

Regional Wetland Management Prioritisation in the GBR Catchment

Identifying Candidate Sites for Greening Australia's *Repair and Restoration of Priority Coastal Habitat and Wetlands Project* - 2018

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March 2018



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> Executive Summary

Econcern was contracted by Greening Australia to support the selection process employed to prioritise candidate wetland restoration sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. The project is aligned to Reef 2050 and regional NRM body water quality priorities with restoration sites to be located within GBR catchments. Throughout the project actions will be aligned to support:

- Reef Trust Outcome # 1 (Improve the quality of water entering the GBR from broad-scale land use), and
- Reef Trust Outcome #2 (Improve the health and resilience of coastal habitats).

As part of the site selection process one-day site nomination and selection workshops were held in four GBR catchment NRM regions: Fitzroy Basin, Mackay-Whitsundays, Burdekin Basin, and Wet Tropics. Prior to the regional workshops a preliminary list of candidate wetland sites was compiled for consideration.

To compile the list of candidate sites for each region Econcern undertook:

- A review of the biophysical and land use features of each region that pertain to wetland management needs, effectiveness and priorities;
- A review of regional NRM plans and past wetland management prioritisation processes to identify the nature of regional commitments to wetland management and focal areas, issues and sites nominated from within each region;
- Email and phone communication with regional wetland managers to review the merits of identified sites and to become informed of current wetland management programs, associated areas of interest and any site nominations; and
- Virtual field examinations of each region utilising Google Earth and the Queensland Department of Environment and Heritage's WetlandInfo's web-based WetlandMaps GIS platform to identify the locations of wetlands with different value suites, site and catchment conditions and land use characteristics, and opportunistic site nominations.

To generate the list of candidate sites a 'gate keeper' approach was employed whereby to pass through the gate to candidature a site must meet criteria No. 1 and at least two or more other of the following criteria:

- (1) Does the site have readily identifiable restoration needs that can be delivered within the context of the current project that will deliver for Reef Trust 1 and/or 2 outcomes?
- (2) Has the wetland site previously been prioritised for NRM investment in wetland specific prioritisations?
- (3) Does the site concern a catchment planning unit prioritised for wetland NRM investment and/or priority actions promoted in regional planning?
- (4) Does the site have high biodiversity and/or water quality functional values?
- (5) Does the site present the opportunity to build upon or maintain past investment?
- (6) Does the site have notable good works capacity associated with: landholder and/or community support; co-investment potential; proximity to project service centre?
- (7) Does the site present a high value demonstration site related to its: public profile, representativeness of required works to regional needs; and/or opportunity to demonstrate highly innovative works?

Given the regional consultation and literature review conducted prior to the workshops, nominated candidate sites were generally well received and only a few additional nominations were proposed during some of the workshop though following workshop review none were recommended for further project scoping.

Information gained from regional stakeholders during the workshop process was invaluable for distinguishing candidate sites with limitations that undermined their viability as implementable projects during the term of the current project and for providing other information that significantly elevated the candidacy of other sites toward readily implementable projects. This included information related to implementable works, landholder and community support for different types of works at specific sites and opportunities for co-investment. Most of this project capacity information cannot be obtained from literature sources and underpins the importance of the regional consultative process for prioritising wetland management investment.

Twenty-nine separate project proposals (Appendix 2) emerged from ninety -four candidate sites presented to the four GBR catchment regional workshops. Ongoing engagement with regional wetland management stakeholders is now being undertaken to finalise a list of scoped regional projects to be pursued by Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project.

> Background

Repair and Restoration of Priority Coastal Habitat and Wetlands Project

Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project is being funded by the Federal Government under Reef Trust V funding to the level of five million dollars. Greening Australia has also committed to raising matching project funds from corporate and philanthropic sources during the project. The project aims to restore key ecosystem components and processes in 500 hectares of coastal wetland habitat adjacent to the Great Barrier Reef (GBR) and builds on the 200 ha of coastal wetland habitat restored under the previous Reef Trust III funded project - 'Restoration of Great Barrier Reef Wetlands and Coastal Ecosystems'.

The project is aligned to *Reef 2050* and regional NRM body water quality priorities with restoration sites to be located within GBR catchments. Throughout the project actions will be aligned to support:

- Reef Trust Outcome # 1 (Improve the quality of water entering the GBR from broad-scale land use), and
- Reef Trust Outcome #2 (Improve the health and resilience of coastal habitats).

The project will deliver coastal wetland restoration actions using sound methodology and a practical approach by working with partner organisations including natural resource management and research organisations, local and state government agencies and other conservation NGOs, such as Conservation Volunteers Australia and Birdlife Australia and in collaboration with landholders in Great Barrier Reef catchments.

The project seeks to identify cost-effective solutions and use a whole-of-system approach to re-establish ecological processes and ecosystem services in the targeted 500 hectares of coastal wetland ecosystem. Restoration activities will be supported by best-available science and include actions such as:

- adoption of best management practices (including stock and fire management),
- feral animal and weed control,
- removal of artificial barriers in waterways,
- restoration of natural hydrology (including tidal ventilation),
- increasing the extent of native vegetation and riparian filter strips and buffers, and
- the creation of habitat corridors.

Through these actions the project aims to have by June 2021 improved the biodiversity of species that use coastal and freshwater GBR ecosystems for part or all their life-cycle and to have improved coastal ecosystem connectivity, condition & resilience. Provision of ecosystem services associated with restored coastal wetland habitats will also be improved in Reef catchments including nutrient assimilation and sediment trapping.

The project will also deliver wetland management extension and community engagement to increase the availability of applied science on system repair interventions and awareness of wetland restoration techniques. This is to encourage their adoption by landholders and to support the broader application of project learnings and toward cost-effective solutions for on-going management of GBR coastal ecosystems.

It was intended that the site selection process for this project be informed by available regional planning initiatives such as, Water Quality Improvement Plans (WQIPs), the QDEHP 'Walking the Landscape' program, Conservation Action Planning (CAP) and any previous wetland prioritisation processes.

It was also proposed that the prioritisation process for candidate project sites include consideration of values such as:

- their ecological values and connectivity to High Ecological Value (HEV) habitats;
- their role in large-scale ecological functions and ecosystem services, such as the amelioration of poor water quality entering the GBR;
- their contribution to supporting migratory species including birds;
- their contribution to recreational and commercial fisheries productivity; and
- their role in biological connectivity for fish and other species.

The final prioritisation of sites will also consider important project capacity criteria including:

- community interest and landholder support;
- level of traditional owner engagement;
- whether the site offers an opportunity to attract additional investment and community interest into wetland restoration; and
- the level of confidence that proposed interventions are achievable within the project timeframes and budget, including the feasibility of the location relative to operational capacity (Greening Australia 2017).

Selection of Regional Candidate Sites

Econcern was contracted by Greening Australia to support the selection process employed to prioritise candidate wetland restoration sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project.

The primary requirements nominated for the prioritisation process were that:

- The decision underpinning prioritisation outputs be transparent;
- Candidate wetland sites meet value and capacity criteria aligned with project objectives;
- It identifies candidate sites where restoration can achieve Reef Trust Outcomes 1 & 2;
- It be informed by existing NRM region planning initiatives and wetland prioritisation processes;
- It considers key biophysical and land use features of each region of relevance to the site selection process; and
- Regional wetland managers and stakeholders are engaged in the process.

As part of the site selection process one-day site nomination and selection workshops were held in four GBR catchment NRM regions: Fitzroy Basin, Mackay-Whitsundays, Burdekin Basin, and Wet Tropics. Prior to the regional workshops Econcern compiled a preliminary list of candidate wetland sites for consideration in the workshops.

To compile the list of candidate sites for each region Econcern undertook:

- A review of the biophysical and land use features of each region that pertain to wetland management needs, effectiveness and priorities;
- A review of regional NRM plans and past wetland management prioritisation processes to identify the nature of regional commitments to wetland management and focal areas, issues and sites nominated from within each region;
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- Virtual field examinations of each region utilising Google Earth and the Queensland Department of Environment and Heritage's Wetland/Info's web-based Wetland/Maps GIS platform to identify the locations of wetlands with different value suites, site and catchment conditions and land use characteristics, and opportunistic site nominations.

