Department of Natural Resources and Mines

Lower Burdekin Groundwater Strategy Project

Discussion Paper | August 2017

Queensland Government

This publication has been compiled by Water Policy, Department of Natural Resources and Mines.

The Queensland Government is committed to supporting a sustainable and productive agricultural sector in North Queensland, while ensuring strong protection for the environment.

Understanding and delivering a prompt response to rising groundwater in the lower Burdekin is central to achieving these goals.

Understand the issues

understand the issues and implications of rising groundwater for enterprises, the regional economy and the environment

Respond

assess management options to develop a plan for action

Work in partnership

work together to develop and implement the plan

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1. Introduction

Irrigated agriculture has held a central place in the economy of the Lower Burdekin since it began operating in the area in 1950. Agriculture continues to play a major role in the local economy, employing the largest number of people of any other industry.[1] The Lower Burdekin area has an annual turnover for sugarcane production estimated at $160 to 180 million,[2] with the region having the highest sugar cane yield, in terms of tonnes per hectare productivity, of any region in Australia.

The establishment of what is now the Burdekin Haughton Water Supply Scheme (Burdekin Haughton WSS), allowed surface water from the Burdekin River to be pumped to channel systems to supply individual farms. Irrigation supplies have also been sourced from groundwater since the mid-1960s (now managed as the Burdekin Groundwater Management Area (Burdekin GMA)). By the late 1970s the channel systems were fully committed with further development dependent on the construction of new storage facilities to increase supply capacity. With the construction of the Burdekin Falls Dam and establishment of the Burdekin Haughton WSS in 1987, additional water was made available to the area as well as providing additional capacity for future development.

With additional water supplies more readily available, the Lower Burdekin saw a dramatic increase in surface water irrigation in the late 1980s. This led to increased groundwater recharge and rising groundwater tables with some parts of the Lower Burdekin Groundwater Strategy project area (project area) experiencing a rise in groundwater levels of up to 10 m over the last 20 years (see section 2 for a description of the project area). This has resulted in groundwater levels at less than 3m below the ground surface across approximately 15 per cent of the irrigated area within the project area. However, the situation is more acute in some areas where the groundwater table has been measured at only 0.5 m below the surface.

The risks to agricultural production associated with rising groundwater and salinity levels have been recognised in the project area since construction of the Burdekin Falls Dam. High water tables can result in water logging of the soil profile and can also mobilise salts from the underlying bedrock which can increase salinity levels. Both of these factors can reduce the productivity of agricultural land and limit opportunities for future development.

High groundwater levels can also lead to higher rates of property and catchment run-off flowing into downstream receiving environments such as the Ramsar listed wetlands at Bowling Green Bay and the Great Barrier Reef lagoon. Nutrient and sediment loads in this run-off can adversely affect the quality of water entering these environments.

Significant investment and effort has already been directed towards addressing rising groundwater and associated issues in the Burdekin region. These efforts have focussed on supporting the adoption of on-farm best management practices and in particular, more efficient irrigation practices, encouraging greater on-farm use of groundwater over surface water, and projects to identify possible channel system leakage. While these projects are going some way to addressing the groundwater issues in the project area, these approaches have had limited broad scale success in reducing the impact of rising groundwater levels. There are concerns that if groundwater levels continue to rise they will continue to affect current agricultural productivity and constrain opportunities for future agricultural development in the area.

[1] Based on Australian Bureau of Statistic (ABS) 2011 Census.
[2] This value refers to sugar cane produced in the Lower Burdekin groundwater management area only. It does not include sugar cane produced in the Lower Burdekin delta.

It is clear that a new approach is needed to manage rising groundwater levels to support current and future agricultural development and to minimise impacts on the environment, particularly the Great Barrier Reef lagoon.

The Queensland Government is committed to developing a Lower Burdekin Groundwater Strategy to set out an overarching plan to address rising groundwater and associated issues in the project area to ensure the long-term health of the economy and environment. This discussion paper is the first step in the development of the strategy.

This discussion paper sets out four broad areas of management actions for consideration as part of an overall strategy to address rising groundwater and associated issues in the project area. They include:

- change to irrigation practices and supporting programs
- operational actions
- regulatory actions
- incentive measures.

The Queensland Government is seeking your feedback on the potential management actions presented in this discussion paper to inform development of the Lower Burdekin Groundwater Strategy. Your feedback will help find the right mix of management actions that we can each support as part of a shared commitment to take action to address these groundwater issues.

Preliminary consultation

In preparing to release this discussion paper, meetings were held with members of the interim Burdekin Local Management Area board, Burdekin River Irrigation Area Irrigators Limited, and Burdekin Water Futures group.

While these discussions have been introductory and preliminary in nature, they have been important for establishing a common understanding of the issues, project scope and potential management actions as well as the way forward for developing a groundwater strategy.

It is proposed to have ongoing engagement with these key water user groups throughout development of the draft strategy. On release of the draft strategy it is proposed to prepare a consultation report which details how the issues raised through consultation will be addressed in the strategy. Public submission on the draft strategy will also be invited so that broader views and opinions can be considered before the groundwater strategy is finalised.

A summary of each potential management action (irrigation practices and supporting programs, operational actions, regulatory actions or incentive measures) together with the preliminary consultation feedback, is provided at the end of each section of this document.

1.1 Great Barrier Reef outcomes

The Queensland Government has made a number of important commitments towards protecting the Great Barrier Reef, particularly in relation to achieving key water quality targets to reduce nutrient and sediment run-off from priority reef catchments, such as the Burdekin. For example, the Queensland Government has responsibility for a number of actions under the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan), the overarching framework for protecting and managing the Reef until 2050.

Proposed management actions in the Lower Burdekin Groundwater Strategy to improve irrigation practices to reduce groundwater levels will deliver important co-benefits to the Great Barrier Reef lagoon by helping to reduce nutrient and sediment loads leaving the Burdekin catchment.

