

Reef Rescue Water Quality Research and Development Program **Research Linkages**



APPROVED DOCUMENT

Prepared by the Reef & Rainforest Research Centre
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1. Executive Summary

Reef Rescue is a five year, \$200 million investment by the Australian Government under its *Caring for our Country*¹ initiative which commenced in 2008. As part of *Reef Rescue*, the **Water Quality Research and Development Program** (referred to in this Research Linkages report as **Reef Rescue R&D**) has been established to improve our understanding of the link between land management practices and environmental impacts.

The Reef and Rainforest Research Centre (RRRC) has been engaged to coordinate and integrate the Program. The objectives for the integration of *Reef Rescue R&D* are to:

1. Facilitate and document project linkages across the *Reef Rescue R&D* portfolio of projects to foster collaboration between researchers and develop integrated outputs that meet the needs of end users;
2. Understand and communicate how *Reef Rescue R&D* links to and builds on companion research to deliver research efficiencies; and
3. Foster synergies between *Reef Rescue R&D* and related research, management and policies that contribute to Reef health so that there is a higher return on investment, targeted knowledge transfer and more likelihood of enduring outcomes for reef water quality and sustainable agriculture.

Reef Rescue R&D will be implemented in collaboration with several key related research and monitoring programs. These include the *Reef Plan Paddock to Reef Integrated Monitoring, Modelling and Reporting Program*, the Reef Protection Package research program (to support implementation of the *Great Barrier Reef Protection Amendment Act 2009* (Queensland)), the National Environmental Research Program Tropical Ecosystems Hub, the Great Barrier Reef Foundation's *eReefs* initiative and a range of industry research programs. Collectively, these programs will support the implementation and evaluation of the *Great Barrier Reef Water Quality Protection Plan* ('Reef Plan') and the measurement of progress towards achievement of the water quality targets defined for Reef Plan and *Reef Rescue*.

This report on Research Program Linkages for *Reef Rescue R&D* documents, within the context of all activities underway across the Great Barrier Reef and its catchments, the objectives and contributing actions that will ensure integrated outcomes of far more benefit to Reef health than if each set of activities was undertaken in isolation. It provides an overview of *Reef Rescue R&D*, the project linkages identified to date and important linkages to other related research and monitoring programs. Approaches to facilitating integration within the program and with other initiatives are also identified. The *Reef Rescue R&D Communications Strategy* contains the plans and actions for delivering the outcomes of *Reef Rescue R&D* to a wide range of interest groups.

¹ <http://www.nrm.gov.au/>

2. Introduction

Reef Rescue is a five year, \$200 million investment by the Australian Government under its *Caring for our Country* initiative which commenced in 2008. *Reef Rescue*'s objective is to 'improve the water quality of the Great Barrier Reef (GBR) lagoon by increasing the adoption rate of improved land management practices that reduce the run-off of nutrients, pesticides and sediments from agricultural lands'. Reducing these pollutants from land-based activities will improve resilience of the GBR ecosystem and the ability of the system to cope with the impact of climate change. The five-year *Caring for our Country* outcomes aim to, (i) reduce the discharge of dissolved nutrients and chemicals from agricultural lands to the GBR lagoon by 25 percent, and (ii) reduce the discharge of sediments and nutrients from agricultural lands to the GBR lagoon by ten percent.

Reef Rescue is made up of five integrated components that work together over five years (2008-2013) to achieve its objective and outcomes (**Figure 1**):

1. **Water Quality Grants** provides funds to land owners and managers to implement sustainable land management practices that reduce the amount of nutrients, chemicals and sediments leaving their farms and impacting on Reef water quality (\$146 million).
2. **Reef Partnerships** provides assistance for extending information to, and help to build relevant skills in land owners and managers (\$12 million).
3. **Land and Sea Country Indigenous Partnerships** strengthens communications between local communities, managers and reef stakeholders and builds a better understanding of Traditional Owner issues about the management of the Great Barrier Reef Marine Park (\$10 million).
4. **Reef Water Quality Research and Development** (the focus of this document), provides the scientific evidence to improve our understanding of the link between land management practices and environmental impacts (\$10 million).
5. **Water Quality Monitoring and Reporting** measures progress towards the objectives of *Reef Rescue*, incorporating reporting of water quality at multiple scales (paddock, sub-catchment and end of catchment), land use, land condition and the uptake of best management practices (\$22 million).

This document focuses on the **Reef Rescue Water Quality Research and Development Program** (*Reef Rescue R&D*). The portfolio of research covers:

1. **Adoption and development of sustainable practices that have water quality benefits:** The development, trial and validation of land management practices that are sustainable and have improved water quality outcomes in the sugar, beef grazing, horticulture and dairy sectors;
2. **Pesticide threat, delivery and management:** Investigation of pesticide management in the sugar, beef grazing and horticulture industries and pesticide transport pathways in freshwater and marine ecosystems; and
3. **Tracking change:** Development of robust and cost effective techniques for measuring and reporting key monitoring indicators.

2.1 The role of integration

Reef Rescue R&D will increase knowledge about the cost effectiveness of implementing improved agricultural practices that have water quality benefits, and the factors affecting practice adoption across industries and regions. Importantly, it will contribute to achievement of the *Caring for our Country* five-year outcomes and targets by informing the effective and efficient delivery of the *Water Quality Grants Program*, and will also contribute to scheduled evaluations of the program's effectiveness and achievements through linkages with the *Water Quality Monitoring and Reporting* program. It will utilize the mechanisms established through the *Reef Partnerships Program* to ensure that the research is conducted in collaboration with landholders and managers, and that the results are communicated efficiently and effectively.

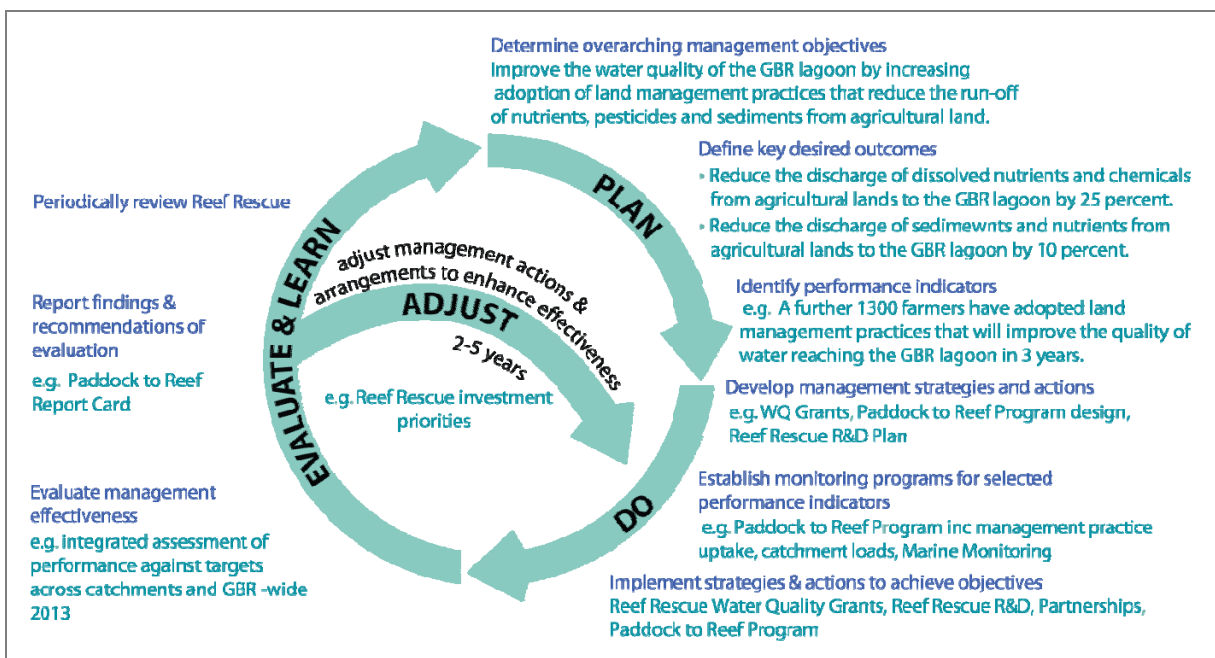


Figure 1: Schematic showing how the components of *Reef Rescue* interact and contribute to an adaptive management approach. The blue text shows the overarching actions, the green text indicates how the components of *Reef Rescue* are achieving these actions.

The Reef and Rainforest Research Centre (RRRC) has been engaged to coordinate and integrate *Reef Rescue R&D*. A key responsibility of the RRRC in providing a Science Coordination team for *Reef Rescue R&D* is to ensure that, to the extent practicable, the work undertaken through these companion programs are complementary and successfully integrated. The objectives for the integration of *Reef Rescue R&D* are to:

1. **Facilitate and document project linkages** across the *Reef Rescue R&D* portfolio of projects to foster collaboration between researchers and develop integrated outputs that meet the needs of end users;

2. **Understand and communicate** how *Reef Rescue R&D* links to and builds on companion research to deliver research efficiencies; and
3. **Foster synergies** between *Reef Rescue R&D* and related research, management and policies that contribute to Reef health so that there is a higher return on investment, targeted knowledge transfer and more likelihood of enduring outcomes for reef water quality and sustainable agriculture.

This report on Research Program Linkages for *Reef Rescue R&D* documents, within the context of all activities underway across the Great Barrier Reef and its catchments, the objectives and contributing actions that will ensure integrated outcomes of far more benefit to Reef health than if each set of activities was undertaken in isolation. It provides an overview of *Reef Rescue R&D*, the project linkages identified to date and important linkages to other related research and monitoring programs. Approaches to facilitating integration within the program and with other initiatives are also identified.

3. Overview of *Reef Rescue R&D*

Reef Rescue R&D includes 18 research projects² and a program coordination and integration role. The projects were selected from an Expression of Interest process, and assessed by a Technical Advisory Panel using set evaluation criteria. The total value of the Program is almost \$9 million, to be carried out between May 2011 and June 2013, with final reporting due in September 2013. Research priorities were determined in consultation with the Queensland Government, universities and research organisations, and other key stakeholders in the development of the *Reef Rescue Research and Development Plan* (December 2009).

The overall objective of *Reef Rescue R&D* is to improve our understanding of the link between land management practices and environmental impacts and improve water quality across the Great Barrier Reef by supporting a reduction in the amount of nutrients, chemicals and sediments reaching the Reef from agricultural lands. The structure of *Reef Rescue R&D* is shown in Figure 2, and comprises three main sub programs (outlined in detail in Section 2):

1. Adoption and development of sustainable practices that improve water quality outcomes;
2. Pesticide threat, delivery and management; and
3. Tracking change.

Each sub program is summarised in Section 3.1.

² A brief description of each of the projects including the research objectives and outputs is provided for download at http://www.rrrc.org.au/reefrescue/downloads/project_overviews_220611.pdf