Candidate sites presented to the regional workshops met more than one of the following criteria:

- They were a site or fell within a subcatchment prioritised for wetland management by regional processes or wetland management experts;
- They have restoration needs that if implemented will contribute to achieving Reef Trust Outcomes 1 or 2;
- They have high ecological values including but not limited to: Water bird and/or Wader Bird habitat, high species richness/diversity, populations of rare or threatened taxa, recreational use, cultural significance, fisheries and/or fishery nursery, assimilative capacity for nutrients and sediments, water quality benefits for D/S Systems, role in large-scale ecological functions and ecosystem services, role in biological connectivity, contribute to supporting migratory species.
- They have the capacity to act as a demonstration site for innovative and/or regionally significant restoration works; and
- They have a high capacity for successful restoration project implementation built on: significant past investment, potential for co-investment, an existing high level of community support or engagement and/or a high level of landholder support.

For each wetland candidate, site boundaries were defined by Google Earth .kmz file polygons and criteria information underpinning its candidature were captured in an excel spreadsheet (separate Appendix 4) for presentation at the regional workshops. A list of prospective restoration activities drawn from a generic potential works template (Appendix 1) was also nominated for each site for consideration.

The potential to use the Great Barrier Reef Catchment Wetland Prioritisation Decision Support System (HLA–Envirosciences 2006) <https://wetlandinfo.ehp.qld.gov.au/wetlands/resources/tools/assessment-search-tool/7/> to short-list and rank regional wetland restoration candidate sites during regional workshops was also assessed. Ultimately it was decided that given the timing and resource constraints (Econcern was contracted three weeks

prior to the initiation of two weeks of successive regional workshops) the application of the DSS was neither viable or desirable. The main constraints identified were:

- Insufficient lead time between the identification of regional candidate sites and the conduction of the regional workshops to enable stakeholder site familiarisation or assemble appropriate expertise;
- The dependence of the DSS on having sufficient experts (in number) and expertise coverage (across sites) to score criteria values;
- The limited capacity to incorporate new sites 'nominated from the floor' during the workshop process;
- The need to review and update DSS criteria to incorporate specific value and capacity criteria identified by regions and/or associated with the Reef V program; and
- The need to run separate criteria weighting exercises to assess the potentially competing or exclusive Reef Trust Outcomes 1 or 2.

With greater opportunity to address these limitations the potential application of the DSS to assisting in prioritising works sites is still seen to be good albeit ideally for a list of candidates that have already undergone some level of regional stakeholder endorsement and familiarisation (discussed in later sections of the report).

During the regional workshops significant additional information was gathered from stakeholders that further informed site candidature prioritisation and scoping of potential restoration works. The most valuable information obtained from regional stakeholders related to capacity criteria such as levels of past or current investment or potential co-investment, levels of community and landholder support and identified management needs and works opportunities. This type of information is nominated to be some of the most critical in the determination of suitable wetland restoration project sites. It is seldom available from published sources and unlike much biophysical information cannot be interpreted from remote sensing.

The need to obtain and consider such information for prioritising potential wetland management works projects highlights the value of the regional workshop process. It also reiterates that the greatest potential role of the existing DSS tool lies in the prioritisation of known candidate sites rather than in the primary generation of such candidates. Application of information gained from the regional workshops to further prioritise wetland sites as potential management works projects is discussed further under *Post Workshop Project Scoping* (below).

> Fitzroy Basin Association NRM Region

Key Regional Wetland Management Features

The Fitzroy River has the largest drainage area of any within the GBR catchment and it is also Queensland's largest eastern flowing basin. Its climate is seasonally dry with rainfall concentrated in a summer wet season which generates regular flood events particularly in the lower basin. This in combination with the basin's relatively flat and low-lying topography has led to the formation of extensive areas of inland and coastal floodplains and associated seasonal and perennial wetland habitats.

The dominant land use of the basin is cattle grazing primarily on native rangeland pastures. Historically there has been extensive clearing of catchment vegetation including floodplain forests and riparian systems to increase pastoral productivity. In some areas of the basin the extensive clearing of vegetation has affected landscape water balance and both dryland and irrigation associated soil salinisation has developed.

Floodplain and coastal intertidal wetland habitats have also been extensively hydrologically modified by earth bunding to provide additional watering points and ponded pasturage using exotic invasive grass species for improved pastoral production.

Within the basin rangeland grazing is a major and disproportionately significant source of elevated sediment loads exported to the GBR lagoon. These are generated principally via gully erosion initiation but also by the poor condition of riparian and floodplain systems (which impact load attenuation) and associated bank erosion and flood scouring. Inland floodplains have also been extensively cleared and developed to dryland and irrigated agriculture and this too has contributed significantly to both elevated sediment and nutrient loads associated with inland sub-catchments.

Rockhampton one of Queensland's largest regional cities is located on the lower reaches of the Fitzroy River. Water infrastructure established to serve this city (Fitzroy Barrage) has created a significant fish passage barrier within its tidally influenced lower reaches. Urban growth from the city expanding into coastal catchments with erosion prone soils is also presenting lower catchment management challenges and a proximal source of sediment that can be exported directly to coastal receiving environments.

Relevant Wetland Management Considerations

- Transport of basin sediment /contaminant loads predominantly occurs during wet season floods and often as basin scale events.
- Ecosystem service provision of individual wetland site may be impacted by floodplain scale vegetation status.
- Wetland conditions and modification driven by floodplain or basin scale processes are likely to require equivalent scales restoration efforts to effect significant change.
- Wetland sites may be impacted by catchment scale landscape water balance processes.
- Condition resetting benefits of large flood events still occur.
- Restoring hydrological (incl tidal) connectivity and seasonality and water quality within bunded wetland systems dominated by exotic ponded pastures is a key regional management challenge
- The benefits of fish passage works in the upper Fitzroy catchment will be limited for catadromous species due to lower basin passage constraints and will return relatively greater dividends in coastal catchments downstream or outside of such constraints.
- Seasonal aridity, fire risks and cultural practices are all likely to present challenges for wetland revegetation needs.
- Some of the greatest opportunities for site restoration works to contribute toward desired Reef Trust Outcomes may be associated with some of the more disturbed and modified wetlands of the basin
- Peri urban near coastal catchments may make a greater relative contribution to sediment loads exported from to basin to the GBR lagoon than more inland catchments due to their greater proximity to the coast.

Regional Planning and Prioritisation Processes

The Fitzroy Basin Association (FBA) is the community based Natural Resource Management (NRM) body covering the Fitzroy River basin and adjoining coastal catchments to the Boyne River in the south and to St Lawrence Creek in the north. It and its predecessor organisations have a twenty-four-year history of planning and implementing natural resource management strategies and projects in the region including those targeting aquatic ecosystem and wetland management.

FBA regional NRM planning including strategic works prioritisation processes were reviewed to help inform the selection of suitable candidate wetland restoration sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. Only the most current operating plans and supporting documents were reviewed for this exercise although a past prioritisation exercise specifically for wetland investment conducted under the 2005 GBR Coastal Wetland Protection Program (Smith et al 2007) was also reviewed. The reviewed plans and documents included:

1. The FBA Strategic Plan 2016-2020 <http://www.fba.org.au/wordpress/wp-content/uploads/2014/01/2469476-FBA-Strategic-Plan-2015-FINAL.pdf>
2. The Central Queensland Sustainability Strategy 2030 (CQSS 2030) <http://cqss2030.com.au/>
3. The FBA Water Quality Improvement Plan 2015 <https://riverhealth.org.au/projects/fba-wqip/>
4. Ecosystem Repair Prioritisation (Baker 2015)
5. Prioritisation of Neighbourhood Catchments: recommendations, gaps and future research (Star et al 2015)
6. A Prioritisation of Fitzroy Basin Wetlands for Natural Resource Investment (Jaensch et al 2015)
7. Candidate Sites: Fitzroy Basin Association. Memo Report to the Independent Review Group (Wetlandcare Australia 2005).

Contributions of these information sources toward the selection of candidate sites for Greening Australia's current "Repair and Restoration of Priority Coastal Habitat and Wetlands" project are discussed in turn below, with documents 3-6 being discussed concurrently, the latter three representing inputs to the former i.e. WQIP 2015.