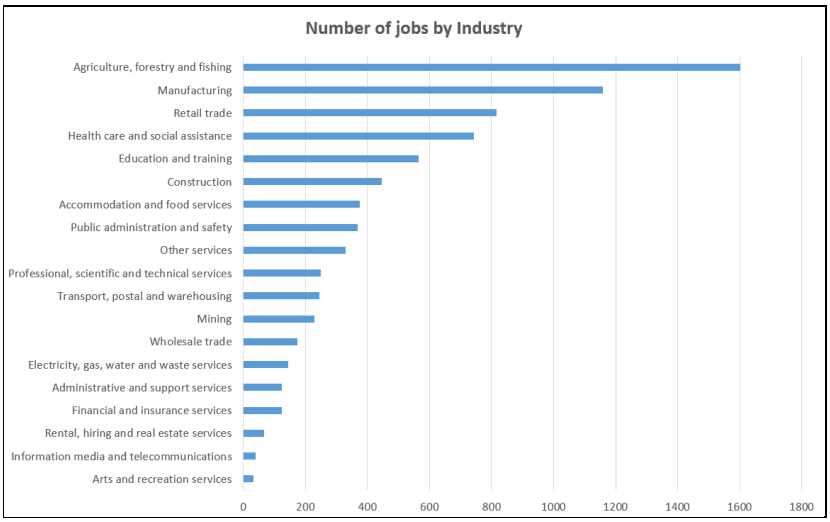
1.2 Out-of-scope

It is important to note that issues surrounding water supplied to Lower Burdekin Water and the establishment of local management arrangements in the Burdekin Haughton WSS are not within the scope of this discussion paper.

2. Lower Burdekin Groundwater Strategy project area

The Burdekin region is Queensland's largest irrigation region and highest sugar cane producer, with approximately 90 000 hectares of cane grown in the coastal Lower Burdekin catchment. Agriculture is the number one employer in the Burdekin local government area, supporting over 1500 jobs (Table 1).[3] The sugar industry accounts for 90 per cent of water demand in the catchment. The region also supports other cropping such as horticulture and vegetable production, along with cattle grazing.

Table 1 – Number of jobs by Industry for the Burdekin local government area



The Burdekin catchment is known as the dry tropics, with high temperatures and highly variable rainfall. There are short periods of heavy rainfall, followed by extended periods of dry weather. The region has been drought-declared since November 2015. Many factors including crop type, weather, agricultural practices and water management arrangements, have contributed in some way to the rising groundwater table.

The Lower Burdekin Groundwater Strategy project area has been defined as that part of the Burdekin Haughton WSS located within the boundary of parts of the Burdekin GMA, as well as the adjacent Leichhardt irrigation area (located on SunWater's Elliot Channel). The project area are those areas that are most likely to be impacted by rising groundwater (Figure 1). The project area does not include the Lower Burdekin delta area.

Within the project area there is approximately 300 000 megalitres (ML) of supplemented surface water allocations and on average, 50 000 ML of groundwater use annually. Under current management arrangements, surface water allocations are supplied from the Burdekin Haughton WSS.

As the scheme operator, SunWater manages the Burdekin Haughton WSS and the associated scheme infrastructure including Burdekin Falls Dam and channel systems. Importantly, parts of the Burdekin Haughton WSS ultimately drain to the Bowling Green Bay Ramsar Wetland area and Great Barrier Reef lagoon.

[3] Figures sourced from Australian Bureau of Statistics' (ABS) 2011 Census.

3. The issue

3.1 What we already know

Groundwater levels change in response to the balance between the rate of recharge (input) into an aquifer and the rate of groundwater discharge (output) from the aquifer. Groundwater levels will tend to rise when the rate of recharge exceeds the rate of discharge. The process of water percolating from the surface through the soil profile to the underlying aquifer is referred to as deep drainage.

Over the last 20 years, increased irrigation in the project area has increased deep drainage into the underlying aquifer, resulting in a rise in groundwater levels. As groundwater levels rise towards the soil surface, water logging and increased salinization of the root zone can occur as the rising groundwater saturates the soil profile and mobilises salts. Over time, this can lead to reductions in, or complete loss of, productivity.

The groundwater level is within 3m of the ground surface under approximately 15 per cent of the irrigated land within the project area. A recent report suggested that maintaining groundwater levels at or below 3m beneath the ground surface is sufficient to ensure that the crop root zone is not impacted by salinity or waterlogging.[4]

Water-logging in the root zone reduces the capacity of the soil to absorb additional recharge during wet conditions, increasing the risk of fertiliser and pesticide losses via surface run-off to downstream receiving environments such as the Great Barrier Reef. Nutrients and pesticides have also been found to move through deep drainage to receiving environments.

Taking action to address rising groundwater levels and associated water quality issues presents an opportunity to secure local jobs, the long-term sustainability of the existing agricultural industry, provide potential opportunities for growth, and deliver co-benefits for environmental outcomes. Technical assessments are being undertaken to inform and underpin the draft Lower Burdekin Groundwater Strategy with robust science.

[4] *Groundwater in the BRIA and recommendation to achieve sustainable groundwater management under a local management authority approach – Report to the Burdekin River Irrigation Area Irrigator's Committee*, April 2014, Roger Shaw

Figure 1 – Lower Burdekin Groundwater Strategy Project area

While increased irrigation is acknowledged as a major factor increasing deep drainage in the project area, other factors have also contributed to the increase in deep drainage such as change in land use, and seepage from water delivery infrastructure.

There are a range of actions that can be taken to address rising groundwater tables. Action can be taken to reduce groundwater recharge, for example by using more efficient irrigation practices to reduce deep drainage. Alternatively, action can be taken to increase groundwater extraction for drawdown, for example by encouraging increased groundwater use over surface water use or actively dewatering the aquifer by pumping groundwater out of the system. While groundwater dewatering will achieve more immediate results, it only addresses the impact of rising groundwater, not the cause. On the other hand, the adoption of more efficient irrigation practices does address the underlying cause of rising groundwater, but the response of the groundwater table will be delayed.

Rates and patterns of both recharge and groundwater rise will vary across a landscape in response to topography, aquifer characteristics, soil type, land use and farming practices. As a result, certain management actions will be better suited and more effective in particular areas. Overall, the best outcome is likely to be achieved by using a mix of different management actions that reflect these different landscape features.

