

Reef Trust Partnership

Lower Burdekin Regional Plan

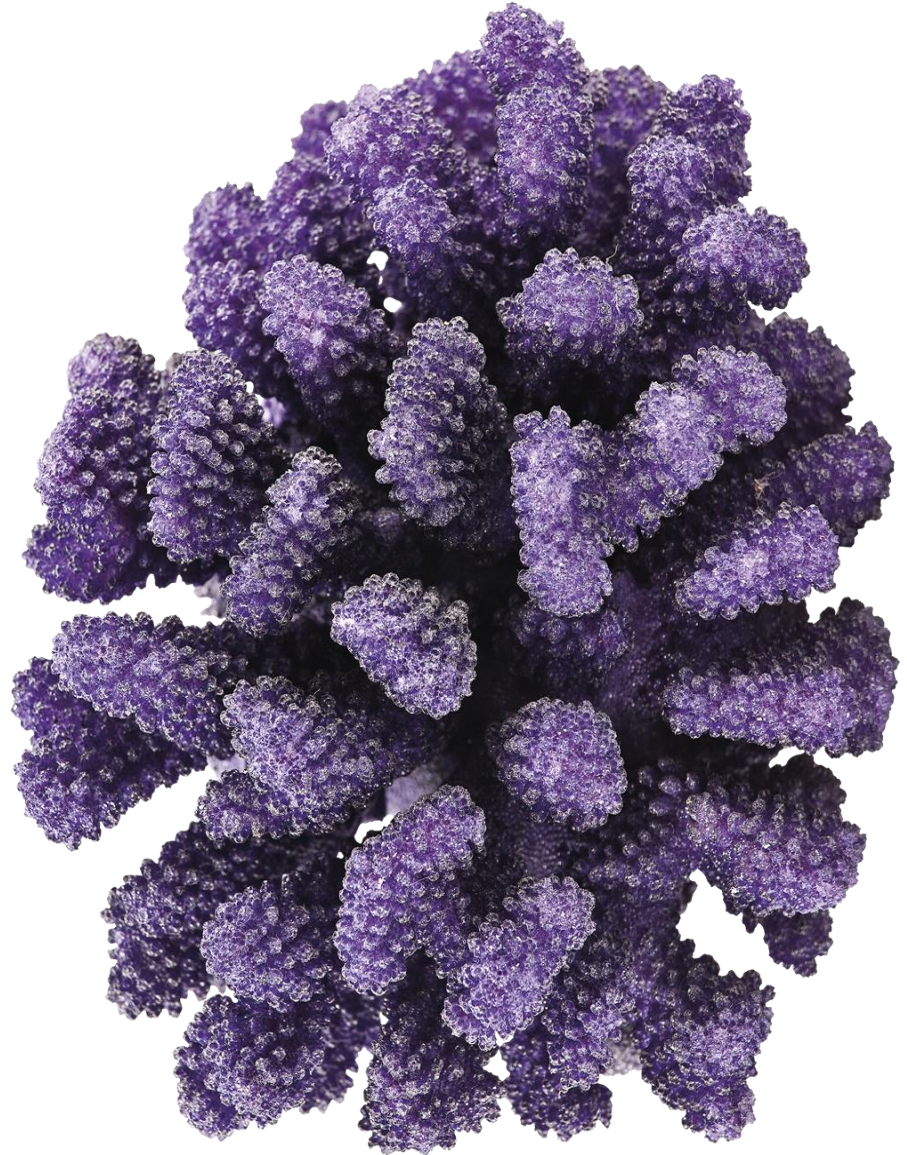


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1. Overview

As part of the Reef Trust Partnership (the Partnership), the Great Barrier Reef Foundation (GBRF), in collaboration with a number of partners, is implementing a series of regional programs aimed at improving the quality of water entering the Great Barrier Reef lagoon from neighbouring catchments.

The Lower Burdekin Water Quality Program aims to improve the quality of water flowing from the Haughton and Lower Burdekin catchment. A total of \$20.4 million has been allocated to the program under the Partnership.

This regional plan describes the framework and activities underpinning the composition and subsequent implementation of the program. The plan sets out:

- the objectives and scope of the program
- the governance arrangements
- an overview of the key actions proposed under the program
- the proposed approach to communications and engagement, including opportunities for stakeholders to be involved in the program.

2. Background

The Partnership, which was established by the Australian Government and the Great Barrier Reef Foundation (The Foundation), is centred on a landmark investment of \$443.3 million to build the resilience of the Great Barrier Reef (the Reef). Commencing in July 2018 and running for six years, the Partnership includes an investment of \$201 million to address water quality improvement targets impacting the Great Barrier Reef World Heritage Area.

The approach to investing the \$201 million for water quality improvement is identified in the Annual Work Plan for 2019-20. The plan allocates:

- \$141 million for regionally focussed on-ground actions
- \$20 million for Traditional Owner-led water quality improvements
- \$10 million for innovation and system change
- \$10 million for protection and conservation measures aimed at maintaining water quality, particularly in less disturbed catchments.

In addition, \$19.7 million has already been contracted under the Reef Water Quality Improvement Grant Program Stage 1.

The \$141 million allocated to regionally focussed on-ground actions will be delivered through a series of regional programs, such as the Lower Burdekin program, targeting catchments identified by the Foundation as a priority for water quality improvement. Regional priorities for investment have been guided by, amongst other factors, the priorities set out in the Reef 2050 Water Quality Improvement Plan 2017-2022 and informed by a consultancy undertaken by Alluvium Consulting (available [here](#)).

Further detail on the various plans related to the Partnership, including the Partnership Investment Strategy, Annual Work Plans, and the Monitoring and Evaluation Plan, are available [here](#).

Alluvium (2019) used a range of water quality and economic tools to determine the most cost-effective catchment management actions to achieve the Reef Trust Partnership water quality targets across the GBR catchment. A range of potential investment pathways were evaluated and further stakeholder input gathered on the anticipated benefits and existing regional delivery capacity to determine the preferred investment pathway for cost-effective delivery of water quality outcomes for high and very high priority basins including the Haughton and Lower Burdekin. As a result of this process, a total of \$20.4 million was allocated to deliver targeted Dissolved Inorganic Nitrogen (DIN) and pesticide reductions in the Lower Burdekin.

In December 2019, the GBRF initiated an open [Expression of Interest](#) and [Request for Proposals](#) to engage service delivery partners to develop and implement on-ground water quality projects in the Lower Burdekin. At the same time, GBRF called for proposals for professional services and engaged NQ Dry Tropics to perform the roles of Regional Program Manager and Regional Partnership Coordinator to assist with the design and implementation of the Lower Burdekin Water Quality Program.

The timeline for engagement of delivery partners and Program Manager and Regional Partnership Coordinator is outlined in the table below. Details of the selection process are provided in the Appendix (Section 24.1)

GBRF Call for Expressions of Interest	16 December 2019
Engagement of Program Manager and Regional Partnership Coordinator (NQ Dry Tropics)	April 2020
Delivery Partner Applicants advised of successful EOs	30 April 2020
Request for Information for shortlisted providers	25 August 2020
Request for detailed proposals from selected delivery providers	2 October 2020
Contracting of selected delivery providers	December 2020

3. Overview of Regional Water Quality Priorities

3.1 Water Quality Drivers

A number of previous investigations, including water quality monitoring and modelling exercises, have helped develop an understanding of the factors driving water quality in the Lower Burdekin catchment. Factors influencing regional water quality are generally well defined with DIN and pesticide losses identified as the priority pollutants with losses primarily driven by application rates and irrigation practices. Modelling of DIN loss pathways (Burdekin Water Quality Improvement Plan 2016) indicated that to achieve Reef 2050 water quality regional targets, significant improvements in application rates and irrigation practices were required. Widespread adoption of 'B' class practices in irrigation and nutrient management practices are required to achieve the 80 per cent reduction in DIN losses.

The predominance of irrigation and reduced reliance on rainfall in the Burdekin creates a relatively 'controlled' agronomic environment compared to other cane growing regions in Australia. This provides a unique opportunity to implement practices which significantly reduce the risk of losses to surface and groundwater systems. As a consequence, projects implementing practice change to better match application rates to crop requirements are critical, but the full benefits can only be achieved when

complemented by matching irrigation timing and quantities to crop and soil requirements to minimise deep drainage and runoff losses. There has been significant public investment to date targeted at providing necessary technical advice, extension and incentives to assist cane farmers to improve water use efficiency. Despite this, adoption rates have been below Reef 2050 Plan targets due to a combination of factors including: outdated irrigation infrastructure; high cost of capital upgrades and low levels of awareness and data of on-farm water and energy use. Combined, these result in cane farmers being unable to identify and prioritise cost-effective actions to enhance irrigation application efficiency. Sugar Research Australia has worked closely with the Burdekin Cane Extension Group (BCEG) to develop the Lower Burdekin Irrigation Extension Action Plan which proposes a collaborative approach to irrigation extension through a framework of prioritised extension activities that are industry focused, improve irrigation efficiency and sugarcane productivity, and reduce off-farm water quality risks.

3.2 Rising Groundwater

The design of the Burdekin Haughton Irrigation Supply System distribution network and the historical prevalence of low-application efficiency in irrigation practices has contributed to rising groundwater tables across significant areas of the Lower Burdekin. The irrigation distribution system uses open channels and balancing storages and makes use of historical water courses to deliver water and receive tailwater across its network. The combined effect has increased levels of seepage entering the local groundwater system and increased soil salinity. Recent assessments indicate current groundwater levels are now within 1.5 metres across approximately 5000ha of the Burdekin Haughton WSS and within 0.5 m across 2800ha, directly threatening crop viability through waterlogging, salinisation of the root zone, and increased risk of fertiliser and pesticide losses via runoff and drainage pathways.