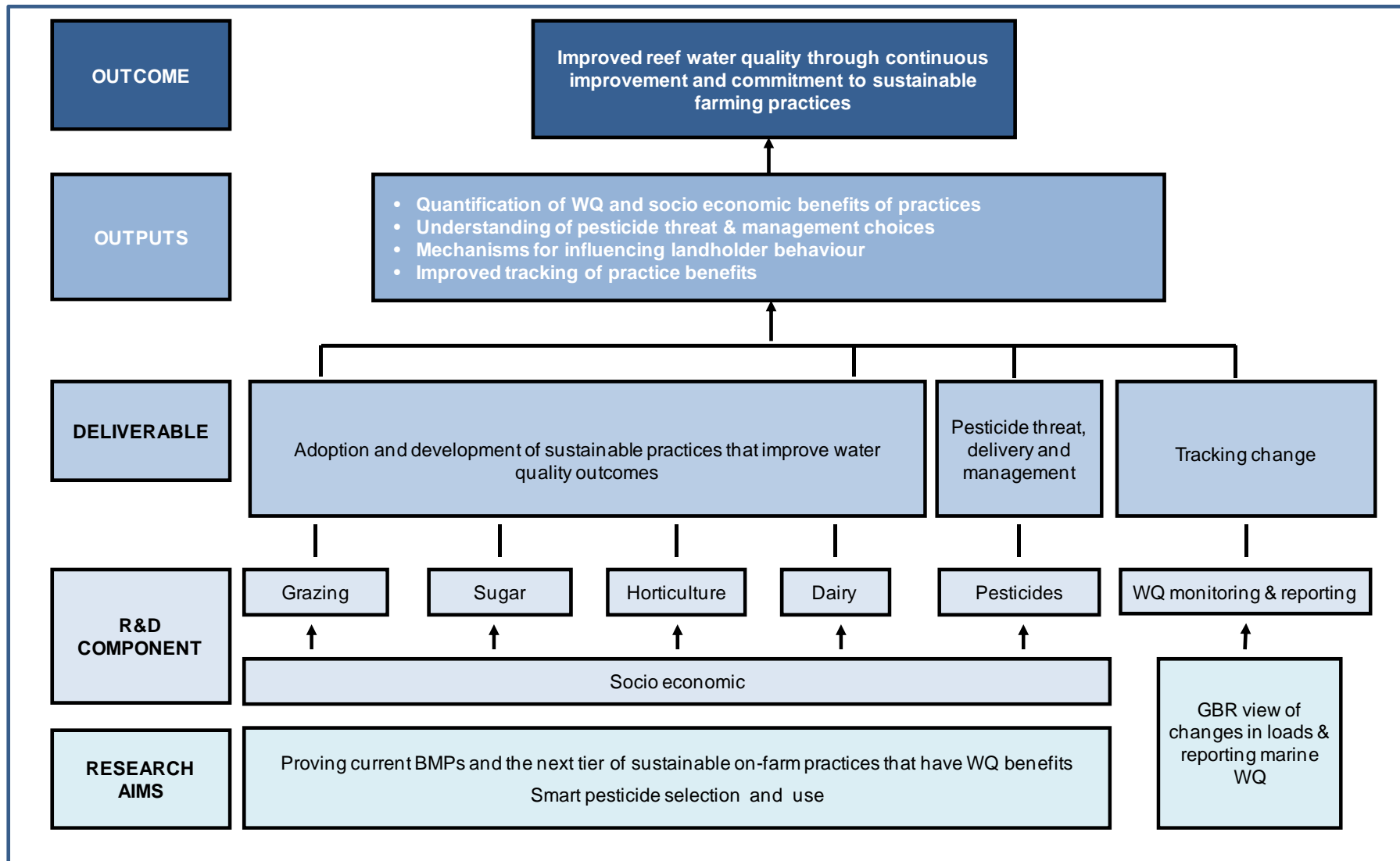


Figure 2: Structure of the Reef Rescue Water Quality Research and Development Program (*Reef Rescue R&D*).

3.1 Adoption and development of sustainable practices that improve water quality outcomes

A total package of \$1,575,000 is allocated to understanding the social and economic motivations for practice improvement and potential constraints to the adoption of improved practices due to impacts on profitability and sustainability. The research will build on the experiences of NRM groups and draw upon existing knowledge about water quality outcomes and economic/profitability and sustainability aspects in order to inform the delivery of *Reef Rescue* incentives. An analysis of what worked, what didn't, key motivations and directions for any next tier of activities in improving practice for the GBR catchments and as a flow on, implications for Australia, will also be delivered.

Further development, trial and validation of sustainable management practices that improve water quality outcomes in the sugar, beef grazing, horticulture and dairy sectors will also be investigated.

Grazing – A total package of \$1,870,000 has been allocated across four projects that address the major issues in improving grazing practice: rehabilitating degraded lands, improving ground cover and reducing sediment loads and evaluating introduced pastures from a nutrient loading perspective.

Sugar – \$1,585,000 has been allocated to a package of three projects that will focus on proving up the water quality benefits and sustainability of 'A-class' practices while also filling gaps in knowledge on smarter irrigation and fertiliser systems and the role of fallows in reducing the need for the application of fertiliser.

Horticulture – On a Reef-wide scale, bananas are the main horticultural crop based on areal extent, pesticides and fertilisers used that contributes to GBR water quality. A total of \$450,000 has been allocated to two projects that foster smarter pesticide use and fertiliser practices for the banana industry.

Dairy – Dairy, the main intensive animal industry, is generally established on the volcanic soils of the Atherton and Eungella Tablelands and the Burnett region, and is managed very differently to the more extensive beef grazing that has its own subprogram of R&D (see above). The greatest impact of dairy operations on water quality is from increased discharge of nutrients, however, intensive animal industries in high rainfall catchments can also increase sediment loads if cattle are not excluded from creek lines and watercourses. A total of \$467,000 has been allocated to a single project that will foster smarter fertiliser practices for the dairy industry.

3.2 Pesticide threat, delivery and management

A total package of \$1,650,000 has been allocated across three projects. These projects combined will deliver a far better appreciation of the magnitude of the chemical pollution issues for the GBR and the contributing sources and land uses. They will also establish systems, protocols and practices for routine monitoring.

3.3 Tracking change: water quality monitoring techniques and reporting

A total of \$714,000 has been allocated through two projects for improving reporting of two primary indicators for *Reef Rescue*: pollutant loads and marine water quality. The research will develop techniques for reporting end of catchment pollutant loads entering the GBR lagoon (catchment by catchment) with uncertainty estimates. It will also develop a metric for reporting marine water quality using datasets collected from remote sensing, and *in situ* monitoring.

4. Integrating *Reef Rescue* R&D

4.1 *Reef Rescue* R&D project linkages

Integration Objective:

- Facilitate and document project linkages across the *Reef Rescue* R&D portfolio of projects to foster collaboration between researchers and develop integrated outputs that meet the needs of end users.

The success of *Reef Rescue* R&D will be highly dependent on the interaction between projects, sharing of data outputs and research outcomes, and establishing efficient communication between projects in the portfolio and externally.

The Science Coordination team will facilitate linkages between projects and encourage participants to build partnerships between project teams with similar end users and research partners, and transfer and share ownership of the research results to other researchers and research user groups.

The primary links that exist between the projects in *Reef Rescue* R&D are identified in **Attachment 1** and illustrated in **Figure 3** (the diagram in Figure 3 will be enhanced and expanded over time). In particular, the socio-economic projects that will assess the cost effectiveness of management practices and landholder behaviour (RRRD010 and RRRD039) will need to establish and maintain direct links with the management practice projects (e.g. RRRD024 Rehabilitating D condition land; refer to Figure 3) to maximise data exchange and minimise duplication, particularly with regard to landholder surveys. This is also the case for collaboration with external programs planning to undertake landholder surveys in the region. The pesticide projects (RRRD037 and RRRD038) will also feed data into many of the management practice projects (e.g. RRRD056 'A-class' practices in sugarcane) regarding pesticide dynamics, management effectiveness and alternative management approaches in the sugarcane, grazing and horticulture industries. Within each 'theme', there are also direct linkages between projects. Close collaboration between these projects will be important for data exchange but also to streamline communication efforts with industry groups and extension officers.

Data management and exchange

Data sharing and exchange between projects will provide direct linkages within the portfolio. **Attachment 1** includes a first indication of data exchange requirements for each project, identifying

specific datasets to be supplied to or received from another project, and the format and timing of the exchange of data. It is envisaged that this detail will be expanded in the first three to six months of the program, with regular follow up of Project Leaders by the Science Coordination team regarding progress.

A number of principles relating to data management for *Reef Rescue R&D* will be followed:

1. All information will be publicly available (only background IP may be restricted);
2. A repository for project derived data will be identified. The RRRC maintains the [e-Atlas](#) for this purpose, and opportunities to contribute to the data management systems being developed for the Paddock to Reef Program will be investigated; and
3. Final reports must include metadata (which describes the data and where it is housed).

Approach

The Science Coordination team will establish program-level data management protocols that facilitate data capture and management for *Reef Rescue R&D* by September 2011. The RRRC team will facilitate the input of spatially explicit information and ANZLIC compliant metadata generated by *Reef Rescue R&D* projects into the e-Atlas. The e-Atlas' ANZLIC-compliant metadata template was developed in conjunction with ERIN and reviewed by them for compliance prior to implementation. Intellectual Property arrangements for existing material will be clarified and, where possible, we will maximise the outputs available to the public and deliver greater certainty around the synthesis of pre-contract and contract data.

Actions for facilitating integration between Reef Rescue R&D projects

A portion of the funding allocation to *Reef Rescue R&D* has been set aside for program coordination and integration. The *Reef Rescue R&D Communications Strategy* provides a detailed overview of how the outcomes of the research will be communicated both throughout and at the completion of *Reef Rescue R&D*, mechanisms for facilitating collaboration between project teams, and approaches to the engagement of end users and the delivery of research results.

Suggested approaches to facilitating collaboration between projects include:

- An annual workshop of Project Leaders, project teams, research partners, industry representatives and other key stakeholders to share updates on project progress and linkages to other research.
- Development of a dedicated website for *Reef Rescue R&D*. Resources will include: web based updates for each project and *Reef Rescue R&D* more broadly; interactive web based tools that show relationships between projects in terms of building on existing knowledge, research deliverables and impact indicators; and a variety of technical and interpreted information, the latter generated by the Service Provider (or researchers) with specific audiences and research users in mind. A temporary site has already been set up to host basic information about the program (<http://www.rrrc.org.au/reefrescue/index.html>). Linkages will be made between the *Reef Rescue R&D* site and related programs (see Section 4.2).

- Development of data management protocols and identification of requirements for formal data exchange between projects in terms of datasets to be provided between projects, the timing and format of exchange (to be incorporated into the project MERI Plans).
- Provision of opportunities for Project Leaders to contribute and house project datasets and interpreted results through the e-Atlas.
- Coordination of meetings of groups of related projects (e.g. industry based meetings or sub programs) as required.

The *Reef Rescue R&D Communications Strategy* contains the plans and actions for delivering the outcomes of *Reef Rescue R&D* to a wide range of interest groups, and also incorporates a timeline of relevant events.

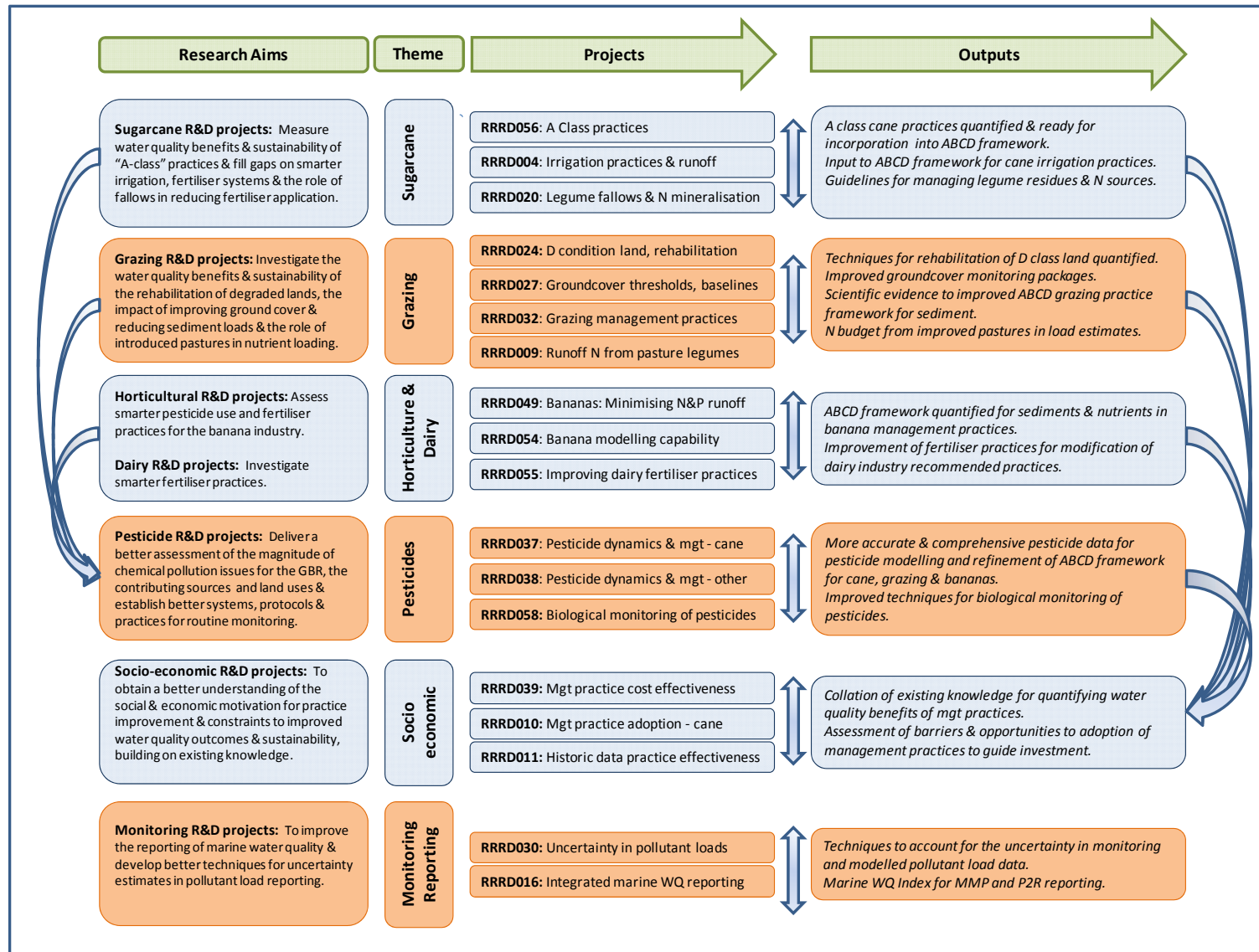


Figure 3: Illustration of the primary linkages between Reef Rescue R&D projects.