Two recent reports investigating rising groundwater tables and potential management options in the Burdekin GMA recognised that no one solution to groundwater management would adequately address the issue—instead, a suite of management actions, directed at both reducing groundwater inputs and increasing groundwater outputs, would be required to return groundwater tables to depths capable of supporting sustainable agricultural production and future development.[5] For example, broadscale adoption of efficient irrigation practices will help reduce groundwater recharge over the long-term, but will be less effective in areas where groundwater levels are already high and impacting productivity. In these areas more immediate action will be required, such as dewatering.

3.2 What action is already being taken?

Government, industry and the community have been working together for many years to address groundwater issues in the Burdekin region, primarily through catchment management activities. In particular, there has been significant effort over the past 15 years towards improving land management practices through a range of programs to encourage landholders to adopt best management practices.

For example, the Queensland Government has been supporting the Smartcane BMP program since its inception in 2013. The Smartcane BMP program is an industry-led, Government supported best practice system for cane growing across Queensland. The program comprises a series of seven modules covering the key aspects of sugarcane growing, aligned to industry standards based on productivity, profitability and sustainability. The drainage and irrigation management module that contains industry standards relevant to irrigation scheduling and deep drainage management is one of the three core modules in the Smartcane BMP program.

[5] *Burdekin Groundwater Management Area – Rising Water Tables, Part A – An Estimate of the Impacts of Irrigation and Water Distribution Activities on Groundwater Levels and Part B – Management Options 2002-2010*, Department of Natural Resources and Mines 2013.

Groundwater in the BRIA and recommendation to achieve sustainable groundwater management under a Local Management Authority approach – Report to the Burdekin River Irrigation Area Irrigator's Committee, April 2014, Roger Shaw.

The Smartcane BMP program enables growers to benchmark their current practices against the industry standard. If any practice is below the industry standard, the farmer can identify areas that need improving and any training needs to work towards reaching the standard over time. Growers also have the choice to become Smartcane BMP accredited by having their performance against the three core modules independently assessed. To be accredited, growers must be assessed as being 'at' or 'above' industry standards in each of the practices across the three core modules. The Smartcane BMP program currently has 24 accredited growers in the Burdekin Region and is aiming to accredit another 40 growers in the next 24 months—which is around 10% of growers.

There has also been significant investment through the Rural Water Use Efficiency – Irrigation Futures (RWUE-IF) program which has operated across the State since 1999. RWUE-IF is a partnership between the Queensland Government and major rural industries where the government funds industry groups to deliver agreed services to irrigators to achieve water use efficiencies. These services include:

- providing information through workshops, field days, fact sheets and web-based tools on ways to improve water and energy efficiency
- conducting assessments on irrigation and pumping systems to determine their efficiency and to identify where water and energy savings can be made
- offering incentives to irrigators to encourage them to make system and practice changes
- providing advice on managing agricultural wastewater, including the management of nutrients applied through irrigation.

Funding of over $2.8 million was provided to Canegrowers for the period 2014 to 2017 to deliver irrigation programs to their members. In areas such as the Burdekin that are impacted by rising groundwater water tables, RWUE-IF has supported a range of activities to promote sustainable on-farm water use. These activities include financial incentives to implement conjunctive use bores and to make irrigation system improvements; undertaking irrigation system evaluations and the installation of irrigation information management system sensors.

There has also been considerable investment in broader catchment management in the Burdekin region as part of initiatives aimed at improving the water quality of the Great Barrier Reef lagoon. The Australian and Queensland Government's Reef Water Quality Protection Plan (Reef Plan) established in 2003 and revised in 2009 and 2013, provides the foundation for managing water quality in the Great Barrier Reef. The Reef Plan identifies actions, mechanisms and partnerships to build on existing Government policies, and industry and community initiatives to assist in halting and reversing the decline in the quality of water entering the Great Barrier Reef lagoon. Initiatives that help reduce groundwater levels can also contribute to improved water quality entering the Great Barrier Reef lagoon because the lower the groundwater table, the lower the risk of nutrient and sediment run-off from saturated soil profiles or via deep drainage. The Reef Plan is currently under review with a revised version anticipated for release in 2017.

The Reef Plan also provides for the development of Water Quality Improvement Plans (WQIP) to set regional and subregional water quality and management action targets that align with Reef Plan. A WQIP was developed for the Burdekin Basin in 2009, focused largely on reducing the water quality impacts associated with beef and sugarcane production in the region. The updated Burdekin WQIP (2016) promotes increasing the community's capacity to implement best management practices to reduce hillslope, stream and gully erosion, by maintaining, improving and restoring river frontage, and soil and pasture condition. For sugar production lands the WQIP also promotes reducing excess irrigation, nitrogen surplus and herbicide losses.

Since 2009, there have been a number of major funding programs to support water quality improvement in the Burdekin Region. The Australian Government's Reef Rescue initiative (2008-2013) invested over $32 million into grazing/farming communities within the Burdekin Region to assist with practice changes aimed at reducing sediment, nutrients and pesticides leaving farms and entering the Great Barrier Reef.

This investment was continued through the Australian Government's Reef Programme, with an additional $15 million (2013-2016) for a targeted extension and financial incentives program, and the 'GameChanger' project has also supported fast-tracking adoption of game-changing sugarcane nutrient and pesticide management practices over the same period.

More recently, the Australian Government's Reef Trust provides targeted investment focused on improving water quality, restoring coastal ecosystem health and enhancing species protection in the Great Barrier Reef region. Reef Trust is currently investing in a competitive tender approach that targets nitrogen discharge from sugarcane in the Burdekin and Wet Tropics (up to $15 million across 2016-2017 to 2021-22). Under Reef Trust Phase Three Investment Programme, the Australian Government is investing around $25 million to improve farm management practices across cane growing areas in Great Barrier Reef catchments from 2015-16 to 2018-19.