Modelling performed for the Queensland Department of Regional Development, Manufacturing and Water (RDMW) has estimated that by 2030, approximately 3,900 ha of currently farmed land will be rendered unsuitable for sugarcane cropping due to rising groundwater levels. This may reduce total cane yield in the Burdekin by up to 265,000 tonnes per annum. RDMW is working in collaboration with irrigation scheme owner-operator, Sunwater and other stakeholders to prepare a coordinated response to rising groundwater. An earlier [Discussion Paper](#) identified the need to assess the efficacy and viability of various interventions including strategic dewatering and conjunctive re-use measures. The Discussion Paper and subsequent economic analysis acknowledges that while dewatering will achieve more immediate results, it does not address the underlying causes of rising groundwater. The recommended long-term solutions involve a mixture of approaches including irrigation practice and associated support programs, operational actions, regulatory actions and incentives measures.

3.3 Decline in wetland extent and condition

The lower Burdekin River floodplain hosts one of the greatest concentrations of wetlands on the east coast of Australia. It has been intensively modified by agriculture and includes high levels of disturbance of wetland extent, riparian and wetland vegetation. Drainage and irrigation water distribution practices have resulted in high levels of hydrological modification of wetland systems. Historically wetlands were subject to low turbidity seasonal flows and ephemeral wetlands that seasonally dried down. Regulated distribution of irrigation water now occurs via major watercourses resulting in perennial turbid flows which promote extensive chronic weed infestations including submerged, emergent and floating aquatic weeds and grasses.

Water quality in floodplain wetlands has also been significantly impacted due to the receipt of nutrient laden irrigation tailwater. Irrigation and floodplain infrastructure also impacts on wetland connectivity, fish passage and habitat values.

Despite this intensive modification, the Lower Burdekin retains significant areas of remnant floodplain vegetation, hosts many nationally important directory-listed wetlands and has numerous High Ecological

Value (HEV) assets in receiving coastal and near shore environments including a Ramsar Wetland, several declared fish habitat areas and GBRWHA assets including seagrass beds and EPB-listed species (Econcern 2018).

4. Current extension and technical support services

An extensive network of extension and technical support personnel operates within the Lower Burdekin region. The Lower Burdekin Irrigation Extension Action Plan (SRA 2020) outlines summarises the existing technical capacity as:

Irrigation Specialists: involving people whose professional practices involve the design, construction or management of agricultural irrigation systems, including, but not limited to AgriTech Solutions, Daley's Water Service and Irrigation Efficiency Solutions (IES Ayr).

Industry Extension: involving people whose professional practices involve working with farmers to improve their business and farming systems including, but not limited to Burdekin Productivity Services (BPS), Department of Agriculture and Fisheries (DAF), Farmacist and Sugar Research Australia (SRA).

Industry Extension (Environmental): involving people whose professional practices involve working with farmers to improve the sustainability of farming systems, including Burdekin Bowen Integrated Floodplain Management Advisory Committee (BBIFMAC) and NQ Dry Tropics.

The Queensland Department of Agriculture and Fisheries Enhanced Extension Coordination Project undertook a detailed [Reef Extension Training Needs Analysis](#) in 2018 to guide future training and development activities to build the capacity of extension service providers in the GBR catchments. There was a very high response rate from Burdekin service providers and extension staff which indicates a strong interest in extension skills and training. The resulting report identified a number of priorities for training and skills development for extension practitioners including: extension and facilitation skills, technical knowledge, undertaking meaningful producer engagement and measuring change. The Lower Burdekin Water Quality Program can contribute to addressing some of these priorities where a clear link to water quality outcomes can be identified. Further planning proposed under the enhanced extension coordination project will prioritise initiatives that address these issues and identify opportunities to add value to training and capacity building activities that contribute to on ground practice change.

5. The Lower Burdekin program key documents

This regional plan establishes the strategies and activities that will be implemented by the Lower Burdekin Water Quality Program. This document, along with a supporting communications plan and a monitoring and evaluation plan, provide the framework for the management and integration of projects, tracking progress, evaluating the program, and for communicating and engaging with key stakeholders.

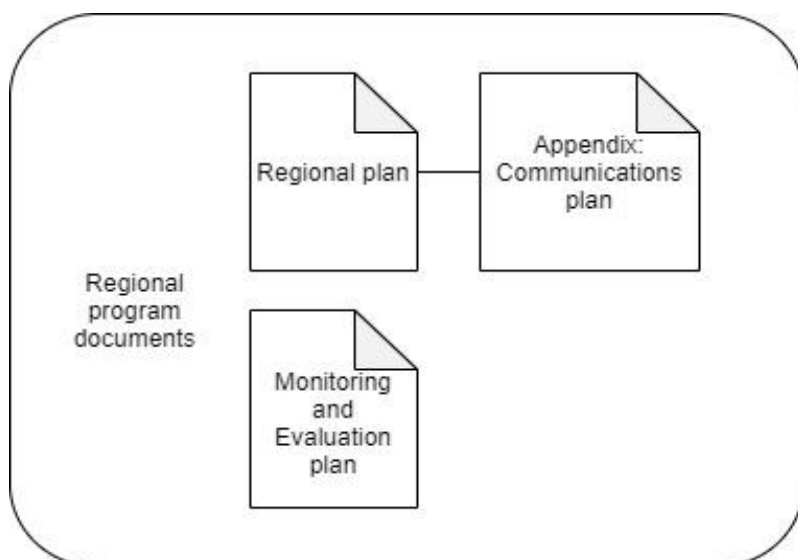


Figure 1. The founding documents of the Lower Burdekin program

5.1 Program Objectives

The primary objective of the regional program is to achieve an enduring reduction in the long-term end-of-catchment pollutant loads from the Lower Burdekin and Haughton catchments. The program aims to achieve the following reductions:

- Dissolved inorganic nitrogen (DIN) - **48 t/year ***.
- Pesticides - **35 kg/year ***.

In addition, the Program will seek to engage with a range of stakeholders, industry participants and the broader community to encourage:

- innovative solutions for complex water quality problems, and
- increasing Traditional Owner participation in water quality improvement initiatives.

*The reduction in pollutant loads is determined via modelled reduction in average annual end-of-catchment load (ie 48,000 kg DIN/year) and is consistent with the catchment loads modelling methods for the Reef 2050 Water Quality Improvement Plan.

5.2 Strategy for implementing the program

The strategic design of the Regional Program is focused on achieving lasting water quality improvements underpinned by sound agronomic and water quality advice. Lasting and meaningful improvements in catchment condition and resulting water quality are requisite on the implementation of land management practices that maintain agricultural production and profitability whilst minimising off-site environmental impacts. The Program is designed to facilitate planning, education and incremental decision support that promote a sense of stewardship and collaborative participation between land managers, extension and technical support organisations, industry stakeholders, government agencies and investors.

This plan draws upon a significant body of work recently undertaken by stakeholders in the region, in particular, the development of the Burdekin Sugar Regional Extension Plan (Qld Government Reef Water

Quality Program) and the Lower Burdekin Irrigation Extension Action Plan (SRA and Qld Government Reef Water Quality Program). The Program and these foundational plans:

- Implement a 'grass roots' approach that promotes practices that enhance production and profitability whilst minimising off farm environmental and water quality impacts.
- Maximise the promotion and uptake of nutrient management approaches to achieve application rates that align closely to anticipated crop requirements.
- Restore and augment existing degraded wetlands to reduce DIN transport to the Reef, and generate additional wetland co-benefits.
- Increase adoption of water efficient irrigation practices that improves irrigation scheduling and application rates that align to crop requirements.
- Promote the use of lower toxicity pesticides and application rates that ensure efficacy and cost effectiveness while minimising impacts to downstream aquatic diversity.
- Explore and implement innovative financing options to enhance uptake and improve program cost effectiveness.

The regional WQ program is guided by the goals, outcomes and activities of the [RTP Monitoring & Evaluation Plan](#). The program activities and how they achieve the intermediate Regional targets and Reef Trust Program outcomes are shown in the Program Logic contained in the [Lower Burdekin Water Quality Program M&E Plan](#).