4.2 Reef Rescue R&D links to other programs

Establishing and maintaining links between *Reef Rescue R&D* and other programs requires delivery and achievement of two aspects of integration as outlined below.

Integration Objectives:

- Understand and communicate how *Reef Rescue R&D* links to and builds on companion research to deliver research efficiencies.
- Foster synergies between *Reef Rescue R&D* and related research, management and policies that contribute to Reef health so that there is a higher return on investment, targeted knowledge transfer and more likelihood of enduring outcomes for reef water quality and sustainable agriculture.

Several research and monitoring initiatives related to water quality management in the GBR are directly relevant to *Reef Rescue R&D* and it is critical that collaboration and linkages with these initiatives are established and maintained. In order to do this effectively, the Science Coordination team must understand and be able to communicate the linkages between *Reef Rescue R&D* and related programs.

Figure 4 shows a summary diagram of the broad scope of each of the key related initiatives. A brief overview of each of the programs mentioned below is provided in **Attachment 2**, which describes each program in terms of its objectives, lead agency, partner organisations, approaches, outputs, and the synergies with *Reef Rescue R&D*.

The programs of primary interest are:

- **Reef Plan Integrated Paddock to Reef Monitoring, Modelling and Reporting Program** (Paddock to Reef Program, Australian and Queensland governments) – measures and annually reports on progress towards the Reef Plan goals and targets;
- **Reef Protection Program’s science framework** (Queensland Government) – developed to support implementation of the *Great Barrier Reef Protection Amendment Act 2009* (Queensland) and deliver a science framework to ensure that the Reef Regulation Program delivery is effective, transparent and evidence-based;
- **National Environmental Research Program Tropical Ecosystems Hub** (NERP – Australian Government) – established to improve knowledge of ecosystem condition and trend, ecosystem function and cumulative pressures, and building resilient tropical ecosystems in the GBR, Torres Strait and north Queensland rainforests; and
- **eReefs** (Great Barrier Reef Foundation) – working towards an integrated system of data, models, visualisation, reporting and decision support tools that span the entire GBR (building on the GBR hydrodynamic model in the first phase).

In addition, the following initiatives are relevant and contain discrete packages of relevant research:

- Queensland Government (DEEDI and DERM) initiatives including ‘Sustainable Agriculture’;
- Queensland Wetlands Program;

- Sugar Research and Development Corporation (sugar industry water quality related research);
- Meat and Livestock Australia (grazing industry water quality related research);
- Horticulture Australia Limited (horticulture industry water quality related research); and
- Dairying Australia (dairy industry water quality related research).

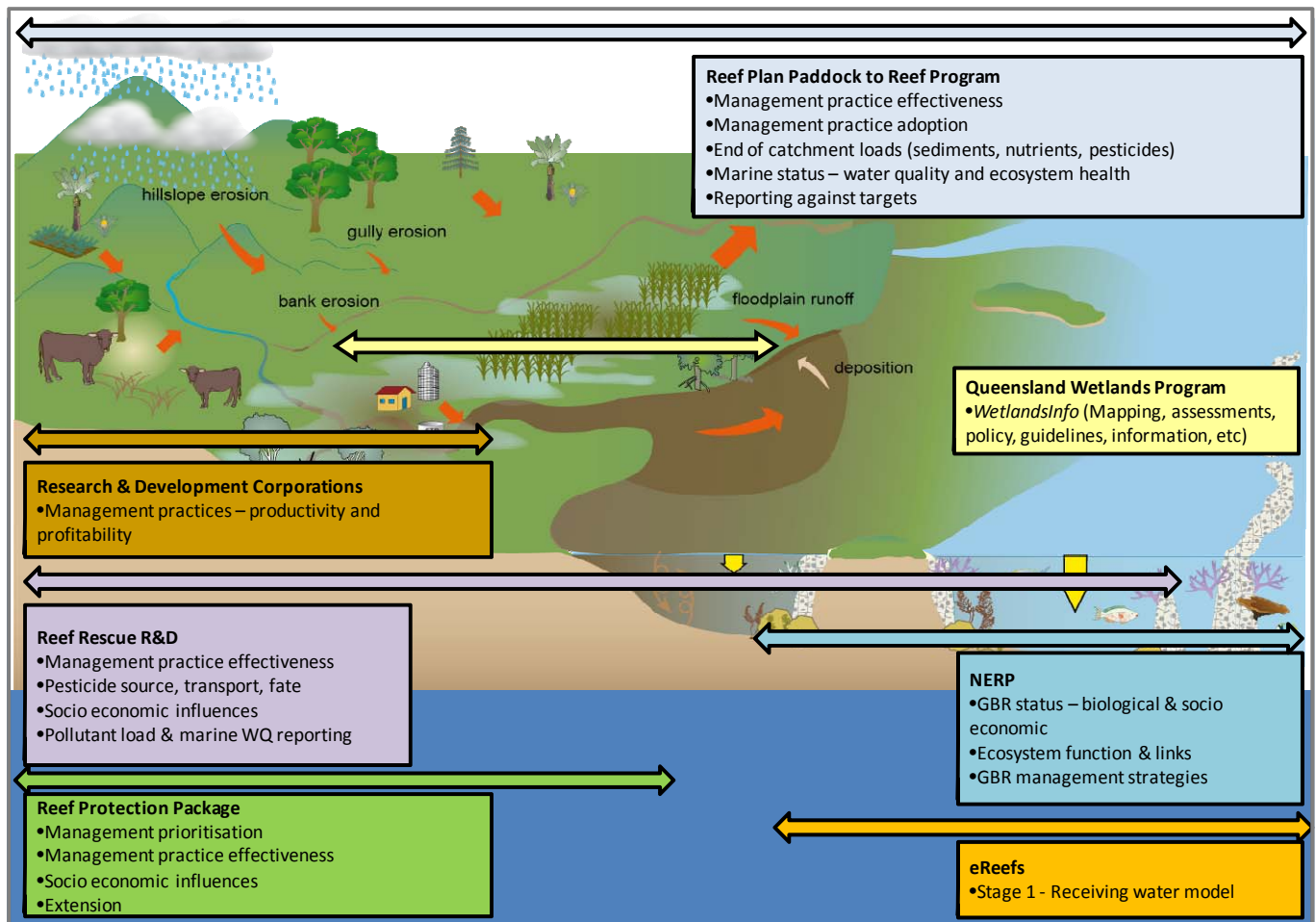


Figure 4: Summary of the scope of research initiatives relevant to Reef Rescue R&D.

Reef Rescue R&D will also build on many research initiatives that have contributed to the knowledge base that informs current water quality management in the GBR. These include the Marine and Tropical Sciences Research Facility (MTSRF), CSIRO Water for a Healthy Country National Research Flagship, CRC Reef and the Catchment to Reef Program, the Australian Government Coastal Catchments Initiative, the Coastal CRC, and discrete research undertaken by industry research and development corporations, the Australian Institute of Marine Science, the Australian Research Council Centre of Excellence for Coral Reef Studies, the Great Barrier Reef Marine Park Authority, Queensland Government agencies and universities. The outcomes of these programs have many linkages to the proposed *Reef Rescue* research and form the basis of the current *Reef Rescue* and Reef Plan policy platforms. Much of this information has been synthesized into products that are

used by Australian and Queensland government agencies, regional NRM bodies, industry groups and non government organizations such as WWF. A prominent example of the synthesis of existing knowledge is the *Scientific Consensus Statement on Water Quality in the Great Barrier Reef*³. The outcomes of the MTSRF have also recently been synthesized into a number of topics of interest to water quality managers⁴.

The synergies between each project and the related Programs – initially in terms of scope – are captured in **Attachment 1**, and are shown specifically in **Figure 5** for the Paddock to Reef Program, Reef Protection Package Science Program, NERP and eReefs. Research being undertaken by industry organisations and specific projects for all initiatives could be added over time, and detailed relationships between projects and programs should be captured.

In addition to linking to related research initiatives, there are several policy areas which will benefit from the results of *Reef Rescue R&D*. These are outlined in Section 4.3 and include other aspects of *Reef Rescue* particularly the Water Quality Grants Program, assessment and review of the Reef Plan and *Reef Rescue* targets, input to the Paddock to Reef Program, and guidance for the Reef Protection Package.

Several actions have been identified for facilitating integration and fostering synergies with related research initiatives, management actions and policies. Achievement and delivery of these actions will enhance the outcomes of the *Reef Rescue R&D* projects in addition to adding value to the greater effort of water quality related research in the GBR by adopting a collaborative approach across the range of initiatives.

Actions for facilitating integration and synergies with related research initiatives, management actions and policies

Many of the approaches identified for facilitating integration between *Reef Rescue R&D* projects will also facilitate collaboration with related research programs, in addition to the following activities:

- Development of specific communication products that provide information on *Reef Rescue R&D* to facilitate engagement with other related research programs and where relevant, specific research projects. Examples include regular emailed news alerts to familiarise researchers and end-users with key personnel and current activities (both researcher activities and end-user activities) and increase opportunities for links both within and outside Reef Rescue R&D over time, an overview of all of the projects, and schematics that illustrate the relationships between programs and projects (such as **Figures 4 and 5**).

³ Brodie, J., Binney, J., Fabricius, K., Gordon, I., Hoegh-Guldberg, O., Hunter, H., O'Reagain, P., Pearson, R., Quirk, M., Thorburn, P., Waterhouse, J., Webster, I., Wilkinson, S. (2008a) [Scientific Consensus Statement on Water Quality in the Great Barrier Reef](#). The State of Queensland (Department of Premier and Cabinet) Brisbane.

Brodie, J., Binney, J., Fabricius, K., Gordon, I., Hoegh-Guldberg, O., Hunter, H., O'Reagain, P., Pearson, R., Quirk, M., Thorburn, P., Waterhouse, J., Webster, I., Wilkinson, S. (2008b) [Synthesis of evidence to support the Scientific Consensus Statement on Water Quality in the Great Barrier Reef](#). The State of Queensland (Department of Premier and Cabinet) Brisbane.

⁴ For further information go to http://www.rrrc.org.au/publications/synthesis_products.html).

- Development and maintenance of interactive web based tools that show relationships between related programs.
- Engagement with a variety of established extension networks for disseminating new information to farmers, particularly the considerable and effective extension officer programs run by industry, NRMs and government departments. We will seek to take advantage of this existing capacity in delivering *Reef Rescue R&D* information to those at the coal face of practice change.
- Coordination of a *Reef Rescue R&D* workshop each year with the objective of maximising opportunities for two-way communication between researchers and end-users of that research. It is proposed that symposia topics will focus on audience needs and synthesis questions. Provision of opportunities for informal conversations at these workshops will be important for building and maintaining useful two-way relationships between researchers and those in a position to use the new information.
- Coordination of *Reef Rescue R&D* events with other industry-centric events such as conferences, field days and shed meetings. Opportunities for *Reef Rescue R&D* participating in a large joint synthesis conference of all agencies and programs involved in Reef Rescue and Reef Plan (including Paddock to Reef Program, Reef Protection Program and NERP) towards the end of the two-year research program will be investigated.
- Regular liaison with a range of stakeholders in three primary phases: Introduction to *Reef Rescue R&D* (July to September 2011), progress updates throughout the program (September 2011 to June 2013) and final outcomes / future directions (May 2013 to September 2013). Target groups include:
 - Leaders of the Paddock to Reef Program, Reef Protection Package Science Program, NERP and eReefs.
 - Representatives of industry organizations including CaneGrowers, AgForce, Queensland Farmers Federation, GrowCom and the Australian Dairyfarmers Association.
 - Reef Rescue Industry Working Groups.
 - Industry Research and Development Corporations including Sugar Research and Development Corporation, Meat and Livestock Australia and Horticulture Australia Limited.
 - Regional NRM groups including Terrain NRM, NQ Dry Tropics, Reef Catchments, Fitzroy Basin Association and Burnett Mary Regional Group.
 - Other interested organisations such as WWF.
- Participation in events or meetings of related programs and industry groups.
- Presentation of the progress of *Reef Rescue R&D* to relevant committees including the Paddock to Reef Program Coordination and Advisory Group and the GBRMPA's Coastal Regional Advisory Committee.
- Meetings of 'clusters' of similar activities across relevant research programs attended by Project Leaders and the Science Coordination team and representatives from related projects. Examples of themes include pesticides, socio economic surveys, and reporting approaches. This will require agreement between the Program Leaders on the objectives and proposed outcomes of the meetings and required attendance in the early stages of the program.