The FBA Strategic Plan 2016-2020

The two-page strategy document defines the charter, approach, vision, mission, values, work methods and seven key goals of the FBA. While all key goals have some relevance to wetland management two are more specific:

6. River health and water quality - To reduce sediment and contaminants flowing into our waterways and the Great Barrier Reef by building strong relationships with all stakeholders to foster sound land use practices, risk management and transparent reporting.

7 Ecosystems - To ensure the ecological integrity of our landscape is preserved by delivering programs that assist in the protection of our threatened species and biodiversity.

While these motherhood statements provide little specific information to guide site candidature they do reiterate the alignment of the current Greening Australia project with regional NRM commitments and identify generic methods by which wetland management outcomes may be achieved.

The Central Queensland Sustainability Strategy 2030 (CQSS 2030)

This web-based strategy presents regional approaches for planning for the future, supporting growth and protecting assets. It also explores key events of the region's past that have shaped current NRM outcomes. The planning section broadly examines the relationship between Natural Assets and Resource Use and the two-way flow of benefits and impacts mitigated by various practices, knowledge and planning underpinning management strategies.

The most relevant section of CQSS 2030 for informing wetland management are the assets protection sections which specifically consider Freshwater Rivers and Wetlands and Coastal and Marine Ecosystems. For each of these ecosystem assets fact sheets provide a very broad regional overview of values including ecosystem functions, pressures, trends and regional management objectives and strategies to achieve them (see below). The documents also have links to all current management initiatives related to these ecosystem assets.

Freshwater Rivers and Wetlands – CQSS 2030 Regional objectives:

- Water resources are fundamental to the health of the region's environment and support many industries.
- We need to maintain or improve the condition of aquatic ecosystems.
- We need to maintain or improve the condition of riparian ecosystems.
- We need to maintain or improve the extent and condition of wetlands.

- We need to manage flow regimes to support human use and natural values.
- We need to manage water quality.

Freshwater Rivers and Wetlands – Key Attribute, Objective and Strategy

Protect our freshwater rivers and wetlands		
Aquatic ecosystems	O7. Maintain the extent and condition of aquatic ecosystems	S21. Identify priority species/ecosystems and critical refugia to maintain viable populations
Riparian ecosystems	O8. Maintain the extent and condition of riparian ecosystems	S22. Understand the cumulative impacts of energy, resources and agriculture on flow, water quality and river health
Wetland ecosystems	O9. Maintain the extent and condition of wetland ecosystems	S23. Promote and support the adoption of land and water management practices that protect/maintain/restore critical refugia, riparian ecosystems and wetlands
Flows	O10. Manage flows	S24. Promote integrated water resource planning (ground and surface water)
		S25. Promote and support water use efficiency measures to reduce water demand
		S26. Reduce the impact of barriers to aquatic connectivity
Water quality	O11. Manage water quality	S27. Promote and support land and water management practices to maintain water quality within appropriate guidelines

Freshwater Rivers and Wetlands – Catchment Health Indicators

Catchment health indicators

Measure	Standard (target)	Monitoring and reporting
Waterway health	All catchments to score A or B	Fitzroy Partnership for River Health annual report card
Riparian and wetland extent	Maintain vegetation cover in riparian and wetland ecosystems	GBR wetland extent monitoring (DSITIA) and GBR reporting
Flows	Water resource plan flow objectives - Annual proportional flow deviation (modelled estimate of change from natural flows)	Water Resource Plan reporting

Freshwater Rivers and Wetlands – Related Current Management Initiatives

1. The [Fitzroy Partnership for River Health](#) collates, assesses and reports on the region's aquatic ecosystem health every year.
2. The [Reef Water Quality Protection Plan](#) is supported by an extensive monitoring program and reports annually on the uptake of improved agricultural practices, wetland extent, water quality and marine health across Reef catchments.
3. Local water quality guidelines have been developed for the [Fitzroy Basin](#) and [Capricorn-Curtis Coast](#). These provide regulatory water quality standards.
4. The Queensland Government has conducted aquatic conservation assessments (ACAs) to determine the conservation values of rivers and wetlands across [Great Barrier Reef catchments \(including the Fitzroy\)](#) using AquaBAMM methods.
5. Water storage and extraction is managed under the region's statutory [Water Resource Plan and Resource Operations Plan](#).
6. An assessment of in-stream barriers to fish passage has been undertaken and priority barriers identified for removal or modification (QDPI).
7. A regional Water Quality Improvement Plan has been developed to guide incentives for the adoption of improved agricultural practices (FBA).
8. Agricultural industry Best Management Practice programs, including [Grazing BMP](#), [Grains BMP](#), Growcom's [Farm Management System](#) and [BMP Cotton](#) promote the adoption of good land and water management practices.
9. [Reef Programme grants](#) to support the adoption of improved agricultural practices with water quality benefits (Australian Government, FBA)
10. [Rural Water Use Efficiency Irrigation Futures Program](#) supports improved water management practices in agricultural industries (DNRM).
11. The DNRM is managing the [legacy issues of acid mine drainage at the Mount Morgan mine](#).

For freshwater rivers and wetlands, the CQSS 2030 web site also provides an online mapping tool that presents data layers for EPP Water (HEV values) Central Queensland Management, Waterway Health - Freshwater Grades 2012-13 for sub-basins and wetland mapping for subcatchment areas.

Coastal and Marine – Regional Objectives:

- Coastal and marine ecosystems support high value industries and significant biodiversity values.
- We need to protect estuaries, shorelines and marine ecosystems.
- We need to manage water flows and water quality that link catchments and the coast.
- We need to manage the coastal shoreline to buffer the impacts of sea level rise and extreme weather events.

Coastal and Marine Ecosystems– Key Attribute, Objective and Strategy

Protect our coastal and marine ecosystems		
Marine ecosystems	O14. Protect/ maintain/ restore extent and condition of marine ecosystems	S35. Assess impacts of rising sea levels/extreme events on coastal human uses and natural values S36. Assess risks of the cumulative impacts of ports, infrastructure and coastal development on coastal and marine ecosystems
Estuarine and shoreline ecosystems	O15. Protect/maintain/ restore extent and condition of estuarine and shoreline ecosystems	S37. Identify and prioritise high value coastal ecosystems for protection and restoration S38. Promote land and water management practices to reduce sediment, nutrient and pesticide runoff from catchments
Flows	O16. Manage water flows to sustain human use and natural values	S39. Promote land and water management practices that improve water use efficiency
Estuarine and marine water quality	O17. Manage water quality to sustain human use and natural values	S40. Reduce the impact of barriers to aquatic connectivity S41. Promote water use planning to maintain timing and volumes of flow to maintain ecosystem health
Shoreline buffers	O18. Manage the coastal shoreline to buffer the impacts of sea level rise and extreme weather events	S42. Promote and support climate adaptation planning

Coastal and Marine Ecosystems– Catchment Health Indicators

Catchment health indicators

Measure	Standard (target)	Monitoring and reporting
Marine health	Overall A or B score, coral, seagrass health and water quality measures	AIMS monitoring and GBR/FPRH report card
Gladstone harbour health	Under development	Gladstone Healthy Harbours monitoring and reporting (under development)
Fitzroy estuary health	Overall A or B score, water quality and ecological measures	DSITIA & InfoFish monitoring program, FPRH reporting
Coastal wetland extent	Maintain vegetation cover in wetland ecosystems	GBR wetland extent monitoring (DSITIA) and GBR reporting

Coastal and Marine Ecosystems –Related Current Management Initiatives

1. The bilateral [Reef Water Quality Protection Plan](#) guides the activities of the Queensland and Australian Governments in managing agricultural impacts on water quality. The plan supports an extensive monitoring program and reports annually on the uptake of improved agricultural practices, wetland extent, water quality and marine health across Reef catchments.
2. The [Fitzroy Partnership for River Health](#) collates, assesses and reports on the region's aquatic ecosystem health every year. It uses the [Reef Report Card](#) information for the marine assessment.
3. The Queensland and Australian governments have undertaken complementary strategic assessments of management arrangements in the [Great Barrier Reef coastal zone](#) and the [Great Barrier Reef Region](#) respectively.
4. GBRMPA releases the [Great Barrier Reef Outlook Report](#) on the condition and future of the reef every five years. GBRMPA have also released a [Climate Change Action Plan](#) for the reef.
5. [Gladstone Healthy Harbour Partnership](#) (GHHP) has been established to manage the health of Gladstone Harbour. Various reports are available on their website.
6. Local water quality guidelines have been developed for the [Fitzroy Basin](#) and [Capricorn-Curtis Coast](#). These provide regulatory water quality standards (EHP).
7. Water storage and extraction is managed under the region's statutory [Water Resource Plan and Resource Operations Plan](#).
8. An assessment of in-stream barriers to fish passage has been undertaken and priority barriers identified for removal or modification (QDPI).
9. A regional Water Quality Improvement Plan has been developed to guide incentives for the adoption of improved agricultural practices (FBA).