6. Program Governance

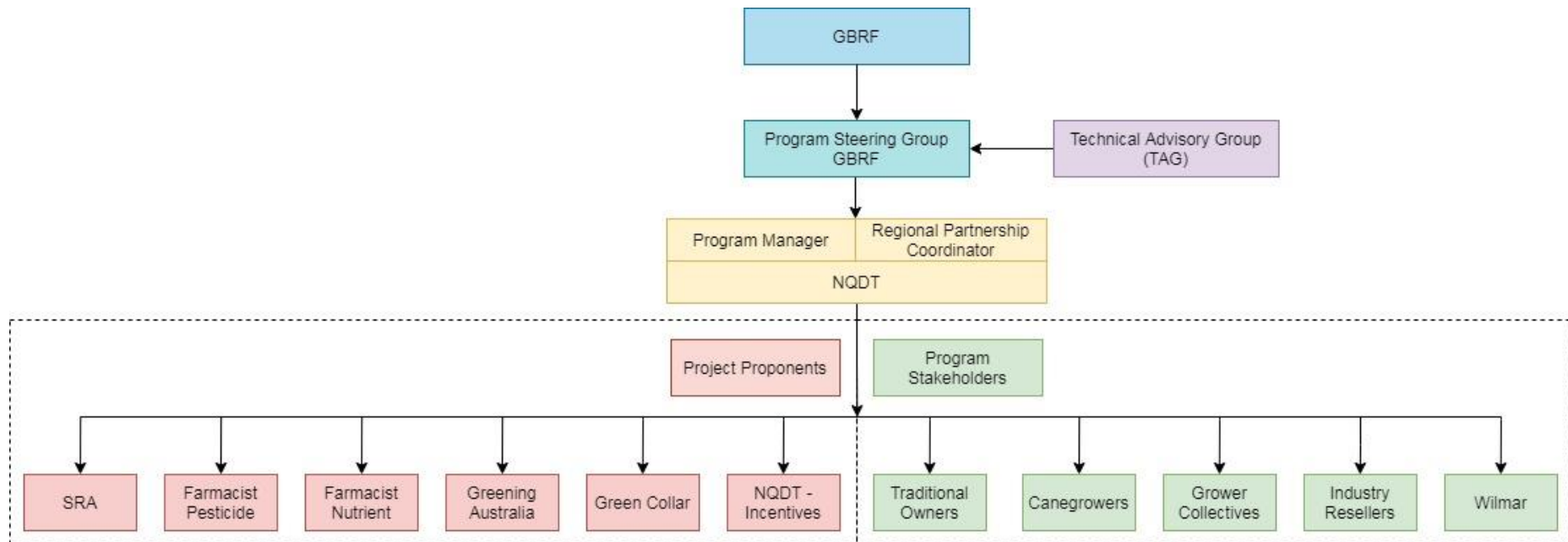


Figure 2. Lower Burdekin Water Quality Program Governance Structure

Organisation	Role	Contact
GBRF	Steering Committee	Robert Speed
GBRF	Program Manager	Carolyn Trewin
GBRF - (TAG)	Technical Advisory Group	Jane Waterhouse and Christian Roth (Co-Chairs)
NQ Dry Tropics	Program Manager	Rob Hunt
NQ Dry Tropics	Regional Coordinator	Luke Malan
Sugar Research Australia	Project proponent	Cathy Mylrea
Farmacist - Nutrient	Project proponent	Jayson Dowie
Farmacist - Pesticide	Project proponent	Jayson Dowie
Greening Australia	Project proponent	Ben Hanrahan
Green Collar	Project proponent	Carole Sweatman

7. Program Linkages

Recent history of cross organisational collaboration founded by the Burdekin Cane Extension Group (BCEG) has greatly assisted in the development of the regional plan, and the subsequent development and alignment of delivery partner proposals.

The Enhanced Extension Coordination Project funded by the Queensland Government, developed a [Burdekin Sugar Regional Extension Plan](#) which includes a detailed Regional Scan of current water quality, farming practice and extension projects operating in the Lower Burdekin Region. The regional scan aligned local projects with the Paddock To Reef Water Quality Risk Framework categories: soil, nutrient, pesticide and irrigation management. Other general projects were grouped under water quality monitoring, whole of farm management, peer-to-peer capacity building, on-farm trials and system reporting and treatment systems. These main themes are reflected in the Lower Burdekin Water Quality Risk Framework. The plan recognises that while the collective impact of these projects are significant, it could be further enhanced through additional levels of coordination and collaboration.

Recent NRM planning activities have highlighted the need for collaborative development of projects to ensure effective allocation of available resources and enhanced outcomes for cane farmers and other stakeholders. Under the guidance of the Burdekin Cane Extension Group and the Cane Regional Extension Coordinator, significant effort was invested in ensuring collaboration prior to the call for Expressions of Interest under the Program. This culminated in all of the region's extension organisations agreeing to participate in a collaborative project in addition to their own projects. As a result:

- Projects initiated under the Program have a high degree of synergy with existing and new initiatives

- Projects address both the priority pollutants (DIN and Pesticide)
- Projects are collectively addressing the priority pollutants via all known pathways (irrigation, nutrient application and pesticide application, wetland treatment system)
- Cumulative project targets are anticipated to exceed the Program's overall water quality targets
- The program will be supported by a range of incentives including a regional practice change and infrastructure incentives project, Reef Credits and any findings of the Incentiv8 project funded under the RTP Incentives initiative.

GBRF farming practice change projects, namely Precision to Decision, Bluewater and Burdekin Irrigation Project have been designed with the intent of collaborating by working across the priority farming management systems, (nutrient, pesticide and irrigation) which significantly influence water quality risk. Focusing on improving these management systems in unison, will result in compounded improvements to the water quality risk framework. Reductions to concentration of nutrient and pesticide coupled with efficient irrigation practices will result in more cost-effective water quality improvements. DIN and pesticide runoff are driven predominantly by application rate (i.e. concentration) and irrigation water acting as the primary dilution and transport mechanism for tailwater leaving farms, through either deep drainage or surface runoff. As such, the GBRF Lower Burdekin Water Quality Program methodology aims to identify and work with growers who have scope to improve farming practice change in the three farming management systems that have the most potential to positively affect water quality risk.

A representation of the linkages between existing and recent projects, and their water quality improvement pathway is shown in Figure 3.

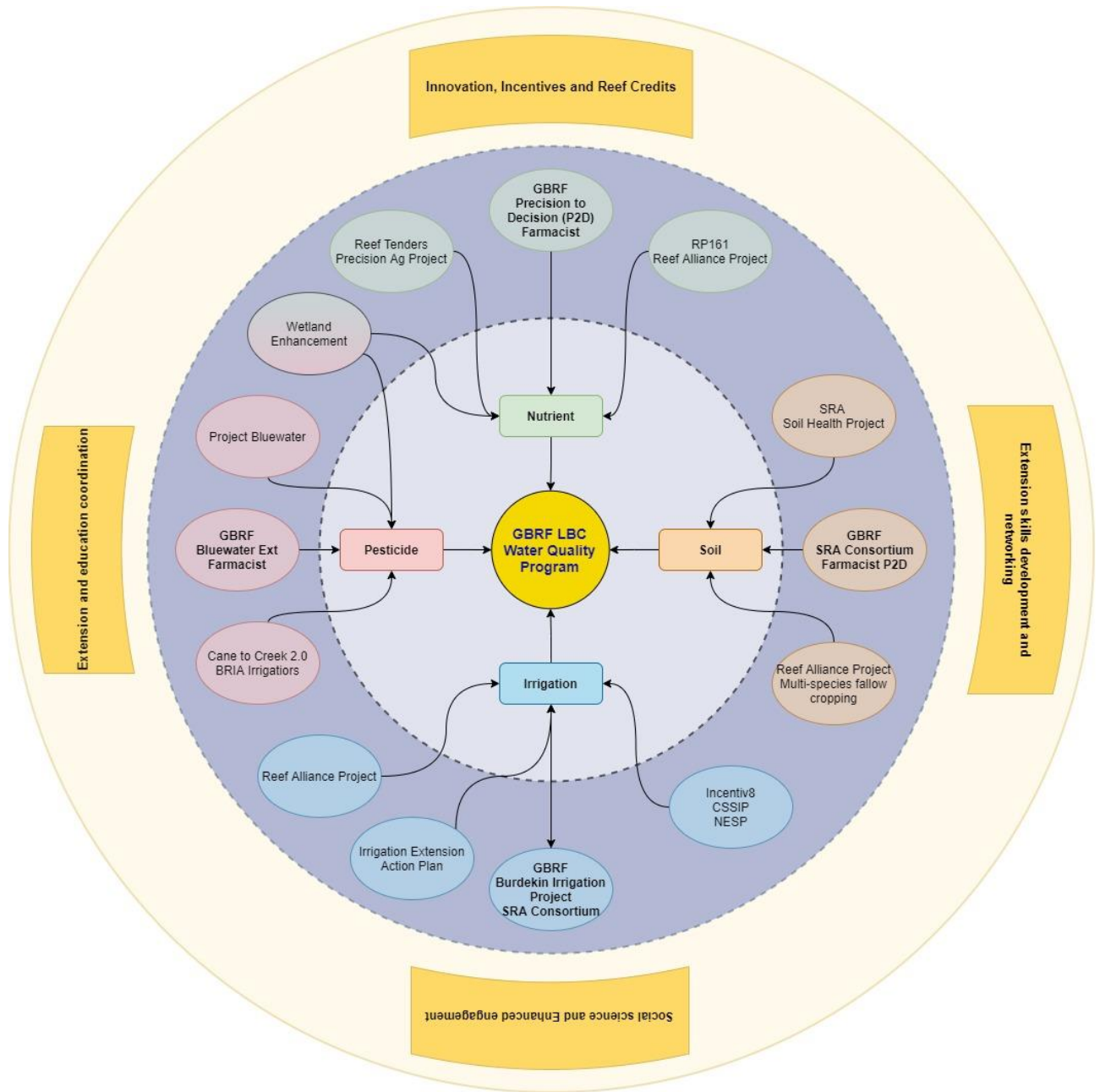


Figure 3: Interrelationship between existing projects and plans, their primary practice change pathway (Pesticide, Irrigation, Soil Health, Nutrient), how they link to the Lower Burdekin Water Quality Program and proposed projects. Note this is not an exhaustive list of existing projects and programs.

