natural Resource Management in the sub-region. Subsequent community consultation was carried out in 2004 for the Burdekin Dry Tropics Natural Resource Management Plan and Investment Strategy published in 2004 and 2005 respectively.

The key priorities for action in Natural resource management in the Burdekin-Bowen region are:

**1. Water management**
i. Groundwater quality, use, recycling and recharge
ii. Irrigation water use efficiency
iii. Surface water management including quality and quantity
iv. Drainage and flooding

**2. Nature Conservation**
i. Fish Habitat
ii. Wetlands management
iii. Environmental weeds management
iv. Remnant Vegetation management and retention
v. Revegetation
vi. BRIA conservation area management planning
vii. Wildlife conservation
viii. Feral animal control

[59] Website of Natural Resources and Water, Queensland Government (2007). Available at http://www.nrw.qld.gov.au/land/management/water_use_plans.html#content

**3. Sustainable land Use and Development**
i. Sustainable development
ii. Primary Production sustainability
iii. On farm resource management

### 5.2.7 Lower Burdekin Initiative

The aim of the Lower Burdekin Initiative (LBI; http://www.clw.csiro.au/lbi/) was to gain a better appreciation of current practices and their likely long-term impacts and, if necessary, to develop and implement new and more effective water management practices at both the scheme and farm levels. The Initiative attempts to highlight current practice and use this to improve understanding of the links between on-farm management practices and response of the groundwater system.

The LBI fostered good collaboration between many of the research/technical projects being carried out in the Lower Burdekin, with a particular focus on the delta. However, the findings did not feed through into changed on-ground practices as expected (hoped for). There was also little input and "buy in" from stakeholders in the BRIA.

### 5.2.8 The Lower Burdekin Water Futures (LBWF) Group

The LBWF has grown out of the LBI with a higher level more strategic focus. It also includes the BRIA Irrigators Committee from the BHWSS, this is a big step forward. It makes it possible to take a whole of system approach. Ideally the delta and BHWSS would be managed as one system, recognising there will be subregional differences and needs.

The LBWF meets monthly and has identified key priority areas for the Lower Burdekin. It is now seeking collaborative arrangements and exploring funding options to address these.

## 5.3 Evaluation of collaboration frameworks

Evaluation of these plans and strategies by the consultant team has indicated that they all provide frameworks and opportunities for collaboration. Initial review indicates that achievement of positive outcomes in the BRIA will contribute to the achievement of the various goals, targets and aims within the plans and strategies.

Stakeholders need to find a way to effectively collaborate to manage the problems within the BRIA. The existing plans and strategies which apply to the BRIA are all frameworks for collaboration. Effective collaboration will attempt to align with the aims, goals and targets of

these plans and strategies and where appropriate use the plans and strategies as frameworks to formalise collaborative arrangements.

## 6.0 Community Engagement

There is currently no mechanism to allow the community to become engaged in decisions on management of the natural resources in the BRIA. These decisions have implications for nearby sites with a high community value.

It is important that the community is engaged in the process of addressing the problems in the BRIA.

Solutions developed between the landholders and the Queensland Government without community consultation are likely to miss key concerns of the wider community.

This could possibly lead to community suspicion and distrust. Given the proximity of the BRIA to sites of high community value (wetlands and reef) it is important to get community support.

A range of views were given at this point of the workshop. These ranged from 'this has been done to death but nothing has been done' to a view that there is a need for leadership to a view that stepping out and doing something lead to being cut down. However the view that it was like a P&C meeting probably took the cake.

Stakeholders must find a way to engage the community in the process of managing the problems of the BRIA.

## 7.0 Risk Management

A robust collaborative approach to the management of risks within the BRIA is not being undertaken by the key stakeholders. This lack of coordination in risk management means that the risks are not being managed.

Stakeholders are undertaking risk management at an individual level. This approach is resulting in a piecemeal approach to managing the problems within the BRIA. This approach at times has a negative impact on the management of the overall risks to the Lower Burdekin.

The problems in the Lower Burdekin will continue to deteriorate if the key stakeholders do not develop a framework to manage risks in a collaborative way at a whole of catchment scale.

Stakeholders must find a way to identify and manage risks in a coordinated way across the BRIA.

## 8.0 Monitoring and evaluation

Some monitoring is currently being undertaken by stakeholders across the BRIA. This information is not being evaluated in a systematic way or made available for all stakeholders to use in decision making. Consequently there is no means of determining the current state of the groundwater and any trends.

NRW currently monitor groundwater levels and quality in bores across the BRIA. This information is collected in a database however, it is evaluated on an ad-hoc basis and is not publically available.

Landholders undertake some monitoring as part of their farm management practices. This information provides value at a farm level but does not provide any wider value as it is not collated and evaluated from a whole of BRIA perspective.

It is anticipated SunWater undertakes monitoring of the volumes of water pumped into the BRIA channel system and the volumes of water removed from the system. This monitoring is not made publically available.

The consultant team are not aware of monitoring or evaluation undertaken by any of the other BRIA stakeholders.

At the workshop views were that monitoring was disjointed, data was not being interrogated and information that was collected was done with no end point in mind.

Stakeholders must find a way to implement robust monitoring and evaluation at the appropriate scale to inform decision making about groundwater management in the BRIA.

## 9.0 Information management

There is currently no co-ordinated information management approach between the stakeholders within either the BRIA or the Lower Burdekin in general.

This lack of coordination means that information and knowledge is not being shared and utilised in decision making. Opinion and ill informed conclusions are currently filling the gap left as a result of knowledge not being shared and available.

Attempts have been made to develop an information management system.

Development of a Lower Burdekin Knowledge Platform (LBKP) was initiated through the Northern Australia Irrigation Futures (NAIF) project which has the lower Burdekin as one of its key case study sites. One component of the NAIF project (http://www.clw.csiro.au/naif/) involved developing a sustainability framework to support debate and decision making regarding irrigation in northern Australia. It is proposed that a component of this framework provides the capability to manage knowledge, tools and processes to support understanding of complex social-ecological systems. The project is currently focusing its work on the Lower Burdekin for the development of the prototype. [60]

Development of the LBKP drew heavily on work carried out through the Lower Burdekin Initiative (LBI), an earlier collaboration involving a broad range of stakeholders with interests in the Lower Burdekin. The LBKP is a simple document control system and electronic representation of a synthesis of the most current understanding of water and other biophysical processes in the Lower Burdekin. Although the LBKP is currently in draft form, it is intended that it be enhanced and made widely available and easily accessible through a

[60] Camkin, J. K., Kellet, B. M., and Bristow, K. L. (2007) *Northern Australia Irrigation Futures: Origin, Evolution and Future Directions for the Development of a Sustainability Framework*, CSIRO Land and Water Science Report No. 73/07, CRC for Irrigation Futures Technical Report No. 11/07 48pp.

web based system. Negotiations are currently underway to deliver the enhanced LBKP through the NAIF project.

This may prove to be a valuable tool for information management if the key stakeholders are able to coordinate an approach to engage with the NAIF project.

Stakeholders must find a way to manage information and ensure it is readily available to inform decisions at all levels.