10. Agricultural industry Best Management Practice programs, including [Grazing BMP](#), [Grains BMP](#), Growcom's [Farm Management System](#) and [BMP Cotton](#) promote the adoption of good land and water management practices.
11. [Reef Programme grants](#) to support the adoption of improved agricultural practices with water quality benefits (Australian Government, FBA).
12. [Rural Water Use Efficiency Irrigation Futures Program](#) supports improved water management practices in agricultural industries (DNRM).

For coastal and marine ecosystems, the CQSS 2030 web site also provides an online mapping tool that presents data layers for Storm Tide Inundation Area (FBA Region) and Coastal Plan - Areas of Ecological Significance (FBA Region).

Summary - CQSS 2030

This document is a relatively high level strategic plan that presents aquatic ecosystem management objectives and strategies that align closely with Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. It is however of limited value for prioritising candidate wetlands at the site scale of for identifying suitable management works other than at a generic level. Some useful context for prioritising wetland projects is provided by:

- the description of current management initiatives which helps identify potential co-investment opportunities and management / monitoring partners;
- The description of the main pressure drivers which helps define the nature of required restoration management activities and the potential demonstration relevance of different works;
- Mapped HEV and wetland aggregation assets and (broad) catchment condition layers which help identify where restoration may be most needed and where outcomes might also serve protective management of high value assets.

Such contextual information helps define areas for further investigation but falls short of in terms of identifying site scale works needs or relative merits.

The FBA Water Quality Improvement Plan 2015

The Fitzroy Water Quality Improvement Plan (WQIP:2015) has been developed to improve water quality in the Fitzroy Basin to protect the Great Barrier Reef. It covers the Fitzroy Basin and coastal catchments (Styx, Shoalwater, Water Park Creek, Boyne and Calliope) as well as adjacent marine waters. The plan sets water quality targets for the region, identifies priority areas to undertake works and recommends management actions to improve water quality. It aims to guide investments in the region which seek to improve water quality and help restore the health of the Reef.

As context for defining priorities the WQIP provides a broad overview of status and trends for freshwater environments, coastal ecosystems and marine ecosystems.

For freshwater environments the WQIP provides a descriptive overview of rivers, the mapped distribution of wetlands and mapped Environmental values (EVs) and water quality objectives (WQOs) defined for the region under the *Environmental Protection Policy 2009* (EPP(Water)).

For coastal ecosystems the WQIP provides a descriptive overview, GBRMPAs blue maps of hydrological connectivity, the associated GBRMPA eco-calculator score for coastal ecosystem process loss/integrity for each of the region's catchments, mapped coastal wetlands and EVs for coastal catchments.

For marine ecosystems the WQIP provides a descriptive overview, and status descriptions for a wide range of marine ecosystem and biota assets including coral reefs and sea grass beds exposed to water quality impacts originating from terrigenous sources. In regard to the latter it also presents an assessed water quality risk score for each sub section of the marine area adjoining the region based on modelled and monitored water quality risks.

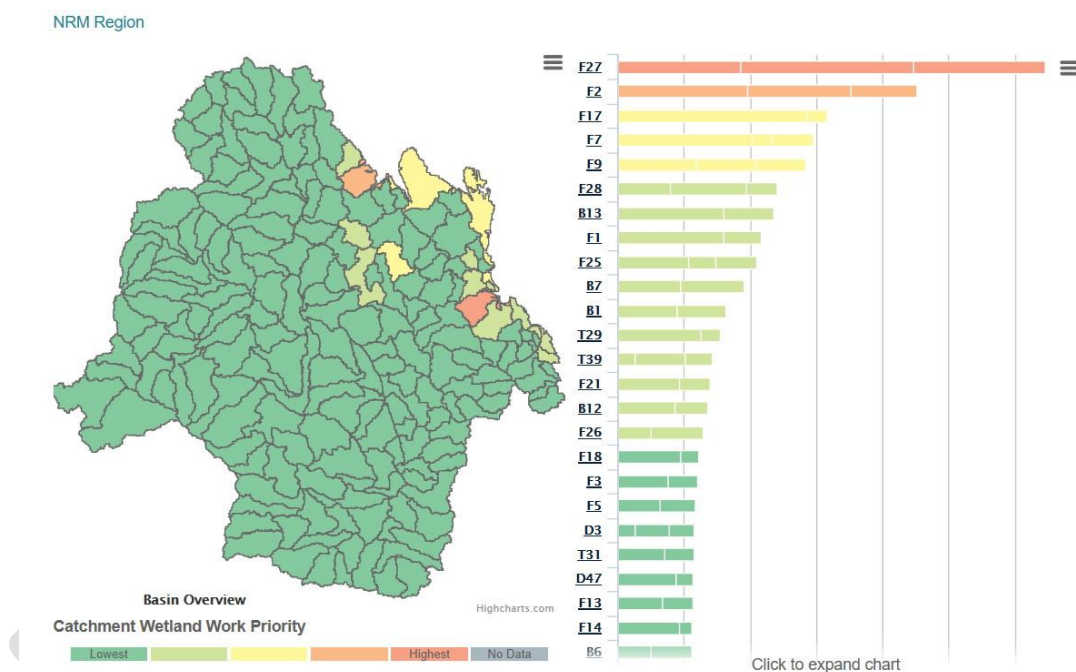
In terms of the current GA project needs it is the prioritisation and targets section of the WQIP which is most useful. Priorities and targets are provided for management investment targeting water quality outcomes for grazing and farming land uses and via the restoration of integrated ecosystem services at the individual neighbourhood catchment scale. Priorities for wetland and fish passage management are defined at the individual site scale but are also incorporated into the prioritisation for integrated ecosystem services.

The integrated ecosystem repair prioritisation was conducted by combining several past prioritisation exercises into a single prioritisation support tool. These included:

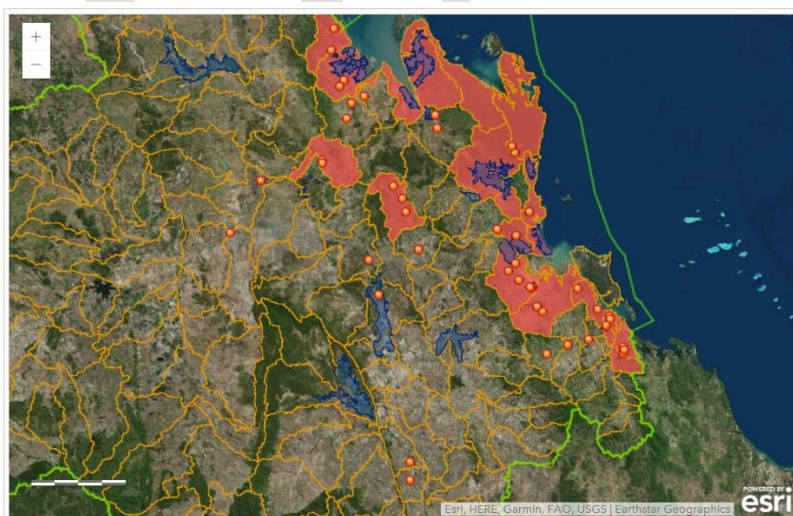
1. the Fitzroy Basin Fish Barrier Prioritisation Project that scored and prioritised the top 46 barriers to fish passage within the FBA region in terms of ecological importance (an update and review of previous work undertaken in 2007–08) (Marsden 2015)

2. a prioritisation of Fitzroy Basin wetlands for NRM investment using the Department of Environment and Heritage Protection's Wetland Decision Support System (DSS) developed by HLA Envirosciences (HLAE 2007) which was used to prioritise the top 20 wetlands for management action out of 40 candidates (Jaensch et al. 2015)); and
3. the GBRMPA developed Eco-Calculator and Blue Maps used to quantify change in the delivery of ecosystem services from modified coastal ecosystems since pre-European times, and to define the level of connectivity of coastal ecosystems with the Great Barrier Reef.