8. Historical Reef Investment Timeline (Burdekin)

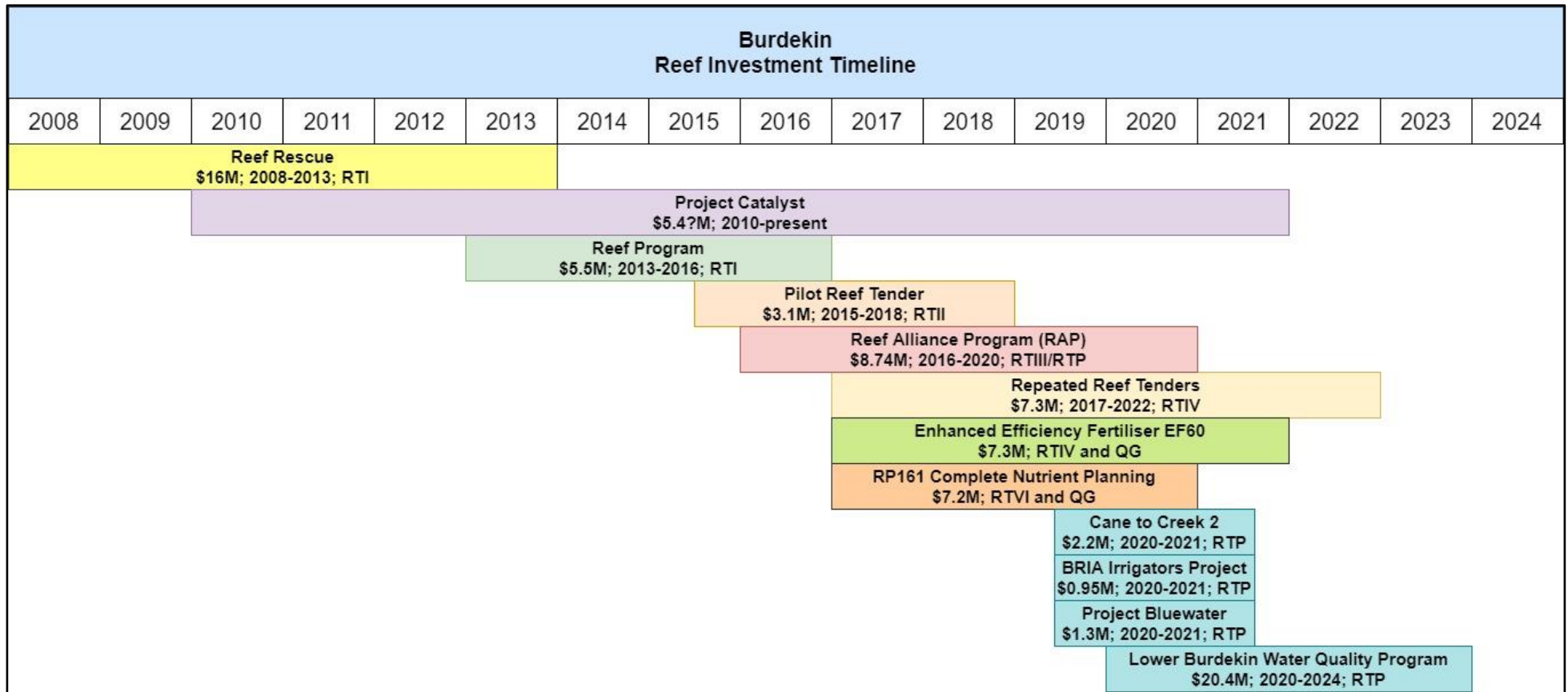


Figure 4. Lower Burdekin Cane Historical Reef Investment Timeline.

9. Regional Overview

The Lower Burdekin Region comprises the floodplains of the Haughton River, Barratta Creek and Burdekin River. The Haughton Basin contains a majority of the sugarcane area within the Lower Burdekin catchment. A portion of the cane growing area is also within the Burdekin Basin, shown (in faded colours) on the south of the Burdekin River bank (Figure 5); around Home Hill and up-river from Home Hill, and in the Millaroo and Dalbeg areas). Both the Haughton and Burdekin Basin targets are relevant to this program.

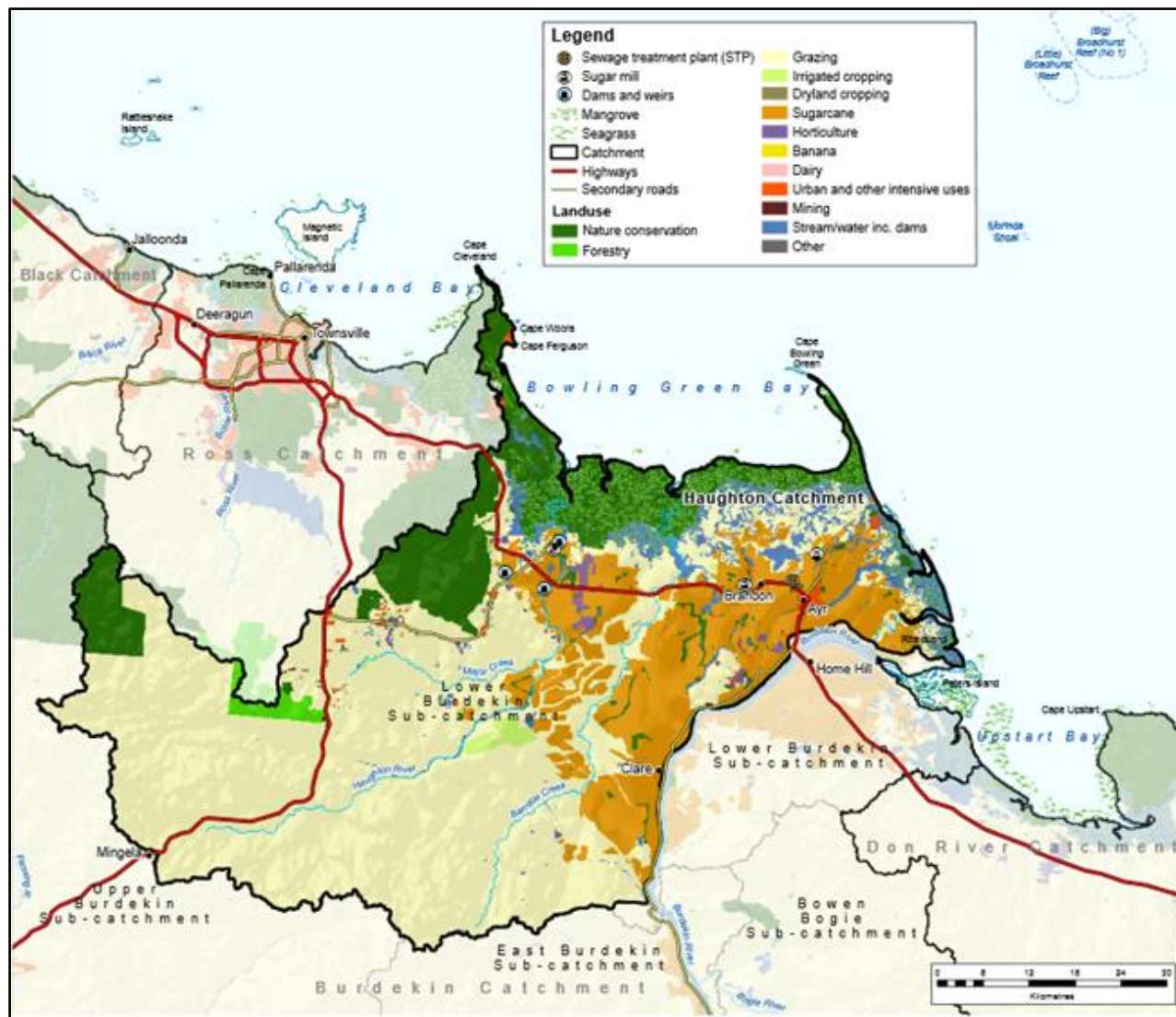


Figure 5. Map of the boundaries used for setting basin specific targets in the Reef Plan 2050 Water Quality Improvement Plan. Source: <https://www.reefplan.qld.gov.au/about/assets/catchment-targets-burdekin-haughton.pdf>

The traditional owners of the Lower Burdekin region are the Bindal and Juru nations who occupied coastal areas from Mt Elliot to Bowen and west to the ranges.

Early European settlement occurred around 1861 when several pastoral runs were established including Jarvisfield and Woodhouse stations between the Haughton and Burdekin river mouths (Vance and Copeman 1989). Sugarcane was introduced to the region around 1879 with the first sugar mill (Airdmillan Estate) established in 1883. The success of sugarcane cropping was impacted by periodic dry periods, until underground water was successfully extracted in the late 1880s, an early indication of the region's

reliance on irrigation. The region now has a population of approximately 18,000 people with the sugar industry being the most significant economic industry and source of employment.

The current area of sugarcane cultivation in the region is approximately 90,000 ha, with approximately 80,000 ha under production in the Lower Burdekin and Haughton catchments (NQ Dry Tropics, 2016). The sugar cane crop of 8 million tonnes, has an average annual value of approximately \$355.2 million and the industry provides regional employment for up to 1,500 people.

The commonly-applied boundaries for the region are the Burdekin River Irrigation Area (BRIA) and the Delta sugarcane growing area (Figure 6). These two areas combined are referred to as the Lower Burdekin sugarcane area.



Figure 6. Map of the two-distinctive sugarcane growing regions in the Lower Burdekin catchment, the BRIA and the Delta.

The characteristics of the BRIA and Delta areas are quite distinct and were summarised by Waterhouse (2018), highlighting the following key points:

- Paddock scale monitoring and modelling data indicates that a larger proportion of DIN loss occurs via surface runoff in the BRIA area than in the Delta.
- Much of the runoff from the BRIA is directly discharged to Barratta Creek, compared to the Delta where the waterways are typically used as water transfer channels (Davis et al. 2012). Recycle pits are also used in the BRIA to capture and recycle irrigation tailwater.
- The soils in the Delta are also more permeable than in the BRIA, making them less suitable for achieving efficient furrow irrigation techniques.
- In the Delta, the majority of irrigators are groundwater irrigators, where irrigation water recharges the aquifer and is subsequently re-used to meet crop requirements.
- Delta growers apply more water per unit of area (e.g. 20+ML/ha) than BRIA growers (e.g. 10-12ML/ha). Reasons include high soil permeability (irrigation water leaches quickly) in the Delta and most of the irrigation water is charged via area (\$/ha – not a volumetric charge) in the Delta. These factors affect the relative economic benefit accrued from improvements in water application efficiency.
- There are approximately 347 farms in the BRIA and 580 farms in the Delta. The average farm size in the BRIA is 140ha (with areas up to 3500 ha) compared to 72 ha in the Delta (with areas up to 500 ha).
- Previous economic analysis conducted by Smith (2015) indicates that it is more cost effective to implement improved nutrient and irrigation management practices on the larger farms as fixed costs are spread across a larger production base.

Key characteristics of the BRIA and Delta cane farming areas are shown in Table 1.

Table 1. Key characteristics of the BRIA and Delta sugarcane growing areas in the Lower Burdekin (Waterhouse et al. 2018).