- Participation of the Science Coordination team and representatives of specific projects, where appropriate, at a range of events including communication and planning events of related initiatives.
- Participation of the Science Coordination team in planning for the next tier of investment in research that supports the objectives of Reef Rescue.

The *Reef Rescue R&D Communication Strategy* contains further details of the plans and actions for delivering the outcomes of *Reef Rescue R&D* to a wide range of interest groups, and also incorporates a timeline of relevant events.

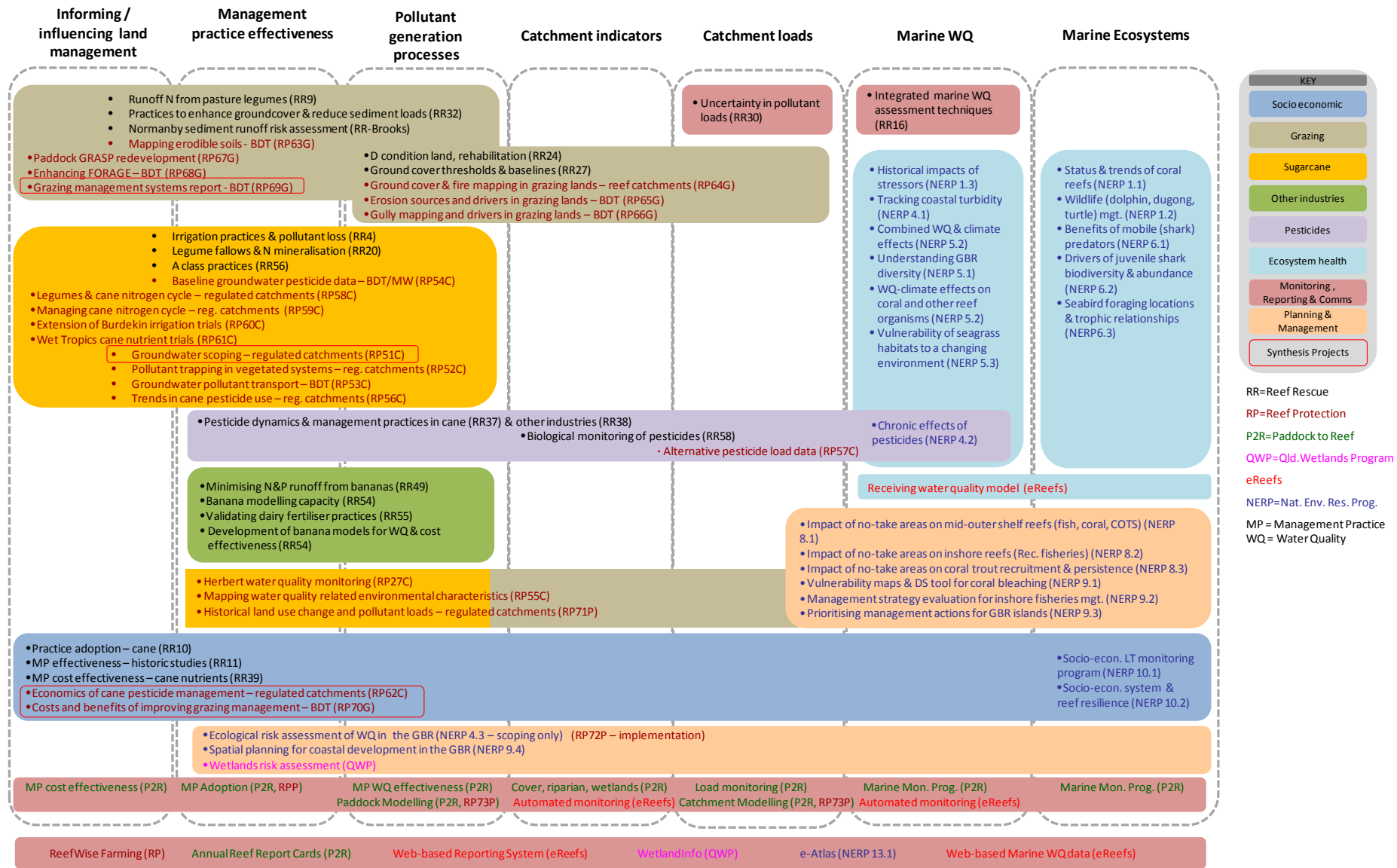


Figure 5: Synergies between the Reef Rescue R&D projects and related research projects and programs.

4.3 Reef Rescue in context

To assist in the coordination and integration of activities within *Reef Rescue R&D* and related initiatives, it is important to clarify how the program fits into the overall scope of activity related to water quality management in the GBR. This section provides an overview of these linkages.

Reef Rescue and Reef Plan

Reef Rescue is one of several initiatives that contribute to implementation of the Reef Water Quality Protection Plan (Reef Plan). The Reef Plan (established in 2003 and updated in 2009) is a joint agreement between the Australian and Queensland Governments with an overarching goal to ‘halt and reverse the decline in water quality entering the Great Barrier Reef’ by 2013. To achieve its aim, the Plan’s objectives are to: (i) Reduce the load of pollutants from diffuse sources in the water entering the Reef, and (ii) Rehabilitate and conserve areas of the Reef catchment that have a role in removing water borne pollutants. It also outlines a set of activities to be carried out by multiple designated participants that would lead to an actual plan of on-ground activities.

Following the approach presented in **Figure 1** for *Reef Rescue*, the range of major activities that are underway for Reef Plan implementation is captured in **Figure 6**, reflecting the adaptive approach to management. It provides context of how *Reef Rescue* more broadly, and specifically *Reef Rescue R&D*, fit into the overall scope of activity related to water quality management in the GBR under the Reef Plan.

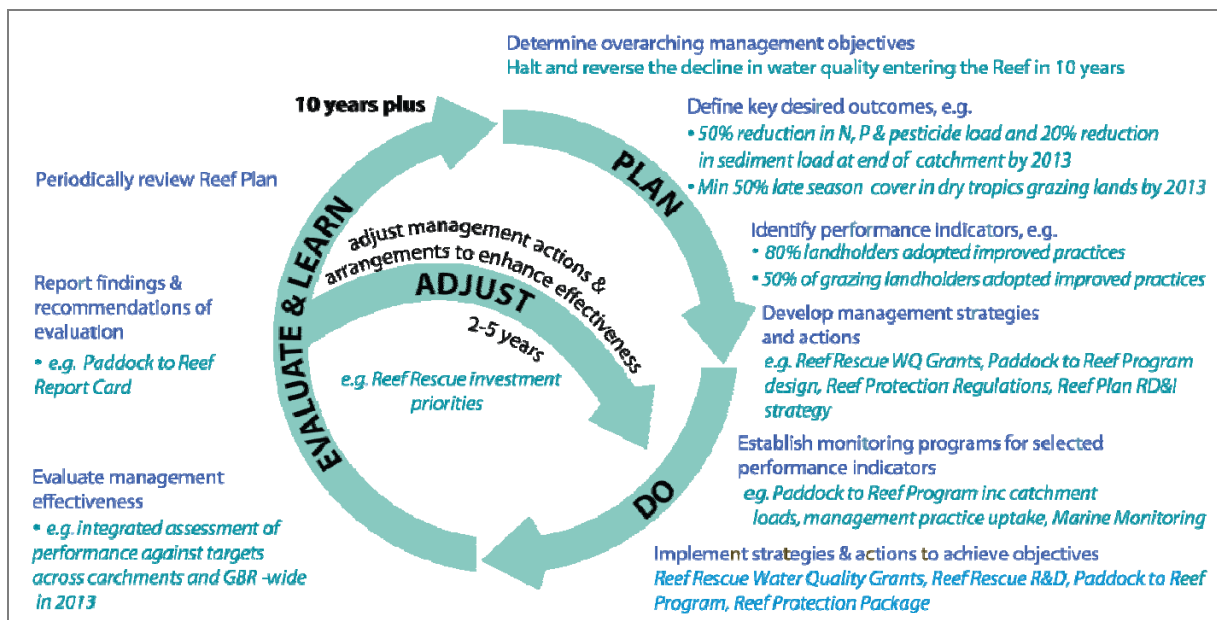


Figure 6: Adaptive management cycle for the Reef Plan showing the main actions, objectives and outcomes, and how the various water quality related initiatives in the GBR contribute.

Figure 6 demonstrates the links between some key initiatives in the ‘water quality scene’, including planning and target setting, implementation of management strategies and actions including development of new knowledge, evaluation and reporting of management effectiveness (which in turn informs management actions) and review. This is particularly relevant in the context of the complexity of the GBR system in terms of ecological relationships from the catchment to the Reef, socio economic influences and regional differences within the system. There are also potentially long time frames associated with measuring change or ecosystem response as a result of on ground actions, and complex institutional arrangements that surround water quality management in the GBR. The underlying assumption is that improvements in land management practices will result in positive changes to GBR ecosystem health through reduced discharge of sediments, nutrients and pesticides to the GBR. However, our capacity to measure these relationships is limited by gaps in our knowledge related to the water quality benefit and cost effectiveness of a range of management practices, transport and processing of sediments, nutrients and pesticides and the influence of different catchment characteristics on material movement, and the quantification of the exposure of GBR ecosystems to these pollutants and the measurable effects or response. This emphasises the importance of research and monitoring programs including *Reef Rescue R&D* that support water quality management in the GBR, and the importance of the feedback loop in the management cycle to inform future planning and management.

The key components of water quality management in the GBR within the feedback loop of the adaptive management cycle are described in relation to *Reef Rescue R&D* below.

Targets and goals

In 2009, Reef Plan 2003 was revised and updated to Reef Plan (2009) with better defined targets and actions for water quality improvement and management practice change by 2013. In addition, Reef Plan 2009 aims to ensure that ‘by 2020 the quality of water entering the Reef from adjacent catchments has no detrimental impact on the health and resilience of the GBR’. While forming an integral component of Reef Plan 2009, *Reef Rescue* has its own five-year outcome targets (i.e. by 2013). Both initiatives specify management action, catchment condition and end-of-catchment (EOC) pollutant load reduction targets for 2013 reported at catchment, regional and GBR-wide scales. These are summarized in Table 2 with an indication of the intended contributions of *Reef Rescue R&D* to achieving these targets.

Table 1: *Reef Rescue* (shaded cells) and Reef Plan targets for the GBR (EOC = End of Catchment).

Target	Scale (area) for reporting	Reef Rescue R&D contribution (sub program)
Reduce the load of dissolved nutrients from agricultural lands to the GBR lagoon by 25% by 2013	EOC for all GBR catchments	Sustainable Practices (Sugar, Hort, Dairy) Tracking Change (Loads)
Reduce the discharge of particulate nutrients from agricultural lands to the GBR lagoon by 10% by 2013	EOC for all GBR catchments	Sustainable Practices (Grazing) Tracking Change (Loads)
50% Reduction in N load at EOC by 2013 Total N plus DIN, DON, PN	EOC for all GBR catchments	Sustainable Practices (Sugar, Hort, Dairy) Tracking Change (Loads)
50% Reduction in P load at EOC by 2013 Total P plus DIP, DIP, PP	EOC for all GBR catchments	Sustainable Practices (Sugar, Hort, Dairy) Tracking Change (Loads)
Reduce the load of chemicals from agricultural lands to the GBR lagoon by 25% by 2013	EOC for all GBR catchments	Chemical threat, delivery & management
50% Reduction in pesticide load at EOC by 2013	EOC for all GBR catchments	Chemical threat, delivery & management
Reduce the discharge of sediment from agricultural lands to the GBR lagoon by 10% by 2013	EOC for all GBR catchments	Sustainable Practices (Grazing) Tracking Change (Loads)
Minimum 50% late dry season groundcover in DT grazing lands by 2013	Sub catchment for Burdekin and Fitzroy.	Sustainable Practices (Grazing) Tracking Change (Groundcover)
20% Reduction in sediment load by 2020	EOC for all GBR catchments	Sustainable Practices (Grazing) Tracking Change (Loads)
To increase the number of farmers who have adopted land management practices that will improve the quality of water reaching the reef lagoon by a further 1300 over 3 years	Sub catchment or catchment by sector	Sustainable Practices (All aspects) – next steps
To increase by 650 the number of pastoralists over an area of 3.8 million hectares, who have improved ground cover monitoring and management in areas where run-off from grazing is contributing significantly to sediment loads and a decline in the quality of water reaching the reef lagoon by 2013	Sub catchment or catchment	Sustainable Practices (All aspects) – next steps
80% of landholders adopted improved practices	Sub catchment or catchment by sector	Sustainable Practices (All aspects) – next steps
50% of landholders adopted improved practices	Sub catchment or	Sustainable Practices (All