Each of these tools was applied to the FBA region, and their outputs standardised and combined to produce an overall score for each Neighbourhood Catchment (NC) within the region. The final prioritisation identified 61 out of 189 NC's that contain multiple ranking wetlands and fish barriers, with high connectivity to the reef. The high-scoring NC's in this combined output are assessed to represent areas with the greatest potential for realising synergistic benefits from management actions (see below). Ecosystem repair actions nominated include improving fish passage past instream barriers such as weirs, as well as restoring and protecting wetlands and riparian vegetation. However, the identified NCs should not be considered as a final prioritisation without careful consideration of the underlying complexities and issues with the individual tools, and those that arise from their combination into a single score (Baker 2015).



Ecosystem Repair Priority:



Neighbourhood catchments prioritised as ecosystem repair priorities (shaded red), prioritised fish passage barriers (red dots) and prioritised wetlands (blue polygons).

The application of the Wetland DSS (HLAE 2007, Jaensch et al. 2015) to the prioritisation of Fitzroy region wetlands for NRM investment is particularly pertinent to the current project. It was felt that few wetlands in the Fitzroy Basin of known significance are missing from the list (Jaensch et al. 2015). Sources used to select this initial list included:

1. The list of wetlands in the Fitzroy Basin that had been included in the Directory of Important Wetlands in Australia and the Australian Wetlands Database (Blackman et al. 1999; DotE 2015)—thereby also including any Ramsar Sites (one exists in the FBA region).
2. A list and map of 20 wetlands considered for similar purposes by an earlier FBA workshop, supplied by FBA.
3. State-wide wetland mapping from the Queensland Government (EHP 2015).
4. Satellite imagery of the online application Google Earth.
5. Collective personal experience of the authors in the FBA region, over more than 10 years

20 candidate sites were selected out of an initial list of 40. For the sites dropped from the prioritisation process reasons cited included:

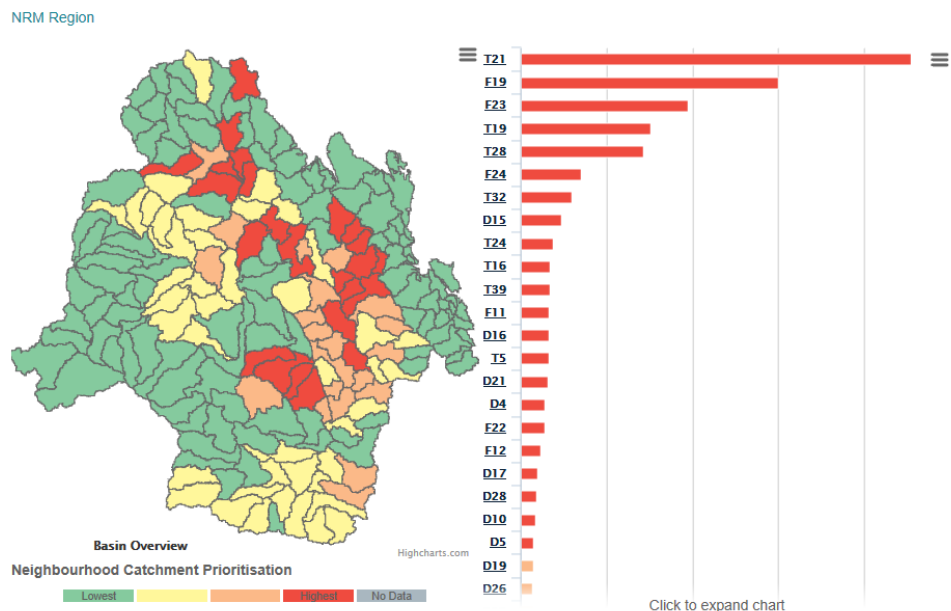
- Relevant NRM investment has occurred and is ongoing;
- Uncertain what could be achieved at the site relevant to the project;
- Possible involvement with offsets in relation to the Curtis Coast Industrial development (i.e. other investment proposed);
- Site is subject to severe flooding impacts;
- Site may be targeted under concurrent FBA projects;
- Insufficient knowledge of site, small size;
- Insufficient knowledge of site, remoteness.

The 20 wetlands selected for the DSS prioritisation were known to or considered likely to contribute to water quality improvement in the Reef lagoon, were wetlands that (otherwise or in addition) had biodiversity values known or likely to be high and to a lesser extent were wetlands where some kind of NRM investment seemed feasible (Jaensch et al. 2015). Outputs of the wetland DSS depend on criteria weighting which is modified to suit different management objectives (water quality, biodiversity etc.). The criteria used fall into three different classes including values, threats and capacity. Values and capacity criteria were treated as evaluation benefits and threats as costs. For the wetland prioritisation the highest weighted (maximum value 10) criteria were *Values*: Indigenous value, Assimilative capacity for nutrients and sediments, Populations of rare or threatened taxa, *Threats*: water quality, Point-source pollution, *Capacity*: Financial incentives, Engagement capacity. The ranking outcome for the 20 selected wetlands is shown in the table below.

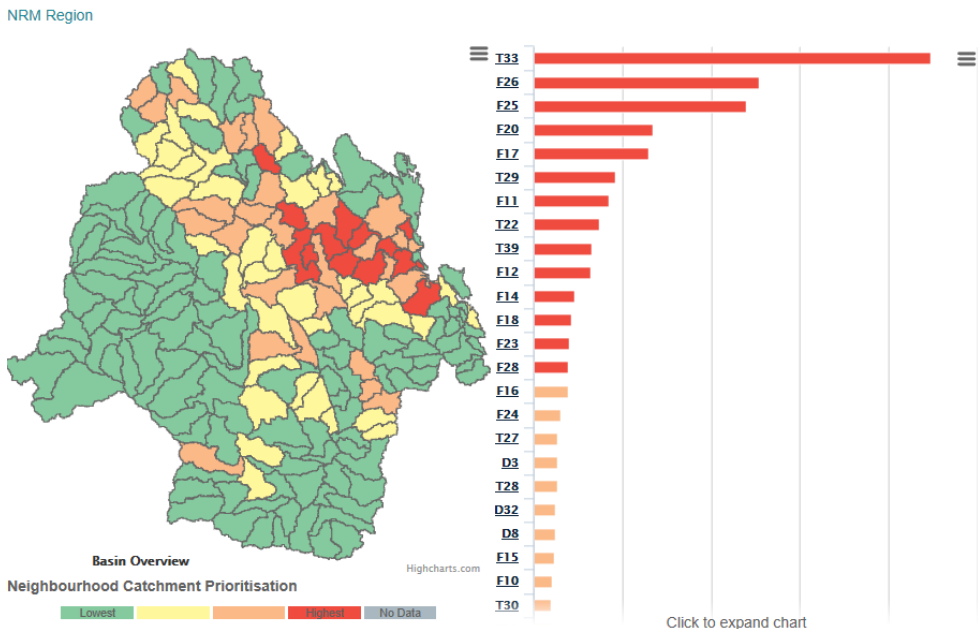
Table 4: Priority rankings from running the DSS application.