The Queensland Government has supported the Reef Plan Paddock to Reef Monitoring, Modelling and Reporting Program (Paddock to Reef program) which is reported annually (Queensland Government, 2015), and has recently established the Office of the Great Barrier Reef, which delivers the Queensland Reef Water Quality Program, including support for industry BMP programs, extension, research and implementation of the recommendations of the Great Barrier Reef Water Science Taskforce on how best to invest $90 million in new Reef water quality funding to meet the Government's ambitious water quality targets. The $90 million of investment in water quality is on top of Queensland's ongoing commitment of $35 million annually to deliver Reef Plan initiatives. Implementation of the Government's response to the Water Science Taskforce recommendations is now underway and new programs include:

- commencing the Major Integrated Projects (including in the Burdekin) to pilot sediment and nutrient reduction approaches
- establishing an innovation fund to support implementation of new technology such as cost effective water quality monitoring sensors
- holding the first science synthesis workshop for Reef water quality
- refining the water quality targets for each of the 35 Reef river basins
- using a mix of tools including extension and new regulations to achieve improved farm management practices.

The Queensland Government NRM Investment Strategy projects are targeting the improvement of landscape resilience in sugarcane in the Lower Burdekin Delta ($240 000; 2013-2016) and grazing lands ($580 000; 2013-2016), and a Regional Delivery Project is focusing on promoting sustainable soils management across the region ($1.5 million; 2013-2018).

Project Catalyst, a project that involves a group of innovative farmers that are developing and testing management practices that improve the quality of the water leaving sugarcane crops, has been supported by the Coca-Cola Foundation ($2.5 million across the Burdekin, Mackay and Wet Tropics regions, 2010-2015).

This investment has resulted in improved rates of adoption of sustainable land management practices by the agricultural sector. For example, there has been a noticeable increase in registration with BMP programs (especially in the last 12 months). However, the adoption of these sustainable practices has not been considered fast enough or sufficiently widespread to provide a significant contribution towards meeting the water quality targets for the Great Barrier Reef.

The other significant initiative in the project area has been implementation of the 1 in 8 conjunctive use policy. This is a licencing policy that was implemented to allow access to additional supplies of groundwater. The policy involved granting a groundwater licence based on the volume of surface held—for every 8ML of surface water held, 1ML of groundwater could be granted as a water licence. This policy was adopted following construction of the Burdekin Falls Dam and was based on the typical leaching ratio of the soils where it was calculated that for every 8ML of irrigation, 1ML would result in deep drainage to the aquifer.

More recently groundwater harvesting has been introduced as a new product for the Burdekin Groundwater Management Area.

Groundwater harvesting allows additional groundwater to be extracted when groundwater levels are above sets values.

Establishment of these values considers:

- maintenance of an appropriate groundwater gradient toward the coast
- sufficient groundwater levels to minimise risk of salt water intrusion from seawater
- recognition of pre-development groundwater levels
- groundwater targets to protect land and crops from potential waterlogging.

This process allows for a targeted approach to deal with rising groundwater levels that protects base groundwater entitlements.

3.3 Why is more action required now?

Despite significant investment and on-going management actions to address rising groundwater levels in the Lower Burdekin, groundwater levels are still rising. As groundwater levels continue to rise, areas affected by rising groundwater will experience a progressive decline in productivity, while the area affected by rising groundwater will expand, putting larger areas of currently productive land at risk of declining productivity.

The risks of declining agricultural productivity and reduced profitability will increase, leading to implications for individual producers, the community and ultimately the broader regional economy. Without further action, opportunities for future agricultural development and expansion will be constrained.

4. What potential new actions can be taken?

Based on previous studies in the Burdekin GMA, and the latest information from State agencies, a number of potential management actions have been identified that either reduce groundwater recharge or extract groundwater from the aquifer. The potential actions broadly fit within the following four categories:

- irrigation practices and supporting programs
- operational actions
- regulatory actions
- incentive measures.

The potential actions are discussed in detail in the following sections. The actions being proposed have been selected based on their ability to both reduce groundwater recharge and to actively dewater the aquifer.

4.1 Irrigation practices and supporting programs

Groundwater recharge from deep drainage associated with increased irrigation has been a significant factor in the rise of groundwater levels in the Lower Burdekin. In addition, where these irrigation practices and systems are inefficient, the contribution to deep drainage is more pronounced. The Queensland Government is interested in finding ways to drive practice change across the Lower Burdekin to achieve greater irrigation efficiency as a way of reducing deep drainage and groundwater recharge. Four potential actions that could deliver this change are outlined below.

Practice action 1: change to irrigation practices

Furrow irrigation is commonly used in the Lower Burdekin. While furrow irrigation typically has low pumping, labour and infrastructure costs and technical requirements, irrigation efficiency can vary quite significantly under furrow systems with potential for deep drainage losses and surface run-off. This has been the case in the Lower Burdekin where historical furrow irrigation methods characterised by long furrow lengths and long irrigation periods has resulted in more water being applied to crops than is required, leading to excess groundwater recharge via deep drainage. In addition, these irrigation practices have also created a pathway for agri-pollutants (e.g. nitrogen, pesticides) and sediment to move off-farm and impact sensitive downstream receiving environments such as Ramsar listed wetlands at Bowling Green Bay and the Great Barrier Reef lagoon.

By contrast, more efficient irrigation practices ensure that the necessary amount of water is applied to the crop, significantly reducing deep drainage as well as reducing downstream run-off of pollutants and sediment. Examples of efficient on-farm irrigation practices include:

- matching water use to crop requirement
- irrigation scheduling
- runoff management
- reducing furrow length
- automation
- alternate pressurised irrigation systems such as overhead spray
- micro-irrigation systems such as drip and trickle irrigation.

Some irrigators will have already switched to more efficient irrigation practices in response to recent drought conditions or to improve productivity, profitability or to demonstrate their environmental stewardship to markets and the community. While these irrigators will be reducing recharge on their farms from the adoption of these practices, broadscale adoption of more efficient irrigation practices is needed to reduce deep drainage and aquifer recharge over the long term and across the Lower Burdekin area.

Practice action 2: additional on-farm conjunctive use

Where available on-farm, it is common practice for irrigators to use both groundwater and surface water for their irrigation needs. This can involve using groundwater and surface water inter-changeably depending on availability, or mixing water from both sources to improve water quality.