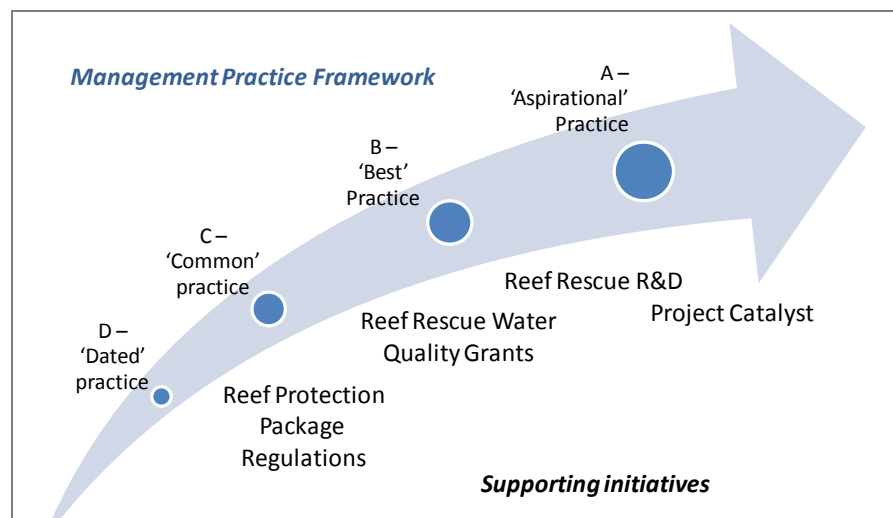
Target	Scale (area) for reporting	Reef Rescue R&D contribution (sub program)
(grazing)	catchment	aspects) – next steps
No net loss or degradation of wetlands	Catchment for all GBR catchments	
Condition and extent of riparian areas improved	Catchment for all GBR catchments	

Management strategies and actions

The management strategies and actions in place to achieve *Reef Plan* and *Reef Rescue* targets include on ground actions, monitoring and evaluation programs and research and development.

Current approaches to improving management practices in the GBR incorporate the complete scope of actions from voluntary actions to incentive based on ground works, regulation of minimum standards and resource allocation for the development of innovative practices. The *Great Barrier Reef Protection Amendment Act 2009*⁵ (Reef Protection Package) directly regulates the water quality impacts of cattle grazing on properties of more than 2,000 ha in the Burdekin Dry Tropics and all commercial sugarcane farming in the Burdekin Dry Tropics, Mackay Whitsunday and Wet Tropics catchments. It introduces a minimum standard of management practices, and is generally aimed at moving landholders towards the adoption of C class practices as a minimum. The *Reef Rescue Water Quality Grants Program* provides a significant contribution (incentive based) to the adoption of B class, or current industry best management, practices across all industries. In addition to examining the effectiveness and efficiencies of B class management practices, *Reef Rescue R&D* is supporting research into innovative, or A class practices, as are other initiatives such as Project Catalyst in the sugarcane industry. The relationship between these programs with regard to incremental improvements in management practices in the GBR is shown in **Figure 7**.

Figure 7: Example of a pathway for improving sustainable management practices that have water quality benefits for the GBR across a range of initiatives. *Reef Rescue R&D* investigates water quality and socio economic outcomes of current B class practices and A class practices.



⁵ Queensland Government, introduced in October 2009, <http://www.reefwise farming.qld.gov.au/>

Research, development and innovation are critical elements in progressing towards the goals and objectives of the Reef Plan. A Reef Plan Research, Development and Innovation (RD&I) Strategy⁶ has been developed to promote a more coordinated approach to reef water quality research and to guide research investment to 2013. The strategy advocates a focus on the needs of end users of reef water quality research and on 'solving the problem' of declining reef water quality. Updated knowledge gaps and prevailing research priorities identified by end users will be documented in annual Reef Plan RD&I Plans.

The Reef Plan RD&I Strategy and synthesis documents such as the *Scientific consensus statement on water quality in the Great Barrier Reef* facilitated the formulation of research priorities for *Reef Rescue R&D*. These priorities are described in the *Reef Rescue Research and Development Plan*. *Reef Rescue R&D* will provide a significant contribution to filling many of the knowledge gaps related to Reef Plan implementation. The Reef Protection Program is also supporting a targeted research program. Reef water quality research and development is also supported through initiatives such as the National Environmental Research Program⁷ (NERP). There are strong potential linkages between these initiatives which are discussed further below.

Reef Plan 2009 includes a monitoring and evaluation strategy⁸ to evaluate the efficiency and effectiveness of implementation and report on progress towards the Reef Plan and *Reef Rescue* goals and targets. A key action of Reef Plan 2009 is the development and implementation of the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program⁹ (herein referred to as the P2R Program). The *Reef Rescue Water Quality Monitoring and Reporting Program* forms a part of this program which was established in 2009. The framework for the design involves monitoring and modelling a range of attributes at a range of scales including management practices and water quality at the paddock, sub catchment, catchment levels and in adjacent marine areas. This approach provides the ability to link the monitoring and modelling outputs at each scale and across scales. The Reef Protection Program will also use the results of the P2R Program.

Evaluation, periodic adjustment and review

The primary mechanism for evaluating progress against the Reef Plan and *Reef Rescue* targets is through assessment of the results of the P2R Program. This is reported annually through a Report Card with supporting technical information. The monitoring results and outcomes of *Reef Rescue R&D* related to adoption and improvement of management practices may be used to guide investment through the *Reef Rescue Water Quality Grants Program*, thereby adjusting management strategies on a regional basis as required using best available knowledge. The outcomes of projects related to sustainable practices and pesticide management will also inform the review and update of the ABCD framework adopted by management agencies and industries in the GBR. Projects that are investigating improved monitoring and reporting techniques will inform the review of the monitoring design and reporting techniques for the P2R Program.

⁶ <http://www.reefplan.qld.gov.au/library/pdf/Reef-Plan-RDI-Strategy.pdf>

⁷ <http://www.environment.gov.au/about/programs/nerp/index.html> and http://www.rrrc.org.au/nerp_te_hub.html

⁸ <http://www.reefplan.qld.gov.au/library/pdf/Reef-Plan-Monitoring-Eval-strategy.pdf>

⁹ <http://www.reefplan.qld.gov.au/publications/paddock-to-reef.shtm>

A more comprehensive review of the Reef Plan and *Reef Rescue* initiatives will be required as the programs draw to a close in 2013. Therefore, the identification of critical knowledge gaps beyond the current *Reef Rescue R&D* will be important for guiding future policy on water quality management in the GBR. Outcomes of *Reef Rescue R&D* will also inform the preparation of the GBR Outlook Report, prepared by the GBRMPA with the next reporting due in 2014.

An important aspect of moving forward is the need to develop a more integrated assessment of available knowledge to test assumptions about the links between management actions, pollutants loads, ecosystem response and associated socio economic drivers. This information could inform a risk assessment for the GBR in terms of prioritising pollutants (e.g. sediment versus nutrients versus pesticides), refining priority areas for intervention and revisiting the targets.

5. Consultation and Review of this Report

The draft version of this report was circulated to a wide range of interest groups for comment and much of the content was originally derived from an inception workshop held for *Reef Rescue R&D* in June 2011. Through this workshop and circulation of the draft report, information has been derived from Project Leaders, the Reef Rescue team, the Science Coordination team, leaders of related research programs, and end users of the research including regional NRM groups, industry associations and industry research and development corporations.

To ensure that the information in this report remains current for the duration of *Reef Rescue R&D*, it will be reviewed and updated periodically, with current versions of the report available for download from the *Reef Rescue R&D* website. Feedback from Project Leaders and representatives of other programs will be invited periodically.

The success of *Reef Rescue R&D* will not only be dependent on the capacity to integrate projects within the portfolio, but also to link to related initiatives. Many research programs in the past have not recognised the importance of the links between disciplinary research and across landscapes and have been managed in isolation from other research programs and policy frameworks. This report outlines how *Reef Rescue R&D* will be coordinated to deliver a more fully integrated information package for a range of end user groups including landholders, regional NRM groups, industry and management agencies. Integrated research offers the best spread of information for managers to address water quality issues in the GBR and its catchments. GBR ecosystems face a myriad of pressures, some of which are difficult to manage. Successful management of water quality through incorporation of best available knowledge will inform policy responses and enhance on-ground land management practices to reduce key pollutants moving into the GBR system. In turn, this will help to reduce pressure on the GBR and help build more resilient reefs and ecosystems.

Attachment 1: Primary linkages between Reef Rescue R&D projects and related programs

Note: Links to other Programs will be updated as relevant initiatives are progressed.

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
Sub-Program 1: Adoption and development of sustainable practices that improve water quality outcomes				
Grazing Practices				
RRRD024: Quantifying the impacts of rehabilitating degraded lands on soil health, pastures, runoff, erosion, nutrient and sediment movement	<u>Trevor Hall</u> DEEDI	<ul style="list-style-type: none"> RRRD027 Groundcover - Remote sensing across Burdekin and Fitzroy catchments RRRD039 BMP cost effectiveness - Economics of rehabilitation treatments and incentive payments 	<ul style="list-style-type: none"> RRRD027 - Groundcover maps to for the Burdekin and Fitzroy catchment by July 2011 in digital format. RRRD039 - BMP Cost effectiveness project to advise economic questions for landholder surveys by July 2011 in test format and assist in economic analysis and interpretation by December 2012. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> Runoff losses – soil, water & nutrients from D class land: Rainfall simulator project (DERM) Pasture growth rate and production related to carrying capacity: GRASP model data (pastures & soils) <p><i>Reef Rescue WQ Grants</i></p> <ul style="list-style-type: none"> NQDT and FBA rehabilitation work with grazing landholders
RRRD027: Getting ground cover right – thresholds and baselines for a healthier reef	<u>Terry Beutel</u> DEEDI	<ul style="list-style-type: none"> RRRD032 will provide additional field validation of cover and condition RRRD032 will contribute to refining VegMachine interpretation methods RRRD024 will receive support in the form of ground cover products to assess on ground changes at various project related sites 	<ul style="list-style-type: none"> Supply groundcover summary and time series products to RRRD024 and RRRD032 for the Burdekin and Fitzroy catchments in digital formats (this will vary with product beginning June 2011). 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> Grazing monitoring sites in Fitzroy & Burdekin <p><i>Reef Rescue WQ Grants</i></p> <ul style="list-style-type: none"> NQDT and FBA reef – specific work <p><i>Reef Protection Package</i></p> <ul style="list-style-type: none"> Burdekin focus

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
RRRD032: Improving grazing management practices to enhance ground cover and reduce sediment loads	<u>Scott Wilkinson</u> CSIRO	<ul style="list-style-type: none"> RRRD024 Hall – land type imagery RRRD027 Beutel – land holder tools and techniques RRRD038 Whitten – productivity data 	<ul style="list-style-type: none"> Supply data to RRRD038 regarding productivity of site management practices. RRRD027 – Groundcover maps for the Burdekin and Fitzroy catchment required by July 2011 in digital format. 	<i>P2R Program</i> <ul style="list-style-type: none"> Grazing monitoring sites in Fitzroy & Burdekin <i>Reef Rescue WQ Grants</i> <ul style="list-style-type: none"> NQDT and FBA reef – specific work <i>Reef Protection Package</i> <ul style="list-style-type: none"> Burdekin focus
RRRD009: Runoff Nitrogen generation rates from pasture legumes – an enhancement to reef catchment modelling	<u>Craig Thornton</u> DERM	<ul style="list-style-type: none"> RRRD011 – Will be one of the studies captured in this program. RRRD038 – This project will be run at the RRRD009 site 	<ul style="list-style-type: none"> Supply pasture biomass and grazing pressure to RRRD032 on a quarterly basis. Supply data to RRRD038 on rainfall, flow and load data to post wet season (May 2012) in tabular “event summary” format. RRRD011 - Complete proforma sheet when requested. 	<i>P2R Program</i> <ul style="list-style-type: none"> Fitzroy monitoring (grazing) Source Catchments modelling and load estimation <i>Reef Rescue WQ Grants</i> <ul style="list-style-type: none"> FBA
Sugar Practices				
RRRD056: Evaluating and improving A-Class practices to control nutrient losses from sugarcane	<u>Peter Thorburn</u> CSIRO	<ul style="list-style-type: none"> Other projects exploring A-Class practices (or components) RRRD004 – Other components of A class practices within sugar industry 	<ul style="list-style-type: none"> Supply data to RRRD039 on BMP cost effectiveness of tested practices. RRRD004 – Nutrient and sediment data from novel drip and optimised furrow irrigation. 	<i>P2R Program</i> <ul style="list-style-type: none"> APSIM modelling and load estimation <i>Reef Rescue WQ Grants</i> <ul style="list-style-type: none"> NQDT, Reef Catchments & Terrain NRM <i>Project Catalyst</i> <ul style="list-style-type: none"> Wet Tropics, Burdekin & Mackay