DSS rank	wetland code	wetland name
1	FBA05	Torilla Plain
2	FBA20	Palm Tree and Robinson Creek (Taroom)
3	FBA12	Twelve Mile Creek (Bajool)
4	FBA01	St Lawrence Wetlands
5	FBA11	Nankin Plain (Fitzroyvale, Broadmeadows)
6	FBA02	Waverley Plains and Bar Plain
7	FBA09	Iwasaki Wetlands
8	FBA04	Glen Prairie Wetlands
9	FBA08	Lake Mary Complex
10	FBA03	Wumalgi Peninsula (Broad Sound)
11	FBA10	Joskeleigh and Long Beach
12	FBA19	Perch and Mimosa Creeks
13	FBA14	MacKenzie Perched Wetlands
14	FBA06	Lower Herbert Creek Wetlands
15	FBA07	Green Lake Complex
16	FBA16	Serpentine Creek (Fitzroy Delta)
17	FBA15	South Yaamba Complex
18	FBA17	Lower Dawson Floodplain Wetlands
19	FBA13	Lower Isaac Floodplain Wetlands
20	FBA18	Callide-Don Junction Wetlands

The WQIP prioritisation of neighbourhood catchments (NC) for management investment targeting water quality outcomes for grazing and farming land uses is also pertinent to the current project's because it specifically addresses Reef Trust Outcome 1 and recommended management interventions include wetland (i.e. riparian zone and stream bank) restoration. Four prioritisation scenarios were generated: for the total load from the whole of the NC; the intensity of sediment generation and export per hectare; the degree of investment necessary to achieve Ecologically Relevant Targets; and the areas which present cost-effective options (Star et al 2015). These scenarios were generated using source catchments modelling, ground cover data, management practice survey data, economic cost data and calculated sediment delivery ratios (Star et al 2015). Prioritised NC for both farming and grazing are presented below.



Farming Priority Catchment



Grazing Priority Catchments:

In addition to the wetland prioritisation conducted with the DSS there have been at least two other prioritisation exercises conducted in the region in the last decade examining the suitability of wetland sites for management works investment. This include proposals developed for the GBR Coastal Wetland Protection Program (CWPP) in 2005 (Smith et al 2007) and a preliminary prioritisation conducted for the Current GA project in 2016 by local wetland management stakeholders and GA project staff.

The CWPP (2005) prioritisation consider 16 Sites nominated by local stakeholders (see below) which were reviewed by a technical consortium including external wetland management consultants associated with WetlandCare Australia. From this list 6 proposals were developed and 4 ultimately implemented

Wetland sites Nominated by GBR CWPP 2005	Criteria Used to Review / prioritise
12-Mile Lagoon* Bylee Fitzroy Vale / Nankin Ck* Frank's Banks Kinka Wetland, Yepoon* Lake Elphinstone** Long Island, Rockhampton* Raglan Creek* Gavial Creek Wetlands* Iwasaki Capricornia International** Hedlow / Alligator Creeks** Broad Sound / Toorilla Plains** Robinson Creek (Dawson basin) Lake Koolingal Lake Nugga Nugga Rockhampton Tip	<ul style="list-style-type: none"> • Water quality / biodiversity gains • Match NRM/RIS priorities • Stakeholder involvement • Address cause c/f symptoms • Avoid adverse consequences • Focus spatially • Public more than private benefit • Include co-investment • Complement other NRM programs • Strategic investment • Permanency of agreements • Flexibility / Contingency

Seven wetland sites (below) were nominated by regional wetland managers for the 2016 preliminary prioritisation conducted for the Current GA project.

Wetland Site	Score	Decision
Shoalwater and Corio Bay RAMSAR wetland site	64	No
Corio Bay		No
Torilla Plain	80	?
Waverley & Bar Plains	74	?
Nankin Plains (Fitzroyvale, Broadmeadows)	4	?
Twelve Mile Creek (Bajool)	81	?
Iwasaki Wetlands	28	No

These were each scored on a scale to 1-5 for seven criteria including:

1. High Ecological Value
2. Aligned to Reef 2050 and NRM water quality priorities
3. Community Interest / Landholder Support for project site
4. Significant (measurable, long term) impact achievable within project timeframes and budget
5. Management issues and proposed responses are representative of the key GBR wetland and water quality issues - Replicable and scalable
6. Site provides good opportunity to attract additional investment and community interest into wetland restoration
7. Acceptable level of project risk

Total scores were assessed along with consideration of regional NRM prioritisation and summary comments from regional managers in deciding to progress the site for further consideration. Four of the six sites were assessed as potential candidates for further project development.

Candidate Project Sites

The approach ultimately adopted for selecting Fitzroy region candidate wetland project sites followed on from the review of wetland management strategies in the FBA Regional Plan 2016-2020, Central Queensland Sustainability Strategy 2030, the Water Quality Improvement Plan 2015 and supporting documents including past wetland management site prioritisations (CWPP 2005, Jaensch *et al* 2015, GAQ 2016).

Wetland sites that previously had achieved high rankings in terms of suitability for NRM investment particularly those that had been nominated in more than one assessment, were considered a rational starting point for consideration. Three other sources of information defining potential candidates were:

1. Consultation with regional wetland managers,
2. Targeted and opportunistic Google Earth explorations of prioritized Neighborhood Catchments informed by regional wetland mapping, and
3. Author's own experience of regional wetland areas including areas of prior investment or areas with some equivalence to or adjoining such areas (often investigated via 2 above).

Consultation with regional wetland managers (1), was primarily employed to reappraise past site nominations, to gain currency in understanding the status and success of any NRM investment at previously prioritized sites (dropping from contention sites where works had been implemented to completion), to ask for any personal site nominations they felt had merit but may have missed recognition in past nominations, and to assess the validity of potential sites nominated by the author via (2) or (3).

Targeted and opportunistic Google Earth explorations of prioritized Neighborhood Catchments (2) was guided by the aquatic ecosystem management and restoration priorities identified in reviewed sub regional assessments. A particularly salient finding of the review was that prioritisations conducted for farming and grazing land uses included wetland management recommendations i.e. riparian zone rehabilitation and revegetation to deliver water quality outcomes very much aligned with Reef Trust Outcome 1. This provided a key insight as to the potential limitations of using existing regional wetland prioritisations for serving the current restoration targeted project. These are discussed more generically in the final section of the report (*considering wetland sites versus wetland projects*), but they are that past wetland prioritisations have:

- (1) been biased toward highly valuing existing biodiversity values including condition, and
- (2) not differentiated between NRM investment opportunities associated with targeting protective management of existing higher value sites versus NRM investment in restorative management where the potential water quality and biodiversity return may be high at a site where they are currently poor.

For a restoration focused projects one of the key determinants of site suitability is its capacity to receive works that will generate benefits. To this end it is suggested that some lower insitu value wetland sites sitting within farming or grazing dominated catchments with significant contaminant load export potential may have high values as restored sites particularly for Reef Trust Outcome 1 (water quality) but also for ecosystem resilience (Reef Trust Outcome 2) in landscapes otherwise dominated by intensive (agriculture) or extensive (grazing) land uses. One of the identified key features of the region relevant to wetland management that also related to this issue is the extensive historical clearing of riparian and floodplain vegetation that has occurred. This means that restoration activities ideally need to target reach or floodplain subcatchment scale areas to restore ecosystem values and processes that cannot be rectified by a spatial focus on an individual wetland or water body. To progress this strategic thinking a number of novel floodplain wetland sites within neighborhood catchments prioritised for grazing and farming management initiatives were put forward as candidates. This thinking also points toward there being a need for much greater overlap in Reef Trust Programs between those targeting soil erosion and wetland restoration.

Following this rationale, previous lists of wetlands prioritised for regional NRM investment were reviewed in terms of their capacity to specifically support investment in restorative NRM actions. On this basis some previously lower priority sites were considered as candidates due to their potential alignment with current project restoration and water quality objectives and/or their occurrence within WQIP priority grazing and or farming neighbourhood catchments.

The use of the authors own field and aerial image interpretation expertise also resulted in the generation of some candidate sites. One was a high value site where there has been significant past management investment which is now threatened by a recently emerged management concern (Raglan Creek). Another is a high value perennial stream system with readily identifiable restoration needs and good works delivery capacity due to its close proximity to Rockhampton (Nerrkol Creek). This values of this site are recognised by at least three other regional wetland experts (T. Marsden, J. McCabe, S. VanNunen) but has missed recognition in past prioritisation exercises possibly due to less emphasis being directed at riverine versus other wetland types.

While the methodology used to define candidate sites described above may seem less than systematic it is argued that within the time and resource constraints it represents an objective, rationale approach. In terms of a process it can be thought of as a 'gate keeper' approach, whereby to pass through the gate to candidature a site must meet criteria No. 1 and at least two or more other of the following criteria 'passwords' (see below).

Site Candidature 'Gate Keeper' Password Questions – need >3 yeses to pass.