In the Lower Burdekin it is common for saline groundwater to be mixed with better quality surface water to reduce salinity levels to make it suitable for crop use. Naturally this approach will not be possible everywhere as it will depend on groundwater salinity levels, groundwater access and yield, soil type, existing soil salinity levels, crop salt tolerances and the practicality and cost of blending water on-farm. However, the approach offers potential benefits to managing rising groundwater levels as it enables additional groundwater use even where they may be some minor water quality limitations.

Potential exists for this approach to be used more often where practical, especially as on average around 50 000 ML of groundwater is currently already being used for irrigation annually in the Burdekin GMA. Indeed, the success of previous programs to support the setup of conjunctive bores indicates there is additional scope and interest in increasing the number of on-farm conjunctive use irrigation systems.

Practice action 3: review of Best Management Practices (BMP)

While significant investment has been made in the Smartcane BMP program, rates of adoption and in particularly rates of Smartcane BMP accreditation remain low. At this current rate, it is estimated that it would take around seven to eight years to achieve 100 per cent accreditation across the project area.

A number of barriers to BMP uptake have been identified, these include:

- complexities of the irrigation and drainage module
- doubts about the potential economic benefits or scientific evidence supporting the program
- costs in terms of time and money to participate in the program.

Given these issues, the Queensland Government, in partnership with industry stakeholders, proposes to review the Smartcane BMP program to investigate the appropriateness of the current practices to achieve groundwater and environmental objectives, and in particular the appropriateness of the drainage and irrigation management module. The review will also investigate the development of area specific and groundwater focused objectives and look at solutions to overcome current barriers to uptake.

Practice action 4: recommitment and investigation into irrigation incentives

Incentive and support programs have long been used to drive management practice change, providing financial assistance and extension support to help landholders make the necessary changes. For many landholders, significant practice change would not be possible without this sort of support.

There are currently two major incentive programs supporting change in irrigation practices in Queensland, the RWUE-IF program and the Reef Trust.

As noted in section 3.2, the RWUE-IF program is a partnership between the Queensland Government and major rural industries where government provides financial support to industry groups to deliver services to irrigators to improve their water use efficiency.

Because the Burdekin catchment is one of the largest catchments feeding into the Great Barrier Reef lagoon, the Reef Trust is another key provider supporting practice change in the project area.

The Reef Trust is an Australian Government program established to provide innovative, targeted investment to the Great Barrier Reef region, focused on improving water quality, restoring ecosystem health and enhancing species protection. The Reef Trust is delivered in collaboration with the Queensland Government and is a key mechanism for delivery of the Reef 2050 Plan—the overarching framework for protecting and managing the Reef until 2050. A number of cane farmers in the Burdekin have received a share of $2.8M under Reef Trust Phase 2 to reduce nitrogen run-off to the Great Barrier Reef lagoon.

Government and industry invest in incentive and support programs as they provide an opportunity to target activity and intervention in areas of particular concern. These sorts of programs and initiatives can help drive widespread adoption of more efficient and sustainable practices than might otherwise occur without any incentive or assistance to change. It is therefore proposed to recommit to existing incentive and support programs and to investigate further opportunities to use incentives as a way of driving the adoption of more efficient irrigation practices across the Lower Burdekin.

Irrigation Practices and supporting incentives – preliminary feedback

Feedback indicates support for irrigation practice change. Suggestions on how to improve irrigation practices include: assisting growers with incentives and support, in the form of an extension officer, accurate metering and assistance to complete the BMP module.

Respondents agree that there needs to be a minimum standard for efficient irrigation, however any changes would need to be implemented over an appropriate time period (3–5 years) and be supported by incentive measures.

There was also support for conjunctive use bores in areas where groundwater could be mixed with surface water with the resulting water quality being suitable for irrigation purposes. Increasing groundwater use could be encouraged through further targeted incentives to support bore construction and running costs.

4.2 Operational actions

There are a range of operational actions that, if implemented, could effectively and quickly reduce the groundwater levels. This could be important in high risk areas where productivity is already being affected by groundwater levels and where immediate action is required.

Operational actions may also be more appropriate in areas where:

- the broad scale adoption of efficient irrigation practices alone will not reverse the trend of rising groundwater levels; and
- poor groundwater yield and quality limits the effectiveness of on-farm conjunctive use irrigation systems.

There are a wide range of operational actions that have been proposed to deal with rising groundwater.

Some solutions due to their cost, return on investment or broader environmental implications may not be practical or feasible in the context of the Lower Burdekin project area. Based on initial assessments, the effectiveness of the following operational actions are believed to be limited:

- Area-based dewatering systems—involves pumping saline groundwater into a local water storage from which irrigators in a local co-op can then access the water for conjunctive use. This is expensive and may be difficult to manage.
- Dewatering and disposal to wetlands—involves pumping saline groundwater into constructed (artificial) wetlands. While these wetlands are effective in dealing with sediment and nutrients, they are less able to treat salinity. This harms the wetland and can lead to saline discharge.
- Dewatering and treatment—involves treatment at a desalinisation plant which is cost prohibitive.
- Sub-surface drainage—involves construction of sub-surface drains to redirect subsurface flow. Understood to be cost prohibitive in an established irrigation area.

A range of channel seepage mitigation works have also been investigated by SunWater as possible solutions to minimising groundwater recharge. Through these investigations, lining channels with high-density polyethylene (HDPE) was estimated at around $500 000 per kilometre. Alternatively, replacing channels with HDPE piping was estimated to cost $750 000 per kilometre.[6]

Concrete and clay lining options were also investigated. These options have high cost and operational impacts, as extended channel closures would be required during construction.

The following potential operational actions are believed to be the most effective in addressing rising groundwater. Feasibility studies will be critical in demonstrating the cost and relative benefit of any potential operational action investigated further.

[6] *Burdekin Haughton Water Supply Scheme – Rising Groundwater Mitigation Project – Position Paper*, SunWater (2013).

Operational action 1: scheme operated dewatering bores

This action involves the installation of scheme operated bores to extract groundwater from the aquifer which is then fed into surface water channels to dilute the saline groundwater to levels suitable for irrigation. The benefit of this action is that it can be targeted to areas of concern, such as areas where groundwater yield and quality are poor, or that are otherwise unsuitable for on-farm conjunctive use.