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
				Whitsunday sites <i>Reef Protection Package</i> <ul style="list-style-type: none"> Wet Tropics, Burdekin & Mackay Whitsunday sites
RRRD004: Advanced drip and optimised furrow irrigation to minimise sediment, nutrient and pesticide losses to the environment through deep drainage and runoff from sugarcane and banana industries of wet tropics in northern Queensland	<u>David Midmore</u> University Central Queensland	<ul style="list-style-type: none"> RRRD037 & 038 Pesticide dynamics (Brodie) re: application of pesticides via dripper irrigation in pot trials RRRD056 – Knowledge of the interaction of A-class practices within the sugar industry RRRD049 - Minimising off-farm movement of nitrogen and phosphorus in the north Queensland banana industry 	<ul style="list-style-type: none"> Supply data to RRRD056 re: water quality outcomes of drip and furrow irrigation. Supply data to RRRD039 on BMP cost effectiveness of tested practices. Supply data to RRRD037 regarding pesticide losses associated with irrigation options. Supply data to RRRD049 regarding pesticide losses associated with irrigation options. 	<i>P2R Program</i> <ul style="list-style-type: none"> APSIM modelling and load estimation Sharing of others research sites, optimizing use of instrumentation and investing in quality data collection (value adding) <i>Reef Rescue WQ Grants</i> <ul style="list-style-type: none"> NQDT, Reef Catchments & Terrain NRM <i>Reef Protection Package</i> <ul style="list-style-type: none"> Wet Tropics, Burdekin & Mackay Whitsunday sites <i>Other Programs</i> <ul style="list-style-type: none"> Linking CQU current research on drip irrigation with number of industries (NPSI, HAL, Woolworths funding). Collaboration between CQU, Netafim, JCU, CSIRO, DERM, DEEDI, BBIFMAC, NQ Dry Tropics, Canegrowers Australia Enhancing the participation of growers, industry & locally based organizations and expertise (e.g. Tom McShane)

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
RRRD020: Mineralisation of nitrogen within the sugarcane cropping system following legume fallows and its effect on water quality	<u>Bernard Schroeder</u> BSES Limited	<ul style="list-style-type: none"> RRRD039 - Integrated assessment of BMP cost-effectiveness and decision tool for regions and landholders RRRD056 - -Evaluating and improving A-class practices to control nutrient losses from sugarcane 	<ul style="list-style-type: none"> Supply data to RRRD039 on BMP cost effectiveness of tested practices. 	<p><i>BSES</i></p> <ul style="list-style-type: none"> Appropriate nutrient management for new farming systems. BSS329 (SRDC): Understanding water quality in sugarcane farming systems. <p><i>P2R Program</i></p> <ul style="list-style-type: none"> APSIM modelling and load estimation <p><i>Reef Protection Package</i></p> <ul style="list-style-type: none"> Wet Tropics, Burdekin & Mackay Whitsunday sites Reducing nitrous oxide gas emissions from sugarcane lands <p><i>DEEDI / QAAFI</i></p> <ul style="list-style-type: none"> Impact of management practices on productivity and off-site water quality
Horticulture Practices				
RRRD049: Minimising off-farm movement of nitrogen and phosphorus in the north Queensland banana industry	<u>John Reghenzani</u> Terrain NRM	<ul style="list-style-type: none"> RRRD054 - Strong linkages to provide data and validation testing of model versions. Extrapolation to various management practices, soil types and climates. 	<ul style="list-style-type: none"> Supply data to RRRD054 on N&P runoff at banana sites. Supply data to RRRD038 on pesticide runoff & practices at banana sites. RRRD049 - Modelled RRRD049 sites including expanded management, soils and climate scenarios using 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> Project output made available to better measure and report on progress resulting from banana adoption of ABCD management practices. Source Catchments modelling and load estimation

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
			current banana module by May 2012.	<i>Reef Rescue WQ Grants</i> <ul style="list-style-type: none"> Direct use in the Reef Rescue grants program in the Wet Tropics region, including improved ABCD list.
RRRD054: Development of a banana modelling capability to enhance reporting of Reef Rescue outcomes	<u>Tony Webster</u> CSIRO	<ul style="list-style-type: none"> Strong linkages to RRRD049 project. RRRD049 trial sites will be used for data collection and validation testing of model versions. RRRD049 trials will be modelled and extrapolated to various management practices, soil types and climates. 	<ul style="list-style-type: none"> RRRD049 to provide available data on banana growth and yield parameters, soils and environmental loss data by May 2012. Model RRRD049 sites including expanded management, soils and climate scenarios using current banana module and provide this data to RRRD049 by May 2012. 	<i>P2R Program</i> <ul style="list-style-type: none"> Project output (the model) to be provided to P2R (APSIM) modelling team to reporting of banana production system ABCD management practices. This modelling allows reporting of progress towards Reef Plan goals. <i>Other Projects</i> <ul style="list-style-type: none"> The banana model will be used by other projects outside of Great Barrier Reef catchments, for example African mixed farming systems project (CSIRO). The banana model can be used to test management practices for banana production in future projects not yet developed, both in Australia and elsewhere.
Dairy Practices				
RRRD055: Validating the cost/benefits of improved fertiliser practices and quantifying nutrient loads	<u>Rick Kowitz</u> Queensland Dairyfarmers'	<ul style="list-style-type: none"> RRRD020 Mineralisation of N within sugarcane cropping RRRD049 Minimising off-farm 	<ul style="list-style-type: none"> Supply data to RRRD039 on BMP cost effectiveness of tested practices. 	<i>P2R Program</i> <ul style="list-style-type: none"> Herbert River land use and water quality project – shared study

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
and pathways from irrigated dairy pastures in the Wet Tropics and the Burnett-Mary regions	Organisation	<p>movement of N in Nth Qld bananas</p> <ul style="list-style-type: none"> RRRD039 Integrated assessment of BMP cost-effectiveness and decision tool for regions and landholders 		<p>site; contact Paul Nelson.</p> <p><i>Other Projects</i></p> <ul style="list-style-type: none"> DAFF Nitrous Oxide Research Program. Dairy Australia, NSW DPI Coastal NSW dairy catchments runoff. Dairy Moving Forward – Dairy N use efficiency & loss.
Socio-Economic				
RRRD011: Capturing historic small catchment study (paddock scale) data to support quantification of management impacts on water quality on the Great Barrier Reef	<u>David Freebairn</u> RPS Australia East	<ul style="list-style-type: none"> Other researchers (current and past) involved in previous field based research. Provide input data to RRRD039 and RRRD010. Search for data based on: <ul style="list-style-type: none"> Sites, people, datasets Guidance on priorities 	<ul style="list-style-type: none"> Supply historic data to RRRD039, RRRD010 on BMP cost effectiveness by Dec 2012. Supply synthesis of WQ data to the GBR WQ science community. 	<p><i>P2R Program, Reef Protection Package, Reef Rescue WQ Grants</i></p> <p>As a set of products:</p> <ul style="list-style-type: none"> Awareness of what has been before. Support for ABCD framework quantifying BMPs. Base data to support existing studies Reference datasets for modelers (APSIM, GRASP, HowLeaky?). Set of documented parameter files.

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
<p>RRRD010: Factors affecting adoption of land management practices that have water quality benefits in the GBR catchments: Evaluation scenarios for Cane Farming</p>	<p><u>Delwar Akbar</u> Central Queensland University</p>	<p>Potential research component(s) with RRRD039 project:</p> <ul style="list-style-type: none"> • Exploring sharing some information about BMP in cane farming, economic indicator data, sub-regional diversity information, social and attitudinal information about cane farming and cane farmers; • Conduct joint workshop; • Exploring an option to collect social and attitudinal information about the management practice adoption in grazing. 	<ul style="list-style-type: none"> • RRRD039- Component 4: Improving adoption of BMPs in the GBR catchments: data related to temporal aspects, likelihood and uncertainty in adoption to be collected from the field survey. Preference is to collect data by face to face interview with the individual; and then share the structured data with the RRRD039 components. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> • Management practice adoption component – link to landholder surveys. <p><i>Reef Rescue WQ Grants</i></p> <ul style="list-style-type: none"> • NQDT, Reef Catchments, Terrain NRM & BMRG <p><i>Project Catalyst</i></p> <ul style="list-style-type: none"> • Wet Tropics, Burdekin & Mackay Whitsunday sites <p><i>Reef Protection Package</i></p> <ul style="list-style-type: none"> • Wet Tropics, Burdekin & Mackay Whitsunday data
<p>RRRD039: Integrated assessment of BMP cost-effectiveness and decision tool for regions and landholders</p>	<p><u>Stuart Whitten</u> CSIRO</p>	<p>Learning, improvement, data sharing:</p> <ul style="list-style-type: none"> • RRRD056 – input data on A class practices. • RRRD004 – input data on cane practices • RRRD010 – input data on cane practices. • RRRD011 – input from collation of historical data sets. • RRRD024 – input data on grazing land condition. • RRRD032 – input data from grazing practices. 	<ul style="list-style-type: none"> • RRRD011 – Collation of historical data on BMP. • RRRD056 - Data on cost effectiveness of A class practices. • RRRD049 – Data on cost effectiveness of banana practices. • RRRD027 – Data on cost effectiveness of rehabilitation of D class land. • RRRD032 – Data on management practices (stocking rate and liveweight gain timeseries) provided by June 2012. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> • Management practice adoption component – link to landholder surveys. <p><i>Reef Rescue WQ Grants</i></p> <ul style="list-style-type: none"> • NQDT, Reef Catchments, Terrain NRM, FBA & BMRG <p><i>Project Catalyst</i></p> <ul style="list-style-type: none"> • Wet Tropics, Burdekin & Mackay Whitsunday sites <p><i>Reef Protection Package</i></p> <ul style="list-style-type: none"> • Wet Tropics, Burdekin & Mackay Whitsunday data

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
Sub-Program 2: Pesticide threat, delivery and management				
<p>RRRD037: Pesticide dynamics in the Great Barrier Reef catchment and lagoon: management practices in the sugarcane industry</p>	<p><u>Jon Brodie</u> James Cook University</p>	<ul style="list-style-type: none"> • Joint project with RRRD038. • Incorporate outputs on monitoring herbicides from RRRD058. Knowledge of pesticide toxicity gradient useful for risk assessments. • RRRD004 pot trials for pesticide application via dripper irrigation. 	<ul style="list-style-type: none"> • Supply data to RRRD004 on pesticide half lives in soil. • RRRD038 – complementary data collection - ongoing. • RRRD058 – pesticide toxicity information. • RRRD004 – pesticide application information. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> • Monitoring -joint sites/objectives • Modelling - input data requirements <p><i>Project Catalyst</i></p> <ul style="list-style-type: none"> • Potential links to sites in Wet Tropics, Burdekin & Mackay Whitsunday sites <p><i>Reef Protection Package</i></p> <ul style="list-style-type: none"> • Wet Tropics, Burdekin & Mackay Whitsunday data & potential project examining pesticide trapping in vegetation and the alternative herbicides and weed control practices. <p><i>NERP</i></p> <ul style="list-style-type: none"> • Pesticide persistence and breakdown in marine environment (Negri et al) <p><i>Other projects</i></p> <ul style="list-style-type: none"> • Atrazine enzyme degradation project (CSIRO)

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
<p>RRRD038: Pesticide dynamics in the Great Barrier Reef catchment and lagoon: management practices (grazing, bananas and grain crops) and risk assessments</p>	<p><u>Jon Brodie</u> James Cook University</p>	<ul style="list-style-type: none"> • Joint project with RRRD037. • Incorporate outputs from RRRD058. • RRRD049 – banana runoff. 	<ul style="list-style-type: none"> • RRRD037 – Complementary data collection – ongoing. • RRRD058 – Pesticide toxicity information. • RRRD049 – Pesticide runoff data from banana sites. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> • Monitoring -joint sites/objectives • Modelling - input data requirements <p><i>NERP</i></p> <ul style="list-style-type: none"> • Pesticide persistence and breakdown in marine environment (Negri et al) <p><i>Reef Protection Package</i></p> <ul style="list-style-type: none"> • Burdekin data
<p>RRRD058: A novel biological method of monitoring herbicides</p>	<p><u>Ben Kefford</u> Uni of Technology Sydney (UTS)</p>	<ul style="list-style-type: none"> • RRRD037 & 038 Pesticide dynamics in the Great Barrier Reef catchment and lagoon: management practices (grazing, bananas and grain crops) and risk assessments-JCU (Brodie) 	<ul style="list-style-type: none"> • RRRD037 – data on half lives of pesticides in wetlands. 	<p><i>DERM</i></p> <ul style="list-style-type: none"> • Existing stream/river biomonitoring <p><i>Other projects</i></p> <ul style="list-style-type: none"> • Potential ARC Linkage project. • Related work in Europe conducted in the Department System Ecotoxicology, UFZ - Helmholtz Centre for Environmental Research, in Leipzig, Germany (who invented the SPEAR indexes).