- (8) Does the site have readily identifiable restoration needs that can be delivered within the context of the current project that will deliver for Reef Trust 1 and/or 2 outcomes?
- (9) Has the wetland site previously been prioritised for NRM investment in wetland specific prioritisations?
- (10) Does the site concern a neighbourhood catchment prioritised for wetland NRM investment and/or priority actions promoted in regional planning?
- (11) Does the site have high biodiversity and/or water quality functional values?
- (12) Does the site present the opportunity to build upon or maintain past investment?
- (13) Does the site have notable good works capacity associated with: landholder and/or community support; co-investment potential; proximity to project service centre?
- (14) Does the site present a high value demonstration site related to its: public profile, representativeness of required works to regional needs; and/or opportunity to demonstrate highly innovative works?

For the Fitzroy basin region 20 candidates wetland sites (see table below and Appendix 4) were ultimately nominated for presentation at the regional stakeholder meeting to be culled, refined and added to in terms of detail or additional sites as part of the prioritisation toward fully scoped works proposal. In general terms these sites included:

- Priority wetlands and/or neighbourhood catchments (ecosystem repair, grazing and farming);
- Two nonspecific generic 'issue type' (cleared and eroding floodplain) sites to assess regional capacity and relevance to proposed works program with potential crossover to reef trust Programs targeting sediment load /grazing/farming prioritisation;
- 8 bunded coastal /intertidal plain wetland sites, 2 large coastal and 2 inland freshwater wetland complexes that are long standing and re-occurring priorities that needed ratification of program objective relevance and works capacity;
- Two peri urban proposals not in high priority neighbourhood catchments but where both values and works capacity was deemed to be high;
- Neighbouring sub-catchment areas and extended boundaries on longstanding recognised priority works sites; and
- A site of significant past investment success where emerging condition impacts threaten past gains.

Wetland Site	'Gate Keeper' Password Questions Passed	Comments
FBA1_Glenprarie	1, 2, 3, 4, 7	
FBA2_Torilla Plain	1, 2, 3, 4,	
FBA3_Waverley & Bar Plains	1, 2, 3, 4, 7	
FBA4_St Lawrence Wetlands	1, 2, 3, 4, 5, 6, 7	
FBA5_Wumalgi Peninsula	1, 2, 3, 4	
FBA6_Lower Herbert Creek Wetlands	1, 2, 3, 4, 5	
FBA7_Iwasaki Wetlands	1, 2, 3, 4, 5	
FBA8_Nankin Plains -Broadmeadows)	1, 2, 3, 4, 5, 6, 7	
FBA9_Blacks Waterhole / Raglan Ck	1, 2, 3, 4, 5, 6, 7	Past investment site threatened.
FBA10_Neerkol Ck	1, 2, 4, 6	Unrecognised high value site.
FBA11_Gavial Ck Corridor & Catchment	1, 2, 4, 5, 6	
FBA12_Twelve Mile Creek (Bajool)	1, 2, 3, 4, 5, 6, 7	
FBA13_Eight Mile Creek (Bajool)	1, 4, 3, 4, 6	Subcatchment extension of preceding site.
FBA14_Lake Mary Complex	1, 2, 3, 4, 6, 7	
FBA15_Green Lake Complex	1, 2, 3, 4, 5	
FBA16_Southern Yamba Aggregation	1, 2, 3, 4, 7	
FBA17_Generic Cleared Fitzroy Floodplain	1, 3, 7	Multiple sites
FBA18_Palm Tree and Robinson Creek Wetlands	1, 2, 4	
FBA19_Perch Creek and Mimosa Creek Complex	1, 2, 3, 4	
FBA20_Inland Cropping Floodplains	1, 3, 7	Nogoa, Isaac, Mackenzie, Dawson catchment examples

DRAFT

> Mackay – Whitsundays / Reef Catchments NRM region

Key Regional Wetland Management Features

Catchments that comprise the Mackay – Whitsunday region including the larger Pioneer and Proserpine Rivers are relatively short and steep. The region has a diversity of land use including large areas of the coastal range uplands dedicated to conservation (i.e. National Park) use. However, much of the lowlands including river floodplains and coastal plains that host most wetlands have been intensively developed to sugar cane farming which is the dominant intensive agricultural land use. The Mackay regions host some of Queensland's oldest cane growing areas which reflect historically very poor riparian and remnant vegetation retention practices. Development pressure has also seen cane farming extend onto more inland colluvial footslopes and undulating areas where cultivation often occurs as relatively small paddocks on sloping land. Expansion of sugar cane agriculture is continuing in the region and in recent and current years is extending into lower rainfall areas of the north and south of the region.

The region has a wet tropical climate with relatively high rainfall which is more evenly distributed through the year than seasonal dry tropic regions to its north and south. Combined with relatively erodible and permeable soils there is a high leakage of nutrients, pesticides and suspended sediments from farm productions systems to receiving environments. The consequent water quality risks to near shore marine HEV assets are some of the highest within the GBR catchment.

Although sugarcane farming represents only 18% of the land area in the region it produces about 32% of the regional load of particulate nitrogen, approximately 65% of the regional dissolved inorganic nitrogen load, 40% of the filterable reactive phosphorus load, and 26% of the regional suspended sediment load. Sugarcane farming also produces the majority of filterable reactive phosphorus, ametryn, atrazine, diuron, and hexazinone (WQIP).

Outside of intensive agricultural areas, significant areas of coastal plain and Proserpine River floodplain (Goorganga Plain) are still dedicated to pastoral production which is supported by bunding of drainage lines and supratidal areas and the use of exotic ponded pastures.

Significant water resource development infrastructure has been established on both major river systems of the region including a large dam (Peter Faust) in the upper catchment of the Proserpine River and multiple weirs (including to the lower reaches) on the Pioneer River. All these structures represent significant fish passage barriers and the Peter Faust Dam has also impacted the occurrence frequency and magnitude of floodplain inundation events.

The major regional city of Mackay has undergone and is continuing to experience relatively extensive urban and industrial development which is expanding into low lying coastal areas including melaleuca paperbark and supra-tidal wetland ecosystems.

Relevant Wetland Management Considerations

- Transport of basin sediment /contaminant loads occurs throughout rainy periods often in association with individual storm events
- The generally high integrity of upper catchment areas particularly in smaller coastal catchments provides a management front line for progressing downstream catchment and wetland restoration works.
- The region's historically high levels of loss of riparian and wetland systems, undulating farming landscape and associated contaminant load 'leakiness' of the region's farm production areas underpin the need for wetland restoration outcomes that deliver functional buffer interfaces between production areas and receiving aquatic ecosystems including improved run off detention.
- For most smaller catchments of the region (excluding Pioneer and Proserpine) catchment hydrology has not been significantly impacted by water resource infrastructure or development and system restoration can be primarily met via a focus on habitat restoration.
- The restoration of riparian ecosystems particularly in older agriculture landscapes of the region are a key need with the potential to deliver on both of the desired Reef Trust Outcomes
- Condition resetting benefits of large flood events have been reduced on much of the lower Proserpine river floodplain.
- The benefits of fish passage works in the upper Pioneer catchment will be limited for catadromous species due to lower basin passage constraints and will return relatively greater dividends in coastal catchments downstream or outside of such constraints.
- Restoring hydrological (incl tidal) connectivity and seasonality and water quality within bunded wetland systems dominated by exotic ponded pastures is a key regional management challenge

- Some of the greatest opportunities for site restoration works to contribute toward desired Reef Trust Outcomes may be associated with some of the more disturbed and modified sub-catchments of the region
- Younger and developing agricultural areas in the north and south of the region provide the best opportunity for management and restoration works designed to protect existing assets.
- Water sensitive urban design including the use of constructed and natural wetland systems to provide floodwater detention prior to discharge to the receiving marine environment is an appropriate wetland management focus for this region.

Regional Planning and Prioritisation Processes

Reef Catchments is the community based Natural Resource Management (NRM) body covering the Mackay – Whitsunday NRM region which is comprised of the Proserpine, O'Connell, Pioneer and Plane Creek drainage basins. It and its predecessor 'Mackay – Whitsunday NRM' have a twenty plus year history of planning and implementing natural resource management strategies and projects in the region including those targeting aquatic ecosystem and wetland management.