The success of this approach will depend on maintaining the supplemented water at a quality suitable for irrigation. Consideration of this option may therefore need to include provisions for monitoring water quality and licencing to manage access and take.

Operational action 2: upgrades to scheme infrastructure

SunWater have identified a number of scheme infrastructure upgrades that may improve functionality and efficiency of their water distribution system. For example:

- Replacement of channel regulating gates—this involves replacing regulating gates so their operation is better coordinated with irrigation demands. This minimises overflow into the drainage system, thereby reducing potential additional groundwater recharge.
- Balancing/off stream storages—balancing or off stream storages provide storage for overflow, rainfall and associated run off to minimise overflow into the drainage system. These storages also allow the scheme operator to reuse stored water in times of peak demand.
- Connecting outfall of the Clare main channel to the Barratta main channel—out flows from Clare Main Channel currently end in a drainage pit where there is an estimated contribution of 1000 ML/yr of excess recharge to the aquifer. Layout of the channel systems is such that it would be possible to connect the Clare Main Channel to the Barratta Main Channel to prevent these outflows from Clare Main Channel.

Operational action 3: aquifer dewatering and disposal in evaporation ponds or waterways

An evaporation pond is a natural salt lake or engineered earth structure designed to store and evaporate saline water. Evaporation ponds are one of the few options available to remove salts from saline groundwater. However, the effectiveness of this approach relies on matching pond design to factors such as daily inflow, salinity levels and water depth to ensure the pond has adequate capacity. Consideration of this option relies on construction costs, available land and the ability to manage the remaining salts.

Dewatering and disposing the groundwater to waterways is one action that can quickly lower groundwater levels and be targeted to areas of concern, such as areas where groundwater yield is poor or quality is unsuitable for blending with irrigation water. However, there are concerns how the quality of the groundwater, which may contain agri-pollutants, will affect receiving environments such as the Great Barrier Reef Lagoon and Ramsar listed sites. Consideration of this action relies on establishing appropriate safeguards and supporting monitoring programs to manage risk to the environment.

Operational actions – preliminary feedback

Feedback indicates support for operational actions including: strategic channel lining, dewatering to waterways and on-farm conjunctive use.

It was supported that strategic channel lining should be focused on areas that have been identified as leaking at more than the appropriate design rate for earthen channels, and it is demonstrated to be contributing to an increase in groundwater levels.

Discharging groundwater to waterways under appropriate flow conditions is supported, providing that water quality meets acceptable standards. Adhering to BMP standards for pesticides and nutrients will be important for ensuring the water quality is suitable for disposal, however, the uptake of BMP standards would need to be improved to provide the appropriate environmental safeguards. An ongoing monitoring program for pesticides and nutrients is required.

Conjunctive use bores are already established in the project area and, along with dewatering bores, are supported as an effective operational action. However, irrigators who install and maintain conjunctive use or dewatering bores will need funding support.

There is concern that pumping saline water into the irrigation channels will cause further channel leakage and will impact the on farm conjunctive use mixing ratios.

4.3 Regulatory actions

Regulatory intervention is a mechanism used to ensure that those parties who do not adopt best practice water management and farm practices voluntarily, are brought to a minimum standard benchmark. Well implemented regulation helps to ensure fairness amongst water users.

There are two existing regulatory options under the *Water Act 2000* (Water Act) that the government is willing to investigate to manage the rising groundwater issues in the Lower Burdekin—the current water planning framework or provisions for the development of water use plans.

Regulatory action 1: review the Burdekin water plan and operations manual

The allocation and sustainable management of water in the Burdekin region is currently managed under the Water Plan (Burdekin Basin) 2007 (water plan) and operations manual for the Burdekin Haughton WSS. The water plan sets out the outcomes, objectives and strategies that will be used to achieve a sustainable balance between water users in the Burdekin catchment (industry, irrigators, town water supply and the environment). The Burdekin Haughton WSS operations manual sets out the day-to-day rules and management arrangements for water users and infrastructure operators to ensure the objectives and strategies of the water plan are met.

The Burdekin water plan expires in September 2019 and is due for review and replacement. This provides an opportunity to review plan outcomes and strategies to ensure the new plan contains strategies that will help reduce groundwater recharge, rising groundwater tables and salinity in the Lower Burdekin. There are a number of ways this could be achieved:

- placing restrictions on surface water use to prioritise groundwater use when groundwater tables reach critical levels
- reviewing the licencing framework to develop other mechanisms to encourage the use of groundwater instead of surface water
- changes to the licencing process to support supply of supplemented (blended) groundwater from dewatering bores (this would include rules to maintain water quality)
- developing environmental management rules to manage groundwater issues
- improving the security of groundwater entitlements to provide the opportunity for trading.

Any review of the Burdekin water plan would be based on technical and scientific assessment as well as extensive community consultation.

Regulatory action 2: a new approach—water use plans

The Water Act provides for the preparation of water use plans (WUPs) to manage water use where there is land and water degradation.[7] While WUPs have not previously been utilised, they may be prepared for any part of Queensland where there are risks that water use in a particular area may have negative impacts on land and water resources including, but not limited to:

- rising underground water levels
- increasing salinisation
- deteriorating water quality
- waterlogging of soils
- destabilisation of bed and banks of watercourses
- damage to riverine environment
- increasing soil erosion.

The WUP must set standards for water use practices, state objectives for water use efficiency, water reuse and water quality, and state the monitoring requirements and responsibilities. The Water Act does not prescribe the nature of the standards and objectives included in a WUP, providing considerable flexibility in how a WUP is used to address different irrigation issues in different parts of the State and at different landscape scales.

A WUP could be implemented in the Lower Burdekin project area as the rising groundwater issues meet the legislative trigger for preparing a WUP (increasing salinisation; deteriorating water quality; waterlogging of soils; damage to riverine environment and increasing soil erosion). A variety of regulatory approaches have previously been introduced into the Burdekin GMA, but without a lot of success. The flexibility of a WUP and its ability to address issues at a landscape scale may offer greater opportunities to more successfully deal with rising groundwater issues across the Lower Burdekin.