Characteristic	BRIA	Delta
Area	49,222 ha	41,262 ha
Establishment	Since 1980's	Since 1880's
Number of farms	347	580
Approx Farm size ¹	Up to 3,500ha Median farm size: 94ha Average farm size: 140ha	Up to 500ha Median farm size: 56ha Average farm size: 72ha
Dominant soils	Sodic duplex/ and light to medium and heavy clays (high denitrification potential)	Coarse sands, sandy loams and light to medium clays (Low denitrification potential)
DIN loss pathway	Large proportion in surface runoff	Large proportion in drainage
Modelled annual average DIN load ³	460t/yr	586t/yr
Average production ²	110 tonnes per ha	120 tonnes per ha
Fertiliser application rates ⁴	214 kgN/ha Plant 227 kgN/ha Ratoon	193 kgN/ha Plant 216 kgN/ha Ratoon
Water source and use	Surface water and <u>ground water</u> in Northcote, Jardine and Selkirk areas 10-12 ML/ha Volumetric charge for water Gravity fed systems leading to lower electricity costs	<u>Ground water</u> and surface water from Water Board supply 20+ ML/ha Largely area based charges for water Pumping leads to higher electricity costs
Irrigation systems	Predominantly furrow irrigation	Predominantly furrow irrigation

Data sources:

¹Wilmar (P. Larsen, pers. comm.), September, 2018. Data extracted from end of 2017 harvest season.

²Wilmar (P. Larsen, pers. comm.), March 2016.

³ Based on modelled estimates of DIN loads from sugarcane areas using the Paddock to Reef Source Catchments model, DNRM (2015).

⁴ Paddock to Reef program Survey data, NQ Dry Tropics (2016).

The Reef 2050 Plan and subsequent separation of the Burdekin and Haughton catchments is confusing to extension practitioners, sugarcane farmers and other stakeholders. Different water quality targets for what is considered a contiguous area of sugar cane production further compounds this issue. For the purposes of the program, this plan will aim to maximise the adoption of improved farm practices, treatment systems and wetland rehabilitation across the entire cane growing area of the Lower Burdekin. The Program will continue to focus on actions to reduce DIN and pesticide losses consistent with the Haughton catchment targets.

Waterhouse *et al* (2018) summarised the current water quality risks associated with sugarcane in the Lower Burdekin. The dominant water quality issues for the Lower Burdekin are DIN and photosystem II inhibiting herbicides (PSII herbicides).

9.1 Dissolved inorganic nitrogen

The annual average anthropogenic load of DIN from the Lower Burdekin sugarcane area using the Source Catchments model (2016 baseline) is estimated to be 836 tonnes per year (Alluvium 2019). Nitrogen losses in surface runoff and deep drainage vary according to soil type in both BRIA and Delta regions. The dominant loss pathway in the largely clay based soils of the BRIA is through surface water runoff whereas in the highly permeable light soils of the Delta the dominant loss pathway is through deep drainage (Thorburn *et al.*, 2011b).

The BRIA and Delta regions contribute approximately equal loads of DIN (accounting for uncertainties in some of the model input data such as current management adoption). In 2016, this was estimated at 44 per cent and 56 per cent respectively, with both areas occupying approximately equivalent areas in the Lower Burdekin catchment. However, the DIN export rates are modelled as being higher in the Delta (~14kg/ha/yr) compared to the BRIA (~10kg/ha/yr).

9.2 Pesticides

Sugarcane is the greatest contributor of PSII herbicide exported load in the Burdekin region, contributing a majority (99 per cent) of the regional load and equates to a Diuron Toxic Equivalent load of approximately 1,319kg per year. The modelled PSII herbicide toxic equivalent load data for the region also shows that the modelled contributions from the BRIA and Delta are roughly equivalent (within the level of accuracy of the model), estimated at 55 per cent and 45 per cent respectively.

The lack of distinction between regions is likely a result of the reporting of relatively homogenous farming practices across both BRIA and Delta, and the factors that influence pesticides loss processes do not vary significantly across regions. However, it is likely that more residuals are applied in the BRIA as standard practices use less cultivation and therefore weed pressure can be greater (E. Shannon, pers. comm.). In addition, the loss pathways are different, and a large proportion of the irrigation tailwater runoff in the BRIA discharges to Barratta Creek, compared to the Delta where the waterways are typically used as water transfer channels receiving surface and groundwater flows (Davis *et al.*, 2012).

The following are considered the priority issues for improved water quality and sugarcane management in the Lower Burdekin:

- **Fertiliser and pesticide application rates and timing** have a significant role in determining losses from the Lower Burdekin sugarcane area.
- **Irrigation timing** leading to unintended crop stress, reduced yield and consequently, poor nutrient use efficiency.
- **Low irrigation application efficiencies** influence the amount of surface runoff and drainage losses of nutrients and pesticides. In addition, typically low irrigation efficiencies in the Lower Burdekin area have led to substantial modification of local hydrological regimes, resulting in significant impacts on freshwater and coastal ecosystems in the region (GBRMPA, 2012; Shaw, 2014, NQDT 2016).

9.3 Reef Protection Regulations

The Queensland Reef Water Quality Regulations require all Burdekin Cane farming operations to comply with the new minimum practice agricultural standards. From December 2019, all sugarcane producers and advisors in the Burdekin are required to keep [records](#) to demonstrate activities are being undertaken in accordance with the minimum standards. All producers must have a farm nitrogen and phosphorus budget and apply no more nutrient than the amount calculated using the prescribed method from 1 December 2021. The prescribed method for calculating nutrient application rates aligns to Moderate Risk (C class) practices under the [Sugarcane Water Quality Risk Framework](#) and [Smartcane BMP Module 1 Soil Health and Nutrient Management](#).

10. Program Design and Logic

The [Lower Burdekin Water Quality Program Logic](#) maps out how the program aligns to the broader Reef Trust Partnership logic and demonstrates how the program will contribute to the delivery of the RTP end-of-program outcomes.

The logic provides ‘line of sight’ on how each project contributes individually and collectively to the overall RTP outcomes. It also informs the Program Monitoring and Evaluation plan to ensure a consistent approach for data collection and evaluation of RTP and Regional Program metrics.

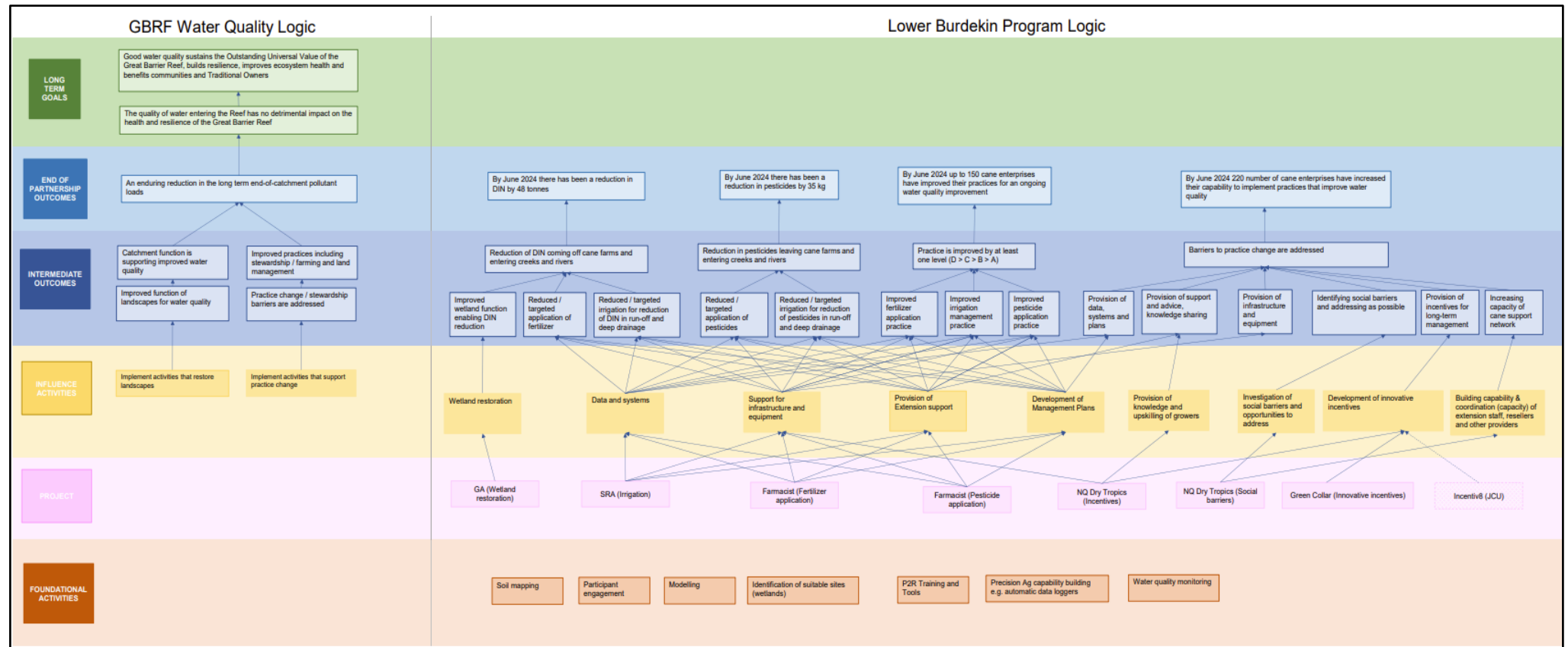


Figure 7. Lower Burdekin Water Quality Program Design and Program Logic

11. Program Budget

RTP GBRF Lower Burdekin Cane (LBC) Water Quality Budget		
Item	Amount	Description
LBC Project Manager & Coordinator	\$ 1,665,233	NQDT Contract for project manager/partnership coordinator
Cross cutting	\$ 408,000	2% of budget in all regional programs reserved to support technical advisory group, working group, and other cross-cutting technical work
Alluvium extension piece	\$ 19,000	Completed work on extension planning
Existing commitments	\$ 537,266	NQDT Reef Alliance Project - Phase 2 extension
Contingency	\$ 1,020,000	5% of budget reserved as a contingency, with view to invest in on ground projects later in the program
Behaviour science	\$ 250,000	Funds reserved pending a decision at whole of WQ component on how behavioural science will be incorporated into regional programs
Projects		
Green Collar - Reef Credits	\$ 500,000	For purchase of Reef Credits - Green Collar. Whole-of-program level
SRA - Burdekin Irrigation Project	\$ 6,014,250	First round budget for projects \$16,587,557
SRA - WQ Monitoring Program	\$ 898,128	
Farmacist - Bluewater	\$ 2,402,433	
Farmacist - Precision to Decision	\$ 3,200,000	
Greening Australia - Constructed Wetland Treatment Program	\$ 2,072,746	
LBC Program Incentives	\$ 1,500,000	
Total Program Budget	\$20,487,056	