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
Sub-Program 3: Tracking change				
RRRD030: Pollutant load estimation for Great Barrier Reef (GBR) catchments: Accounting for the uncertainty in monitoring and modelled data using data assimilation techniques	<u>Petra Kuhnert</u> CSIRO	<ul style="list-style-type: none"> • Link to RRRD016 water quality assessment framework with the incorporation of a more accurate load estimate. • Link to RRRD032: Improving grazing management practices to enhance ground cover and reduce sediment loads. 	<ul style="list-style-type: none"> • Supply TSS data to RRR016 on end of catchment loads in the Burdekin when methodology has been established and applied. • Identified grazing management practices to be incorporated into the loads methodology when management actions are being investigated. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> • Source Catchments modelling and load estimation. • Requirement to report on loads and assess under prescribed targets for nutrients and sediments - provides uncertainty estimates for loads that are interpretable. • Assimilate all sources of available information. • Assess monitoring requirements and identify where more data is required or better information about the parameters of the physical process are needed.
RRRD016: Developing integrated assessment metrics for reporting of water quality in the Great Barrier Reef lagoon	<u>Vittorio Brando</u> CSIRO	<ul style="list-style-type: none"> • Measurement of WQ status – links with all upstream projects. 	<ul style="list-style-type: none"> • RRRD030 – end of catchment pollutant loads incorporating uncertainty by end of year 1. 	<p><i>P2R Program</i></p> <ul style="list-style-type: none"> • P2R Report Card indices and MMP reporting. • MMP complementary programs (assessment of inshore corals and seagrasses). • Links to GBR exposure and risk mapping <p><i>Other projects</i></p>

Project Title	Project Leader & Organisation	Links to other Projects	Data Exchange Requirements	Links to other Programs
				<ul style="list-style-type: none"> • Better understanding of WQ data – link to receiving water models (eReefs). • IMOS & TERN Australian Coastal Ecosystem Facility - potential uptake of uncertainty measures.

Attachment 2: Overview of Related Programs

The following information provides a summary of GBR water quality initiatives that are directly related to *Reef Rescue R&D*.

Queensland Government Reef Protection Package Science Program

Program Leader	Gay Crowley, DERM
Lead agency	DERM
Participating agencies	DERM, DEEDI, Australian Government, Regional NRM bodies, CSIRO, JCU
Objectives	<p>Deliver a science framework to ensure that the Reef Regulation Program delivery is:</p> <ul style="list-style-type: none"> • Effective • Transparent • Evidence-based <p>RPP will be investing in science that helps deliver the program:</p> <ul style="list-style-type: none"> • Provide advice and support to land managers (cane – Wet Tropics and grazing – Burdekin) <ul style="list-style-type: none"> – Avoidable loss – Profitable improvement • Assess Environmental Risk Management Plans • Assess program delivery and management improvement
Approach	<p>Program Logic developed for the Program (Attachment 2) and 5 sub-programs identified:</p> <ul style="list-style-type: none"> • Pollutant loading • Sources and pathways – cane, grazing • Management effectiveness, data and tools – cane, grazing • Socio-economics • IT, map delivery and record keeping
Key milestones	<pre> graph LR subgraph Milestones M1[Peer Review Workshop – 23 Jun – assess and prioritise R&D needs] M2[Stakeholder briefings – Jul – Aug – including TTG] M3[Peer Review Workshop – Late Jul – First round proposal assessment & prioritisation] M4[Subsequent assessment (as required)] end subgraph SubProgramDevelopment S1[Sub-program development] S2[Status reports] S3[Thematic workshops] S4[Gap analysis] S5[Proposal development] S6[Proposal negotiation Contracts signed (Jul-Sep)] end M1 --> S1 M2 --> S1 M3 --> S1 M4 --> S1 S1 --> S2 S2 --> S3 S3 --> S4 S4 --> S5 S5 --> S6 </pre> <ul style="list-style-type: none"> • Peer Review Workshop – 23 Jun – assess and prioritise R&D needs • Stakeholder briefings – Jul – Aug – including TTG • Peer Review Workshop – Late Jul – First round proposal assessment & prioritisation • Subsequent assessment (as required) <p>Sub-program development</p> <ul style="list-style-type: none"> Status reports Thematic workshops Gap analysis Proposal development ----- Proposal negotiation Contracts signed (Jul-Sep)
Synergies with Reef Rescue	Refer to above diagram
End user engagement and delivery	<p>Dedicated extension teams</p> <p>Defined synthesis products.</p>

Reef Protection Program				
Pollutant loading	Sources and pathways	Management practice effectiveness, data and tools	Socio economics	IT, map delivery and record keeping
Grazing – RRRD032**				
		Grazing – RRRD009, RRRD024, RRRD027** Sugar – RRRD056**, RRRD004, RRRD020**		
Pesticides – RRRD037, RRRD038				
		Socio economics – RRRD039**, RRRD010**, RRRD011**		
	Reporting – RRRD030			

Reef Plan Integrated Paddock to Reef Monitoring, Modelling and Reporting Program

Program Leader	Chris Chinn, DPC
Lead agency	Reef Plan Secretariat, DPC
Participating agencies	DPC, DERM, DEEDI, Australian Government, Regional NRM bodies, CSIRO, JCU
Objectives	<ul style="list-style-type: none"> To measure and annually report on progress towards the Reef Plan goals and targets: <ul style="list-style-type: none"> Increased adoption of improved land management practices Catchment targets (Wetlands, Riparian extent and Groundcover) Water quality load reduction targets Great Barrier Reef health and resilience Management driven with a focus upon diffuse source pollution from agriculture.
Approach	<ul style="list-style-type: none"> Modelling, supported by monitoring Multiple lines of evidence and integration Highly collaborative and complex Rapid exchange of data and information Continuous improvement philosophy <p>Lines of evidence:</p> <ul style="list-style-type: none"> Adoption of improved practices Practice effectiveness

	<ul style="list-style-type: none"> • Status of key catchment indicators (e.g. groundcover) • Load reductions at the end-of-catchment • Marine water quality and ecosystem health
Synergies with Reef Rescue	<ul style="list-style-type: none"> • Alignment predominantly relates to Improved Land Management and Practice Effectiveness. • Anticipated outcomes: <ul style="list-style-type: none"> – Address some P2R knowledge gaps – Methods are complementary (avoid duplication) and rigorous – More/improved knowledge (less uncertainty) for reporting and decision making
End user engagement and delivery	<ul style="list-style-type: none"> • Data and information sharing – agreement between projects and with end users on sharing information in a timely manner. • Coordination - ‘Buddy system’ with P2R program leaders and end users. • End use - Knowledge management and synthesis process. <p>DPC facilitating communication and integration across programs in an informal way – meeting of science program leaders</p>

Paddock to Reef Monitoring, Modelling and Reporting Program					
Improved Land management (K McCosker)	Practice effectiveness (Silburn/Attard)	Catchment indicators (C Witte)	Catchment loads (D Waters)	Marine (K Martin)	Reporting (C Chinn)
	Socio economic – RRRD039, RRRD010, RRRD011				Socio economic – RRRD039, RRRD010, RRRD011
	Grazing – RRRD024, RRRD027				
	Grazing – RRRD032, RRRD009				
Sugar – RRRD056, RRRD004, RRRD020 Horticulture – RRRD049 Dairy – RRRD055					
	Pesticides – RRRD037, RRRD038 Pesticides – RRRD037, RRRD038				
	Horticulture – RRRD054				
			Reporting – RRRD030	Reporting – RRRD016	

National Environmental Research Program – Tropical Ecosystems Hub

Program Leader	Genine Sutton, SEWPaC and Dr David Souter RRRC on behalf of SEWPaC
Lead agency	SEWPaC
Participating agencies	Australian Government, AIMS, CSIRO, JCU, UQ DERM, DEEDI, ANU, UWA
Objectives	<p>The NERP aims to improve Australia’s capacity to understand and respond to priority environmental concerns affecting national environmental assets.</p> <p>NERP TE Hub is focused specifically on:</p> <ul style="list-style-type: none"> • The Great Barrier Reef and its catchments • Tropical rainforests including the Wet Tropics World Heritage Area and • The Torres Strait.
Approach	<p>3.5 year research program, \$25.8M investment. Strategic areas:</p> <ul style="list-style-type: none"> • Understanding ecosystem condition and trend • Understanding ecosystem function and cumulative pressures • Building resilient tropical ecosystem • Delivering an effective and efficient program
Outputs	<p>Reports and web-based visualisations on:</p> <ul style="list-style-type: none"> • The state of key assets, identifying possible threats, the socio-economic values of the assets and cost-effective methods for longer term assessment • Critical information on the condition, trends and projected futures of nationally threatened species such as marine turtles, dugongs, sharks and cassowaries • Identification and quantification of the cumulative pressures on ecosystems; and • Options to assist decision makers to better manage threats that are critical to the future environmental, economic and social underpinning of North Queensland
Synergies with Reef Rescue	<ul style="list-style-type: none"> • <i>1.1 Pandolfi</i>: Characterising cumulative impacts of stressors on the present and past biodiversity of the GBR • <i>4.1 Fabricius</i>: Tracking coastal turbidity • <i>4.2 Negri</i>: The chronic effects of pesticides and their persistence in tropical ecosystems • <i>4.3 Brodie</i>: Ecological risk assessment for water quality in the GBR • <i>5.1 De’ath</i>: Understanding GBR diversity • <i>5.2 Uthicke</i>: Experimental and field investigations of combined water quality and climate effects on coral and other reef organisms • <i>5.3 Collier</i>: Vulnerability of seagrass habitats in the GBR to changing coastal environments • <i>9.4 Pressey</i>: Spatial planning for coastal development in the GBR region • <i>10.1 Marshall</i>: Socio and economic long term monitoring program • <i>10.2 Stoeckl</i>: Socio economic systems and resilience • <i>13.1 Lawrey</i>: e-Atlas

End user engagement and delivery	<ul style="list-style-type: none"> • Knowledge brokering and communication arrangements still under development • Science Leader appointed for each Hub – Peter Doherty, AIMS • Steering Committee, Working Groups
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National Environmental Research Program – Tropical Ecosystems Hub (selected Programs)				
Program 1: Historical & current condition of the GBR	Program 4: Water quality of the GBR and Torres Strait	Program 5: Cumulative impacts on benthic diversity	Program 9: Decision support systems for GBR managers	Program 10: Socio economic value of GBR goods & services
Reporting – RRRD030	Pesticides – RRRD037 & 038			Socio economic – RRRD039

Great Barrier Reef Foundation - *eReefs*

Program Leader	Eva Abal and Theresa Fyfe, GBR Foundation
Lead agency	GBR Foundation
Participating agencies	Partners: Australian Government, Queensland Government, GBRMPA, BHP Billiton, Bureau of Meteorology, CSIRO, AIMS
Objectives	<p><i>eReefs</i> is an integrated system of data, models, visualisation, reporting and decision support tools that spans the entire Reef area—from paddock to catchment, estuary, Reef lagoon and ocean.</p> <p>Objectives</p> <ul style="list-style-type: none"> • To provide integrated, comprehensive and defensible information and forecasting capability as the basis for a decision-making system for the Reef. • To create a communication tool via its visualisation layer to enable information and decisions to be conveyed to a range of different audiences for regulatory, advocacy, governance and more general user/consumer purposes. <p>Scope</p> <ul style="list-style-type: none"> • Phase 1 of the project is currently being re-scoped due to recent project budget changes relating to corporate investor funding. This re-scoping is being driven by the needs of the key end-users (DERM, DPC, GBRMPA, SEWPAC and DAFF). Scoping will be finalised by the end of June 2011.
Approach	<ul style="list-style-type: none"> • Phase 1: Developing key components • Phase 2: Automation, Integration and Extension • Phase 3: Transition to Final Operation