[7] Section 60 *Water Act 2000* (Qld)

Water use plans are able to link with other existing or future programs targeted at similar outcomes, for example, the Reef 2050 Plan water quality targets, as well as accreditation under industry-led BMP programs, such as Smartcane BMP. They can also draw on existing internal and external monitoring and modelling programs (e.g. Paddock to Reef) to support the setting and reviewing of objectives and the evaluation of plan performance. In this way, the water use plan becomes an adaptive management tool.

Water use plans are developed in a similar way to water plans in that the Water Act prescribes a staged approach for its development, including extensive community consultation.

Regulatory actions – preliminary feedback

Feedback indicates that regulation will not fix the groundwater problems in the short-term. Any regulatory action will serve as complimentary to the chief solutions of; irrigation practice change and operational actions supported by strategic funding and incentive measures. Regulation is recognised as having a role in implementing BMP and authorising actions, such as BMP adoption and dewatering.

4.4 Incentive measures

The Treasurer and Minister for Energy and Water Supply set prices for water users supplied by the Burdekin Haughton WSS based on recommendations from the Queensland Competition Authority. The current prices are set to recover SunWater's minimum costs of supply.

In the project area, surface water is generally used in preference to using groundwater. One way of addressing rising groundwater in the area is to find a way to encourage greater use of groundwater over surface water. Pricing has been identified as a potential driver to encourage this change in water use. It is recognised however, that price alone is not the only reason why surface water is currently preferred to groundwater, particularly where the operating cost of surface water use is already higher than for groundwater use, as is likely within the channel schemes.

Incentive measure 1—reviewing the pricing mechanism

Economic principles suggest that if prices are set too low for a resource such as the supply of surface water, there is little incentive for use of that resource to be reduced, even if it is recognised that use of that resource is causing environmental damage.

In the Burdekin Haughton WSS, the water prices may not reflect the costs associated with the impact of surface water use on rising groundwater tables. Lower prices provide less incentive for irrigators to use surface water more efficiently or find alternative water supply sources, such as groundwater.

Incorporating environmental externality costs into water prices would be consistent with the objectives of the National Water Initiative pricing principles for water planning and management in terms of allocating costs of water planning and management activities between government and water users.

Pricing actions have the potential to achieve the following objectives:

- to act as a demand management tool by influencing users to use less surface water (by encouraging users to adopt efficient watering practices or adopt innovative farming practices)
- to influence users to switch to, or increase uptake of, groundwater (substitute product), where available and accessible.

While there is no price associated with the use of groundwater, it is reported that infrastructure and pumping cost alongside water quality and yield are significant barriers to the additional uptake of groundwater. Any consideration of pricing would therefore also need to consider these existing barriers.

It is also noted that the current pricing structure allocates costs on the basis of fixed and variable (volumetric) costs. Currently this is apportioned approximately 90 per cent to fixed costs and approximately 10 per cent to variable costs for bulk supply, providing little incentive to drive behavioural change in water usage. A solution could be to re-balance the fixed–variable price ratio with a smaller fixed charge and larger variable charge. This may encourage greater use of groundwater or more efficient use of surface water.

Pricing could also be structured with an inclining block tariff structure. This could be undertaken with effective on-site metering such that the current pricing structure and levels are maintained up to a point that is considered efficient practice. This ‘efficient threshold’ would be determined based on common understandings and research into an efficient amount of water (a nominal megalitre amount) per hectare of irrigated crop. Water take beyond this ‘efficient threshold’ would then incur an environmental levy and be charged at a greater rate than water below the ‘efficient threshold’. This mechanism would also encourage behavioural change for inefficient water use, again providing an incentive for greater use of groundwater or more efficient use of surface water.

Incentive measure 2—market based instruments

Market based instruments (MBIs) are economic policy tools that seek to influence resource management practices through market (price) signals rather than through direct regulation. MBIs are increasingly being used to deliver natural resource management outcomes as they can often deliver the same outcomes as direct regulation but at lower costs by giving landholders the choice and flexibility to decide whether to change their practices or incur higher costs.

MBIs are typically used to deliver environmental outcomes in relation to biodiversity and ecosystem conservation, catchment protection, groundwater recharge and land salinization, greenhouse gas emissions and soil conservation. This is because the costs and benefits associated with these outcomes, regarded as public good outcomes, are not fully captured by market transactions—there is no market incentive to work towards delivering these outcomes.

There are a number of different MBI mechanisms that can be used, in isolation or in combination, to influence behaviour:

- cap and trade schemes to reduce pollution (this could include salt water as a pollutant)
- price signals to discourage undesirable activities
- improving the way current markets work
- creating new markets for environmental services (for example through auctions and tenders).

The rising groundwater issues in the Lower Burdekin project area fall into the category of natural resource management issues that may benefit from consideration of MBIs as a way of driving practice change.

Incentive measures – preliminary feedback

Feedback indicates that incentive measures and an increase to the cost of water is not generally supported. Any change to the cost of water will need to be carefully considered in light of the compromise it will mean to implementation of other management actions and impact on irrigators. Effective metering would serve as a better way to manage water use.

5. Co-ordinated and targeted response

The Lower Burdekin is one of North Queensland's largest and most productive irrigation areas with annual turnover for sugarcane production estimated at $160 to $180 million. Agriculture is also the largest employer by industry, supporting over 1500 jobs in Burdekin local government area.

There is significant interest in expanding the agricultural sector in the Burdekin region. However, rising groundwater and associated issues in the Lower Burdekin have the potential to threaten the productivity and profitability of the region if not dealt with in the near future.

Government and industry have been working in partnership for many years to address land management issues in the Burdekin region to reduce the impacts of agricultural production on the natural resource base and to reduce impacts on the Great Barrier Reef. This investment in improved management practices has initiated a sustained change in land management practices across the region.

The Lower Burdekin Groundwater Strategy will build on this existing effort and investment to develop a co-ordinated and targeted response to address rising groundwater issues in the Lower Burdekin area. Taking steps to address the rising groundwater issue in the Lower Burdekin is part of the Queensland Government's broader agenda to support the economic potential of North Queensland and the development opportunities the region presents. It is also important for the strategy to align with and leverage support from those programs already addressing the impacts of land management practices on the Great Barrier Reef.