12. Program activities

The end of Partnership outcomes will be achieved through the following broad activities:

1. *Practice change projects specifically targeting:*
 - *nutrient application rates (DIN);*
 - *pesticide application rates (Pesticides); and.*
 - *irrigation practices to achieve greater water use efficiency and further reduce DIN and Pesticide losses from irrigation events.*
2. *Wetland restoration and wetland treatment train to further mitigate DIN and pesticide losses from cultivation areas.*
3. *Innovative use of incentives to improve the cost-effectiveness of water quality investment and increase the broadscale adoption rate of improved land management practices.*
4. *Increased awareness of factors influencing cane farmers motivation and capacity to implement land management practices that improve water quality.*
5. *Increased skills and capacity amongst regional extension organisations and agricultural support service providers to assist cane farmers to plan, design and implement management approaches that improve water quality outcomes.*

A precis of each project, funding allocated, outcomes and cost effectiveness is provided below.

12.1 Nutrient Management

Delivery provider: Farmacist - Nutrient	
Budget	\$3,200,000
Cost-effectiveness	\$130.6 / kg DIN
DIN savings	24,500 kg DIN
<p><i>This project will directly engage with up to 100 growers farming 10,000 hectares in this priority catchment and will deliver 24.5 tonnes DIN load reduction, achieving a large proportion of the GBRF target DIN load reduction of 48 tonnes for the Lower Burdekin catchment. Proposed delivery is consistent with the GBRF Alluvium investment strategy recommendations that intervention must shift nutrient management practices from D or C class practice to B or A class.</i></p> <p><i>Presents cost-effective investment and confidence that GBRF DIN targets for the program will be exceeded when combined with the SRA Consortium proposal. DIN reductions will be readily reportable to the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program and quantifiable via the P2R Projector Tool.</i></p>	

12.2 Pesticide Management

Delivery provider: Farmacist - Pesticide	
Budget	\$2,402,443
Cost-effectiveness	\$16,455/kg pesticide
Pesticide savings	146 kg pesticide load reduction
<p><i>This project will directly engage with up to 100 growers farming 18,758 hectares in this priority catchment and will deliver 146 kg of pesticide load reduction, exceeding the GBRF target pesticide load reduction of 35 kg for the Lower Burdekin catchment. Proposed delivery includes a combination of approaches including pesticide efficacy, application rates and relative toxicity considerations which are consistent with GBRF Alluvium investment strategy recommendations. All growers in the project will have a tailored pesticide management plan to guide all pesticide use. The plan will consider soil types, slopes, drainage water flows, irrigation, weed pressures, cane grub pressures, pesticide selection guidance for lower ecotoxicity products and product plans to move to knockdown herbicide programs.</i></p> <p><i>Presents cost-effective investment and confidence that GBRF pesticide targets will be exceeded. Pesticide reductions will be reportable to the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program using the MSPaf methodology.</i></p>	

12.3 Irrigation Management

Delivery provider: SRA - Irrigation Consortium	
Budget	\$6,912,378
Cost-effectiveness	\$312/kg DIN (excludes water quality component)
DIN savings	19,300 kg DIN
<p><i>This project will directly engage with up to 165 growers farming 4,875 hectares in this priority catchment and will deliver 19.3 tonnes DIN load reduction, contributing to the GBRF target DIN load reduction of 48 tonnes for the Lower Burdekin catchment. Irrigation practices to achieve greater water use efficiency will result in further reductions in DIN and Pesticide losses from irrigation events. The proposed delivery approach involves a whole of systems approach which transitions growers to more technologically advanced and profitable irrigation management practices that are scalable. Improving irrigation volumes to match crop requirements and optimising irrigation scheduling. It includes water quality monitoring to ensure water quality outcomes are verifiable. The project's consortium approach standardises the process of grower engagement and attempts to maximise strategic coordination, collaborative linkages and consistent messaging to deliver more value to growers and industry stakeholders.</i></p> <p><i>This proposal presents cost effective investment and provides confidence that GBRF DIN targets for the program will be exceeded when combined with the Farmacist Nutrient proposal. DIN reductions will be readily reportable to the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program and quantifiable via the P2R Projector Tool.</i></p>	

12.4 DIN reduction through improved catchment function (wetland restoration)

Delivery provider: Greening Australia	
Budget	\$2,072,746
Cost-effectiveness	\$228/kg DIN
Pesticide savings	9,100 kg DIN
<p><i>This project will construct three wetland systems through the restoration and augmentation of three existing drainage features to achieve a DIN load reduction of 9,100kg DIN. The restoration works will also buffer irrigation tailwater and stormwater impacts on adjacent areas, improving existing wetland condition and resilience and enhancing intrinsic wetland values. The project will provide additional data on the efficacy of wetland treatment systems in the Burdekin and contribute to the current level of understanding on the applicability and cost effectiveness of similar water treatment systems. Greening Australia has identified a range of sites across the Burdekin floodplain and prioritised three to deliver cost-effective water quality outcomes. Independent technical assessment of the design of the wetland treatment systems will be undertaken to assess the technical feasibility of the project and provide confidence in its long-term efficacy.</i></p>	

12.5 Regional Incentives

Delivery provider: NQ Dry Tropics	
Budget	\$1,499,925
Cost-effectiveness	Min \$358.15 / kg DIN
DIN savings	TBC (minimum forecast 4,189 kg DIN)
<p><i>Lower Burdekin Cane Farmers who actively participate in and complete farming practice projects under the Program, namely Farmacist - Precision to Decision Project; Farmacist - Bluewater Pesticide Project and SRA - Burdekin Irrigation Project will be eligible to submit a competitive project proposal to access incentive funding through the GBRF Lower Burdekin Water Quality Incentives Program.</i></p> <p><i>Eligible growers will be invited to submit competitive project proposals through three incentive funding rounds from 2021 - 2023. An incentive funding pool will be available to eligible growers to action key recommendations identified by delivery providers through grower consultation and development of project management plans (Irrigation, Nutrient, Pesticide) through the LBWQP.</i></p> <p><i>Projects will be prioritised and assessed using several criteria and evaluation parameters to ensure cost effective and lasting outcomes. Successful incentive projects will be required to deliver additional water quality outcomes separate to those achieved in the LBWQ Program Projects, at a 'reserve' cost per unit equal to or less than the LBWQ Program Projects. Successful applicants will be contracted through NQ Dry Tropics and GBRF will generate contract variations for LBWQ Program Project delivery providers to reflect the additional project outcomes. NQ Dry Tropics will lead the assessment, administration, review and validation of incentive projects.</i></p>	

12.6 Land Management Stewardship

To increase the likelihood of lasting improvements in management practices, all projects delivering farm management management changes are underpinned by a detailed Farm Management Plan. These plans will form the basis for nutrient, pesticide and irrigation extension, design and implementation. The plans, developed by the respective delivery partners will identify existing on-farm infrastructure and practices, provide a template for assessment of practices and identify opportunities for staged implementation of improvements and optimisation.

System repair projects (wetlands restoration) will also include development of plans to inform the long-term maintenance and operation of wetland sites to ensure they continue to perform their DIN removal functions as designed.

13. Program Technical Advisory Group

Some funding from the Lower Burdekin WQ Program (\$408,000) has been set aside for various supporting services that cut across all regional programs. These initiatives include:

- Technical review of engineering design for intervention activities such as treatment systems and wetlands
- Independent verification of on ground interventions
- Technical advice on design and procurement of supplementary monitoring and analysis of monitoring results
- Maintenance of a GIS database to support monitoring and evaluation of on-ground activities across the Reef Trust Partnership.

These services are provided via a Technical Panel, Technical Advisory Group and Monitoring and Evaluation team established by the GBRF to support program delivery across all regions.

14. Activities that involve Traditional Owners

NQ Dry Tropics will engage with the existing Traditional Owner Management Group (TOMG) to inform the local Traditional Owners about the design of the lower Burdekin Water Quality Program and ensure those groups are well informed of the intended outcomes of the program. This engagement will also provide a foundation to facilitate traditional owner input and participation in delivery components whenever possible.

Traditional Owner engagement will assist in creating linkages with relevant delivery partners, share valuable traditional owner knowledge, and identify further opportunities for engagement in individual project delivery, education and monitoring.

The Greening Australia Wetlands Restoration project has been identified as having strong potential for linkages to traditional owners and NQ Dry Tropics will continue to work with Greening Australia to facilitate engagement and participation in this project.

15. Innovation activities

As noted above, \$10 million has been allocated from the Reef Trust Partnership Water Quality Improvement Program towards projects focussed on innovation and system change. The Lower Burdekin Water Quality Program will make appropriate linkages to projects funded under the innovation program. Piloting innovative technologies and approaches is expected to lead to new practices being available for farming, land management and stewardship. There is a focus on seeking to facilitate changes in how farmers make decisions, how agronomists provide support services, and how donors choose to invest. This will lead to improved practices (improved land management pathway) and contribute to innovative solutions for systems change in water quality.

GBRF is supporting two innovation projects of specific relevance to the Lower Burdekin Water Quality Program:

1. **Robotic herbicide use on sugarcane farms for precise weed control** (James Cook University - \$400,000).