	<div style="display: flex; flex-direction: column; gap: 10px;"> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; display: flex; align-items: center;"> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; width: 150px; text-align: center;"> Enhancing existing monitoring efforts </div> <div style="margin: 0 10px;">➔</div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px;"> Expanding and improving the data set available from monitoring efforts through the more extensive use of <u>real-time sensors</u>, remote sensing, integrated ocean monitoring systems, <u>internet and mobile tools</u>, and other innovative measurement technologies. </div> </div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; display: flex; align-items: center;"> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; width: 150px; text-align: center;"> Interoperable data and information systems </div> <div style="margin: 0 10px;">➔</div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px;"> <i>eReefs</i> will establish a "distributed platform" for comprehensive access to existing monitoring and measurement data through the application of data storage and sharing technologies and the use of an open and accessible standards-based web interface. </div> </div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; display: flex; align-items: center;"> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; width: 150px; text-align: center;"> Operational catchment and marine modelling </div> <div style="margin: 0 10px;">➔</div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px;"> <i>eReefs</i> will expand and integrate existing modelling to operationally support whole-of-reef understanding and decision making (preferably operational coverage of the paddock to ocean continuum). </div> </div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; display: flex; align-items: center;"> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px; width: 150px; text-align: center;"> Reporting and visualisation frameworks </div> <div style="margin: 0 10px;">➔</div> <div style="border: 1px solid orange; border-radius: 10px; padding: 5px;"> <i>eReefs</i> will deliver <u>a web-based reporting and visualisation suite</u> to communicate key data, reports and forecasts to managers, policy makers, Reef users and the general public </div> </div> </div>
Outputs	<p>Total project anticipated project outputs include:</p> <ul style="list-style-type: none"> • Operational water quality standards and tools (interoperable) • Operational remote sensing tools (WQ Dashboard) • Real-time catchment models • Real-time receiving water quality models • A model orchestration engine to integrate models • Reporting and visualisation tools for standard and customised reporting • Establishment of infrastructure required to operationalise eReefs • Citizen Science applications <p>Project outputs are dependent on outcome of re-scoping, however anticipated Phase 1 outputs include:</p> <ul style="list-style-type: none"> • Receiving Water Quality Model: Transport and Biogeochemical models – POC only in Phase 1 • Operational Water Quality Dashboard • Scoping of Interoperable Data Integration System • Functionality for automated online report card
Synergies with Reef Rescue	<ul style="list-style-type: none"> • Scope of <i>eReefs</i> has been developed to address the priority needs of Reef managers and policy makers, without any duplication of existing programs or projects • The high level deliverables and the project path to impact has been structured around key milestones for user groups. • The <i>eReefs</i> project has been structured to align with and strategically contribute to existing Reef research and management programs.
End user engagement and delivery	<p>End users of <i>eReefs</i> have been involved with all aspects of the project development including:</p> <ul style="list-style-type: none"> • Development of the initial project concept idea • Development of the <i>eReefs</i> pilot scope • Governance of the <i>eReefs</i> pilot project • Development of the full project proposal and business case • Development of an appropriate governance structure for the full project • Moving forward, end-users will continue to play a key role in project governance to ensure that outcomes delivered meet their needs and requirements.

Sugar Research and Development Corporation

Program Leader	Bianca Cairns, SRDC
Lead agency	SRDC
Participating agencies	BSES, DERM, DEEDI, Canegrowers
Objectives	<p>To foster an innovative and sustainable Australian sugar industry through targeted investment in R&D.</p> <p>SRDC investments span the sugarcane industry value chain; breeding, farm management practices, harvesting and sugarcane processing. SRDC project outputs include new knowledge, new technologies and development of human capacity.</p>
Approach	<p>Current projects relevant to water quality:</p> <p><i>BSS329 – Understanding water quality in sugarcane farming systems (Funded February 2010 – August 2012)</i></p> <ul style="list-style-type: none"> • Continuing BSES led project. • Addressing the effect of new farming systems on water use efficiency and water quality. • New farming system principles of controlled traffic, minimum tillage and legume crops have become accepted best management practices due to their ability to improve soil health and profitability, however in many of the past trials the water quality impacts have not been assessed. <p><i>CGH003 - Herbert Catchment Water Quality Monitoring - Sugar Industry and Catchment Partnership (Funded May 2011- Sept 2014)</i></p> <ul style="list-style-type: none"> • New project led by Herbert River Canegrowers. • Brings together a broad range of partners including DERM, DEEDI, local Government, and forestry industries. • Aims to develop and implement a regional integrated monitoring program to support landholders involved in improving land management practices associated with water quality. • It will form a part of the Paddock to Reef Program, and will provide baseline of water quality data in the Herbert River catchment. <p><i>GGP061 –Effective use of lower mill mud rates in the nutrition program (New project funded May 2011- May 2014)</i></p> <ul style="list-style-type: none"> • The Mount Catherine Cooperative group are assessing the effectiveness of banded mill mud (at rates lower than conventional practice) to provide enough phosphorous for the entire crop cycle. • The group is also investigating whether the mill mud needs to be incorporated into the soil for sufficient nutrient access and whether this new application method will result in improved runoff water quality. <p><i>CSE022 – A collaborative approach to precision agriculture for the Australian sugarcane industry (Funded July 2008 - September 2014)</i></p> <ul style="list-style-type: none"> • Continuing CSIRO led project. • Coordinating and integrating an evaluation of precision agriculture technologies in collaboration with leading farmers.

- This project brings together investigators from three leading research organisations (CSIRO, BSES and National Centre for Engineering in Agriculture) to provide growers with confidence in managing on-farm variability.
- The project has established experimental sites in Bundaberg, Herbert and Burdekin regions and collated available data.
- During 2011-12 the project team will conduct a third season review of precision agriculture strategies and technologies. A crop yield monitor instrument will be produced, evaluated and tested.

DPI021 – Remote sensing based Precision Agriculture tools for the sugar industry (Funded July 2009 - August 2012)

- Continuing project led by DEEDI.
- Aims to assess remote sensing technologies with imagery that will accurately depict mid-season crop information to direct mid-season management. The project will assess the utility of this imagery for explaining yield variability; implement optimal image processing; deliver protocols for rapid distribution of technology; and provide guidance to industry on remote sensing technology. It was also provide a cost benefit analysis for implementation.
- During 2011-12 the project will continue assessment of commercial imagery and the airborne system. All data will be assessed and cost benefit will be undertaken to assess most viable and useful technology. Protocols will be developed for the use of viable technology.

NCA011 - Development of precision spray technologies for the Australian sugarcane industry (Funded July 2010 – August 2013)

- This project will continue to develop both new target orientated precision weed spraying technologies (weeds in crop - Green from Green) and assist with the implementation of existing technologies (Green from Brown) to more finely manage herbicide use. The application of these technologies will improve productivity, reduce off site movement of herbicides and impacts, reinforce minimum tillage and provide greater flexibility in weed management strategies.
- In 2011-12 the project will initiate field sampling and monitoring at field study sites in Bundaberg, Mackay and Burdekin, conducting tests of spray equipment. Upon the analysis of field data, a draft guide for precision weed spraying strategies will be developed and where required refinements to spray equipment will be made.

UQ044 – SaveN Cane: Developing selection tools for N-efficient sugarcane (Funded July 2009 - December 2013)

- Continuing project led by the University of Queensland.
- Aims to advance knowledge of traits that make sugarcane more nitrogen use efficient. Such knowledge will assist in developing tools for breeding nitrogen use-efficient clones, thus lowering nitrogen fertiliser demand.
- In 2011-12 the project will undertake a preliminary comparison of the responsiveness of the clones to nitrogen treatments, report the results of the Burdekin plant crop trial results to the project consultative group and plant similar trials in Mackay.

STU073 - Danielle Skocaj - Climate forecasting to improve sugarcane nitrogen management in the wet tropics. James Cook University (New Project Funded January 2011 – July 2014)

- This new PhD project will be aimed at investigating cane production variability associated with climatic variability in a rainfed farming system and developing improved nitrogen management guidelines to ensure that the sugarcane production system remains environmentally sustainable and profitable.

UQ045 – Streamlined life cycle assessment (LCA) tool for assessing the environment benefits of progressive cane growing (Funded July 2010-February 2012)

- This continuing project aims to refine an existing sugarcane life-cycle assessment (LCA) model into a streamlined LCA tool for industry use. The LCA tool will provide information on the environmental impacts of different sugarcane farming practices and will complement the economic information currently available via the Queensland Department of Employment, Economic Development and Innovation's (DEEDI) Farm Economic Analysis Tool (FEAT).
- This is a joint University of Queensland (UQ) and BSES Limited project. The university developed the current LCA model and has experience in environmental modelling, whilst BSES has extensive knowledge in relation to cane farming systems.
- During 2011-12 the project will finalise the development of the streamlined LCA tool and make it available via a web-interface. The project team will use the tool to compare the LCA results of conventional and progressive cane growing practices. The project results will be presented to industry in conference papers at the 2012 Australian Society of Sugar Cane Technologists (ASSCT) conference.

GGP053 - Improvement of internal soil drainage and yield on heavy clay soils in the Herbert (Funded January 2010-December 2013)

- The Molonga Grower Group of Ingham are undertaking this project with the aim of addressing drainage issues in areas of clay soils in the Herbert region. The group are investigating three methods (zonal application of mill ash below the soil surface, GPS positioned mole drainage, and single leg deep ripping below the cane row using zonal tillage), to potentially increase internal soil drainage and cane yields. Information will be extended to other farms within the region with similar problems.
- During 2011-12 the project will be harvesting and conducting analysis of the trial results. A cost-benefit analysis will be undertaken of the potential systems change.

CVA004 – Managing Climate Variability Program – Phase 3 (Funded July 2010 - September 2014)

- SRDC will continue its support to improve seasonal forecasting and provide tools and services to manage climate risk on farm through its investment in the Managing Climate Variability Joint Venture. This joint venture (JV) is managed by the Grains Research and Development Corporation on behalf of the JV partners (Grains Research and Development Corporation, Meat and Livestock Australia, Rural Industries Research and Development Corporation, and SRDC). For 2010–2013 the aim of the JV is to continue investment in the following four areas:

	<ul style="list-style-type: none"> – <i>Climate forecasting research</i>-Climate science projects aimed at improving the skill of forecasts, from multi-week to seasonal. – <i>Climate forecasting development and services</i>- Translating climate forecasting research outputs into climate forecasting products for Australian agriculture. Most of this investment is in partnership with the Bureau of Meteorology to continuously improve <u>Water and the Land</u>. – <i>Climate risk management for agriculture</i>- in particular decision-support applications. – <i>Climate knowledge, adoption and communication</i>- Fostering increased adoption of climate-risk management tools on farm through, for example, the <u>Climate Champion program</u> and <u>Climate Kelpie</u>. The Climate Champion program is made up of 30 innovative farmers using climate forecast tools as a major input to their enterprise management strategies.
Outputs	<ul style="list-style-type: none"> • Assessment of the effect of new farming systems on water use efficiency and water quality. • Extension of the P2R Program into the Herbert River catchment and establishment of baseline data sets. • The role of mill mud for nutrition in crop cycles. • Evaluation of precision agriculture technologies in collaboration with leading farmers. • Assessment of remote sensing technologies with imagery that will accurately depict mid-season crop information to direct mid-season management. • New target orientated precision weed spraying technologies (weeds in crop - Green from Green) and assist with the implementation of existing technologies (Green from Brown) to more finely manage herbicide use. • Refined sugarcane life-cycle assessment (LCA) model into a streamlined LCA tool for industry use. • Assess drainage issues in areas of clay soils in the Herbert region. • Improve seasonal forecasting and provide tools and services to manage climate risk on farm through its investment in the Managing Climate Variability Joint Venture
Synergies with Reef Rescue	<ul style="list-style-type: none"> • Sharing a dairy site in upper Herbert for data collection.
End user engagement and delivery	TBC

Meat and Livestock Australia

Program Leader	Mick Quirk and Rodd Dyer
Lead agency	MLA
Participating agencies	CSIRO, DEEDI, Regional NRM groups
Objectives	<ul style="list-style-type: none"> • Grazing mgt • Fire • Weeds • Sown pastures, forage crops • Productivity • Maintain resource base <ul style="list-style-type: none"> – Soil condition – Water quality
Approach	<ul style="list-style-type: none"> • All GBR catchments <ul style="list-style-type: none"> – Burdekin, Fitzroy, Burnett • Discrete R&D <ul style="list-style-type: none"> – Virginia Park (CSIRO, DEEDI) – Wambiana (DEEDI) – Pasture recovery (DEEDI) - Clermont, Wambiana • Integrating initiatives <ul style="list-style-type: none"> – Northern Grazing Systems (NGS) – D&E focus (multi-org) <ul style="list-style-type: none"> • Research synthesis • Modelling • Property case studies – Managing pasture rundown (DEEDI)
Outputs	<ul style="list-style-type: none"> • More informed decision-making <ul style="list-style-type: none"> – What will make the most difference for land condition and profit – How best to implement • Greater producer involvement
Synergies with Reef Rescue	Joint field sites.
End user engagement and delivery	TBC