Government recognises that no single solution in isolation will return the groundwater table to levels that would support a sustainable and productive agricultural sector. The management actions presented in this discussion paper represent a range of strategies that have the potential to address rising groundwater issues in both the short and long term. In particular, the options presented recognise the variability of groundwater issues across the Lower Burdekin and seek to find fit-for-purpose solutions across the landscape.

For example, in some areas the groundwater table is less than a metre below the ground surface. In these high risk areas, immediate, direct action is needed to reduce groundwater levels to reduce waterlogging and salinity in the root zone. Operational actions such as dewatering bores may be the most appropriate and effective management action in these areas. By contrast, in areas less affected by rising groundwater, measures to increase the adoption of best management practices and more efficient irrigation practices may be more appropriate.

Government wants to consider all possible management options to find the best mix of actions to effectively and efficiently address rising groundwater levels in the Lower Burdekin.

As resource manager and regulator, government has a responsibility to sustainably manage the State's natural resources. Industry and stakeholders also have a role as land managers to use resources sustainably and efficiently. Consequently, industry and stakeholder feedback on potential management actions is important to ensure a shared approach and commitment to addressing groundwater issues in the Lower Burdekin.

6. Strategy development process and next steps

The Lower Burdekin Groundwater Strategy is being developed in stages to provide opportunities throughout its development for stakeholder feedback and further refinement. Final release of the strategy is anticipated in December 2018. The process for developing the Lower Burdekin Groundwater Strategy is outlined in Figure 2.

Development of the strategy will draw upon further work including a socio-economic analysis and hydrogeological assessments to understand the short and long term implications of the potential management actions and their effectiveness in maintaining groundwater levels that support a sustainable agricultural industry in the Lower Burdekin and minimise impacts on the environment.

The strategy will also be informed by the outcomes of meetings, targeted consultation and other consultation that will occur throughout 2017 and 2018..

Future opportunities to provide feedback will be provided when a draft Lower Burdekin Groundwater Strategy is released in the first half of 2018.

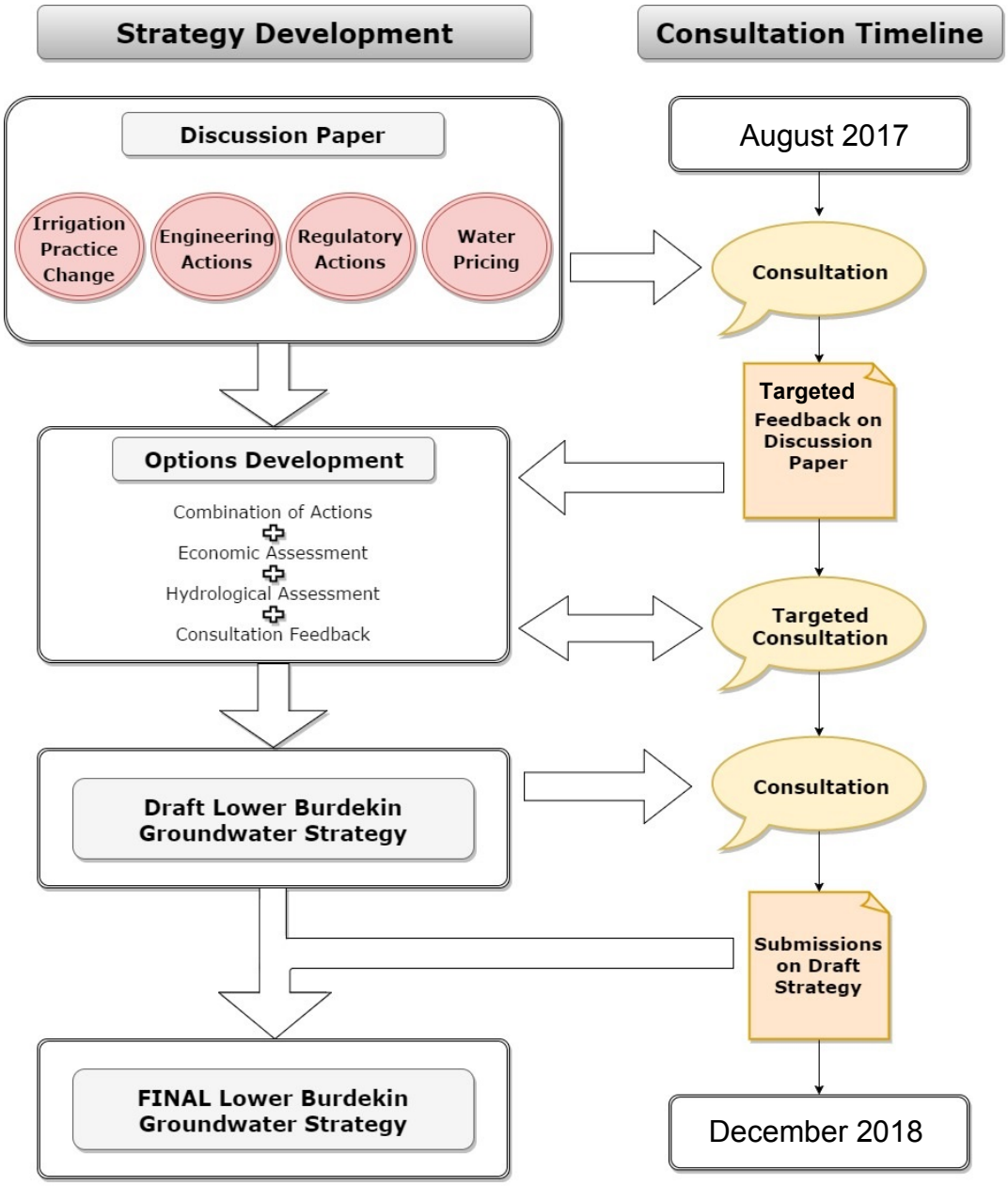


Figure 2 – Process to develop the Lower Burdekin Groundwater Strategy