The project aims to lower herbicide run-off to the Reef and reduce costs for farmers, by creating new smart weed detection and spraying systems that will reduce herbicide usage on sugarcane farms by at least 80 per cent. Partnering with AutoWeed and Sugar Research Australia, the technology will initially be trialled in the Burdekin and uses deep learning to detect and spray weeds without hitting non-target crops, supporting a healthy Reef.

2. **Incentiv8** - A rapid assessment visualisation tool for incentivising irrigation stewardship (James Cook University - \$400,000).

The project aims to accelerate uptake of improved irrigation practices and drive new ways to finance water quality improvements by developing a tool that allows growers to readily identify the implications of different irrigation approaches for farm economics, as well as linkages to opportunities for green finance. The project will increase irrigation efficiencies, potentially leading to reduced water and electricity costs and pollutant runoff threatening the health of our Reef. The INCENTIV8 tool will initially be trialled in the Burdekin irrigation district and serves as a boundary object to navigate conversations, converge thinking from different stakeholders and bridge the gap between better irrigation management and sustainable finance.

16. Projects linkages and expected load reductions

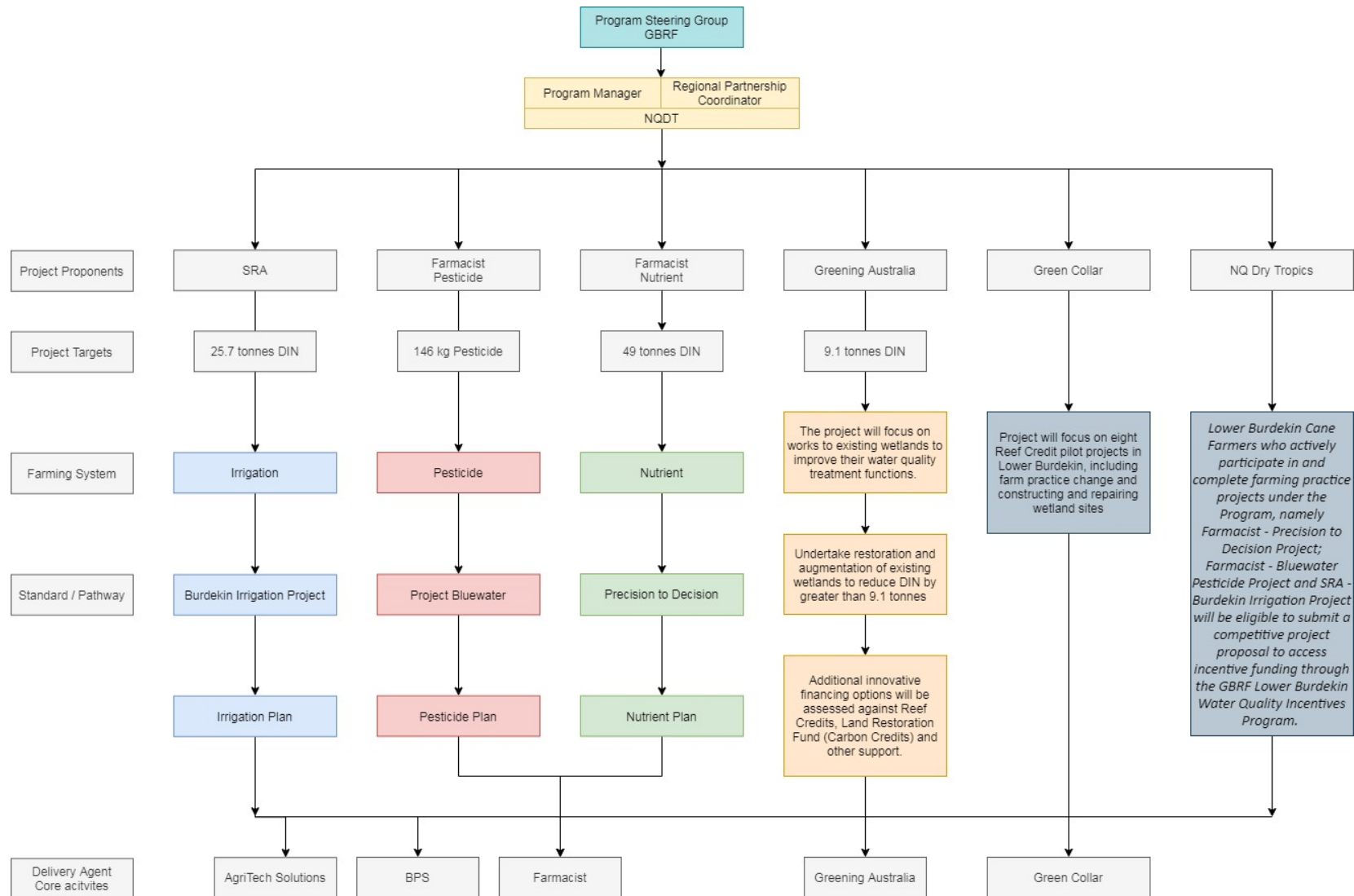


Figure 8: GBRF Program Framework with Project linkages and associated target load reductions

17. Future opportunities

17.1 Precision Agriculture

The NQ Dry Tropics Precision Ag Project (Reef Trust 7) will build on historical Reef investments to support sugarcane growers to effectively utilise equipment, software and extension services to fully realise their potential environmental outcomes. The project has been designed to directly value-add to existing GBRF farming practice change projects and contribute to the targets of GBRF Lower Burdekin Water Quality Program, resulting in improved grower profitability, reportability, and water quality of Great Barrier Reef.

Previous Australian Government reef investments total \$21.5m in Burdekin Cane from 2008-2016, of which \$6.7m (31 per cent) was dedicated to funding of GPS systems, including rate control of spraying and fertiliser application, variable rate application of fertiliser and implementation of controlled traffic systems. The anticipated environmental outcomes of this investment have not fully been achieved due to a lack of technical expertise, extension and mentoring of growers in effective use of the specialised equipment and infrastructure funded. Delivering additional technical support is intended to re-activate the historical investment made towards precision technology and presents a significant opportunity to fully deliver the potential environmental outcomes of this earlier investment. The project will complement other activities towards the broader application of precision agriculture techniques which are considered essential to support sustainable farming in the reef catchments.

This project methodology focuses on interrogating historical investment data, targeting recipients of GPS precision agriculture equipment, and identifying technical extension opportunities that will consolidate the associated environmental outcomes. Additionally, participating growers will be provided with tools to automatically record irrigation event frequency and input event volumes with minimal effort. The Project will support and motivate farmers to continue to improve irrigation, pesticide, nutrient and soil management practices by providing necessary extension support and tools.

17.2 Peer Support and Enhanced Extension

The Reef Extension Training Needs Analysis (Queensland Government 2018) identified a range of opportunities to build capacity amongst rural extension, reseller and other providers to facilitate change in farm management practices and natural resource management in the Great Barrier Reef catchments. Increasing capacity through enhanced skills and coordination is seen as a highly cost effective means to further enhance the effectiveness of extension services and accelerate changes required to meet Reef 2050 targets.

The Program incorporates an allocation towards better understanding and incorporating social science expertise into the regional extension framework. Program contingencies are also potentially available to address further skills and/or knowledge gaps identified through the Burdekin Cane Situation and Gap Analysis currently being overseen by the Burdekin Cane Extension Coordination Role in DAF.

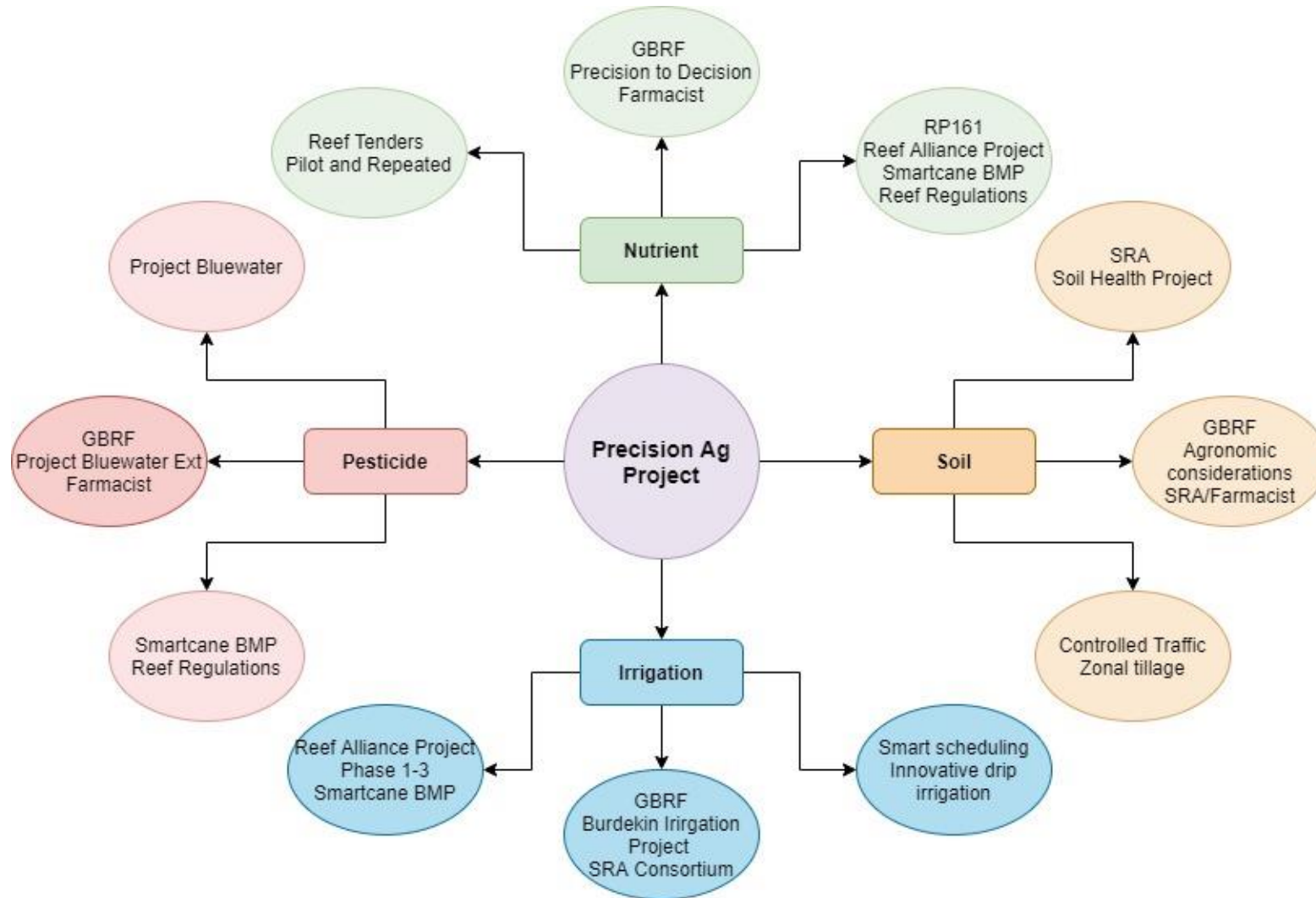


Figure 9: Reef Trust VII - NQDT Precision Ag Project linkages to GBRF farming practice change projects and historical investment.

18. Communication and Engagement

18.1 Communication and Engagement Plan

A Lower Burdekin Regional WQ Program [Communications and Engagement Plan](#) has been developed to guide the communication activities for the program and each individual project.

This plan supports the overarching [RTP Communication and Engagement Plan](#) developed by the GBRF, and is critical to building understanding, trust and community ownership of the Partnership projects in an area where multiple programs are underway that are underpinned by government and industry investment.

The plan outlines general actions and messages necessary to ensure communication and engagement activities for the RTP projects are driven by the strategic objectives of the Partnership, as illustrated in Figure 5.

Project-based communication and engagement plans outline how each delivery partner intends to engage with participating stakeholders to implement their projects and support the delivery of overall program outcomes.

A program-wide web page hosted by NQ Dry Tropics will provide general information on the Lower Burdekin Water Quality Program. The site will provide access to key reference information, a portal for landholders to link to participating delivery partners' websites and project information.

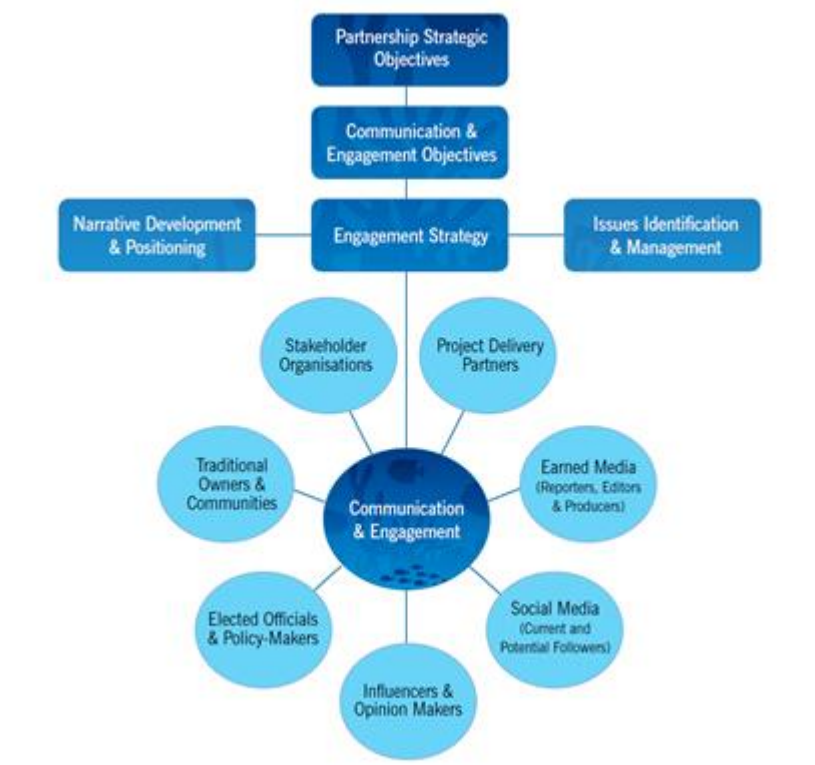


Figure 10. Reef Trust Partnership Communication and Engagement approach

18.2 Regional Forum and Events

A regional partner forum was held on 10 June 2020 via Zoom Teleconference due to COVID19 restrictions. The forum was attended by GBR Foundation representatives, NQ Dry Tropics (Program Manager and Partnership Coordinator) and representatives of each of the shortlisted delivery partner proposals. The forum topics included:

- An overview of the intent of the regional program.
- The proposed process for development of the regional plan.
- Provided each proponent with an opportunity to present a project overview the shortlisted projects.
- Discussed data requirements and possible workflow arrangements.
- Communications planning.
- Monitoring and Evaluation.
- Key events and foundational activities.

A range of engagement events will take place throughout the life of the program offering the opportunity to engage with a broader network of stakeholder including cane farmers, industry representative organisations, local government, community groups and traditional owners. These may take the form of program-specific events or collaboration and participation in existing events, including but is not necessarily limited to:

- Paddock to Reef Regional Integrated Science Forum.
- Cane Industry Shed Meetings.
- Burdekin Irrigation Futures Forum.
- End of Year Wrap Up.
- Burdekin Irrigation Expo.

19. Monitoring and Evaluation

The Program Monitoring and Evaluation Plan is designed to help track and assess the results of activities throughout the life of the program. NQ Dry Tropics has engaged with all Program Delivery Partners to develop a 'whole of program' M&E Plan that clarifies the linkages between the RTP Program and Lower Burdekin Program. The plan sets out indicators, who is responsible for data collection, how the data is intended to inform the program evaluation and reporting. An associated data collection plan ensures that each project will gather and report on the relevant indicators required to evaluate and report on the Program key indicators.

[Lower Burdekin Program and Project M&EI](#)

20. Appendices

20.1 Work Plan

[Link to work plan](#)

20.2 Details of Selection Process for Professional Services and Delivery Partners.

In December 2019, the GBRF made an open call for expressions of interest (EOI) seeking potential delivery providers to implement on-ground water quality improvement projects under the Reef Trust Partnership in the Lower Burdekin. At the same time, GBRF called for proposals for Professional Services

and engaged NQ Dry Tropics to perform the roles of Regional Program Manager and Regional Partnership Coordinator to assist with the design and implementation of the Lower Burdekin Water Quality Program.

The intent of the EOI process was to have potential delivery providers submit project concepts, their organisational capacity and capability to implement projects that will achieve an enduring reduction in the long-term end-of-catchment pollutant loads from the Lower Burdekin catchment. Suitable applicants would then be invited to submit detailed project proposals as part of a subsequent funding process. Furthermore, information obtained through the EOI process was to be used by the Regional Program Manager to inform the development of a detailed plan for the regional program.

The EOI process was undertaken in accordance with [EOI Guidelines](#) and resulted in 14 delivery partner applications being received. All applications were initially screened for compliance with eligibility criteria before being assessed by an independent assessment panel, with panel members scoring proposals against the following qualitative assessment criteria:

1. Cost-effectiveness of the project in contributing towards improved Reef water quality;
2. The Applicant's demonstrated ability to implement the project; and
3. Proven effectiveness of the proposed approach in achieving water quality outcomes.

The resulting shortlisted projects then proceeded to a Request for Information (RFI) stage to assist with further detailed evaluation of the proposals and evaluation of their alignment and contribution to the outcomes of the Regional Program targets. Proponents were provided [RFI/RFP Guidelines](#), received general feedback on their project proposals and were requested to respond to specific questions raised by the assessment panel during the EOI process. During the RFI process, NQ Dry Tropics coordinated a Regional Forum involving all shortlisted proponents to explain the RFI process and promote further collaboration between projects. NQ Dry Tropics, as the Regional Partnership Coordinator took a lead role in promoting alignment and collaboration between projects to ensure the regional water quality targets could be achieved in a cost-effective manner. Support and advice was also offered to short-listed proponents to ensure projects were clearly aligned to the Paddock to Reef water quality risk frameworks to facilitate monitoring and evaluation of project outcomes against Program targets.

The independent assessment panel was reconvened to evaluate the applicants' RFI responses giving consideration to the responses provided to the specific questions raised, overall quality of the proposals, project technical feasibility, likelihood of success, proposed contribution towards regional water quality targets, cost-effectiveness and the capacity of each project to be scalable to a 25 per cent increase or decrease in budget. A semi-quantitative evaluation was used to determine the ranking of each project and guided recommendations on whether projects should be supported and how proposals could be amended to suit budgetary constraints.

20.3 References

Alluvium (2019) Effective and Efficient Pathways for Investment in Improved Water Quality in the Great Barrier Reef: Final Report. A report for the Great Barrier Reef Foundation, Brisbane .

Econcern (2018) Regional Wetland Management Prioritisation in the GBR Catchment.

Great Barrier Reef Foundation (2021) www.barrierreef.org

NQ Dry Tropics (2016) Burdekin Water Quality Improvement Plan.

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

SRA (2020) Lower Burdekin Irrigation Extension Action Plan.

Vance, G. and Copeman, G. (1994) Thuringowa Past and Present. Thuringowa City Council

Waterhouse, J., Attard, S., Rickert, A., Buono, T., Hunt, R. 2018. Burdekin Water Quality Improvement Plan Lower Burdekin Implementation Plan: Water quality improvement through improved irrigation management in sugarcane. Phase 1 – Knowledge synthesis, evaluation of past programs and identification of preliminary strategies for implementation. NQ Dry Tropics, December 2018.