Reef Catchments' NRM planning including strategic works investment prioritisation processes were reviewed to help inform the selection of suitable candidate wetland restoration sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. Only the most current operating plans and supporting documents were reviewed for this exercise although a past prioritisation exercise specifically for wetland investment conducted under the 2005 GBR Coastal Wetland Protection Program (Smith et al 2007) was also reviewed. The reviewed plans and documents included:

1. Natural Resource Management Plan Mackay Whitsunday Isaac 2014 – 2024
http://hcmif3k7kt343pwrn2ytk39.wpengine.netdna-cdn.com/files/2015/02/MWI_NRM_Plan_2014_2021.pdf
2. Water Quality Improvement Plan 2014 – 2021 Mackay Whitsunday Isaac
http://hcmif3k7kt343pwrn2ytk39.wpengine.netdna-cdn.com/files/2018/02/FINAL_ELECTRONIC_WQIP_MAIN-DOCUMENT_DEC2015.pdf
3. O'Connell River Stability Assessment. (Alluvium 2014).
4. Mackay Whitsunday Region Freshwater Fish Community Health Report (Moore 2015)
5. Mackay Whitsunday Region Fish Barrier Prioritisation (Moore 2015)
6. Edgecumbe Bay, Whitsunday Coast, Repulse Bay, Seaforth Coast, Sandringham Bay, Sarina Inlet, Ince bay, Carmilla Coast: application of the whole of systems management framework. Eight Publications (Great Barrier Reef Marine Park Authority 2016)
7. Stream type assessment of the Mackay-Whitsundays region (Alluvium 2017).
8. Specific Wetland Management Works Prioritisations incl. (1) Candidate Sites: Mackay Whitsunday NRM. Memo Report to the Independent Review Group (Wetlandcare Australia 2005) and (2) Preliminary prioritisation conducted for the current project (Greening Australia 2016)

Contributions of these information sources toward the selection of candidate sites for Greening Australia's current "Repair and Restoration of Priority Coastal Habitat and Wetlands" project are discussed in turn below, with documents 2-5 being discussed concurrently, the latter three representing inputs to the former i.e. WQIP 2014-2021.

Natural Resource Management Plan Mackay Whitsunday Isaac 2014 – 2024

Like most regional NRM plans this document is a high level strategic planning instrument that provides the regional context for undertaking NRM in the Mackay - Whitsunday – Isaac region. While some regional wetland assets are identified in the regional summary, most sections do not provide greater than regional resolution in examining the regional context, condition and trends for (1) Marine, (2) Plains and Ranges and (3) Coasts and Islands ecosystems, associated values, drivers of change and the planning process.

The central section of the plan divides the region into 8 described 'landscapes' which provide more resolved descriptions of regional natural environments and local priorities that for some landscapes include references to wetland and aquatic ecosystem management needs. Key priorities for identified landscapes include:

Whitsunday Coast and Islands – Connectivity to natural areas - We need to provide habitat connectivity, in particular between the key land and sea interface and in areas of riparian vegetation. Such connectivity should also be considered in development proposals and in adapting to increased climate variability.

Proserpine and Bloomsbury – Support the protection of important wetlands - Goorganga Plains Wetland is valuable to our community both environmentally and economically, while also providing cultural significance to Traditional Owners. The wetlands and surrounding areas support beef cattle, sugar cane and forestry as well as nearby residential land use. It also provides ecological functions including floodwater detention, nutrient assimilation and sediment trapping and habitat for rare and endangered species. We need to work with not just landholders, but other beneficiary stakeholders to design and implement programs that ensure appropriate management.

Pioneer Valley – the transition from traditional to contemporary farm practices is promoted - We need to renew the reputation of farming as an industry, lifestyle and culture so that people understand that innovative management practices have enabled farmers to reduce their impact on water quality.

Mackay region – Community capacity and stewardship - We would like to explore the options for looking after resources so that decisions are fair and sustainable. For example, having a percentage of land on a property left intact for our own purposes i.e. ecosystem services, and seek reimbursement for additional areas left untouched which will contribute to the bigger system. This would create a spirit of stewardship.

Mackay City – Well planned urban areas with functioning natural areas - We would like to draw on existing models of urban areas that are developed with the natural environment woven throughout. Our foreshores and beaches are some of our most valued resources, and we would like to see them protected. Development is occurring on areas where we have seen flood historically. We are concerned that this is not appropriate,

Sarina and Isaac – a landscape of connected natural areas - We need to invest in projects that provide habitat connectivity, in particular at the marine-terrestrial coastal interface and in areas of riparian vegetation. Such connectivity should also be considered in development proposals.

Regional goals are defined within the NRM plan for People, Terrestrial Environments, Coastal and Marine Environments, Agriculture, Industry and Climate. Several have direct relevance to Wetland management initiatives (see below).

Terrestrial Environment

Key Outcome TE1: Promote a collaborative multistakeholder approach to identify sustainable land use options – Includes - Contribute to and coordinate innovative and cooperative landscape scale projects that reduce environmental pressures and threats.

Key Outcome TE2: Regional land use planning and activities integrate maintenance and connection of valuable biodiversity areas – Includes - Provide assistance and incentives to landholders for re-alignment of management practices by supporting development and implementation of property plans that have production and environmental outcomes and - Maintain or improve water quality and in turn ecosystem health by supporting activities that reduce terrestrial pollutants in priority areas.

Key Outcome TE3: High biodiversity natural areas are actively managed to maintain and improve their ecosystem function – Includes - Improve condition of high priority in-stream fish habitats, including creating fish passages at fish barrier sites.

Key Outcome TE4: Ecosystem services delivered by natural areas are understood and valued by the broader community – Includes - Promote biodiversity values of wetlands and of the impacts of various management and rehabilitation regimes on fisheries values.

Coast and Marine Environment

Key Outcome CME1: Integrated and multidisciplinary marine and coastal plans are developed and implemented by stakeholders – Includes - Implement collaborative coastal management plans that engage community and ensure protection of coastal ecosystems

Key Outcome CME3: High priority coastal and marine areas are actively managed to ensure natural values are maintained or improved – Includes - Improve marine water quality in line with targets and objectives identified in the water quality improvement plan via improved land management practice targeting high priority terrestrial areas and - Improve collaborative land use planning and management to deliver projects that minimise threats to threatened coastal and marine ecosystems such as saltmarsh, mangrove, seagrass and beach scrub communities, and key species such as turtle, dugong, humpback whale, Indo-Pacific humpback dolphin, Australian snub-finned dolphin, various shorebird species, and water mouse.

Agriculture

Key Outcome A1: Landholders have capacity and knowledge to move towards implementation of evolving best management practice activities – Includes - Identify impact of improved management practice on freshwater, estuarine and marine ecosystem health and undertake key indicator species monitoring to measure change.

Industry

Key Outcome I2: Industry has the capacity to be environmentally sustainable, and to promote this – Includes - Support water management planning for commercial uses that takes into account protection of natural flows and ecosystem health and - Support the implementation of stormwater quality management plans for the region's urban area

Climate

Key Outcome C3: Promote and support emerging mitigation and adaptation opportunities and action – Includes - Prioritise activity that is known to increase resilience to future climate scenarios, for example maintaining coastal vegetation as a buffer from storm tide, cyclones and high winds and - Collaboratively identify and maintain ecological corridors to improve landscape connectivity and resilience.

The final section of the NRM plan that deals with 'achieving the vision' translates identified goals into key outcomes of which several are related to regional wetland management e.g.

Terrestrial Environment – Goal - Balanced, sustainable land use and functional, connected natural areas with biodiversity maintained – Key Outcomes - TE2: Regional land use planning and activities integrate maintenance and connection of high value biodiversity areas, TE3: High biodiversity natural areas are actively managed to maintain and improve their ecosystem function.

Coastal and marine Environment – Goal - Functional coastal and marine ecosystems that contribute to Reef health – Key Outcomes - CME3: High priority coastal and marine areas are actively managed to ensure natural values are maintained or improved.

While the high-level planning strategies in the regional NRM plan provide little specific information to guide site candidature for wetland management investment they do reiterate the alignment of the current Greening Australia project with regional NRM commitments and identify some focal investment priorities.

Water Quality Improvement Plan 2014 – 2021 Mackay Whitsunday Isaac

The 2014-2021 Mackay Whitsunday Water Quality Improvement Plan (WQIP) seeks to ensure regional water quality is suitable for human uses, agricultural uses and aquatic ecosystem protection. It builds upon an earlier 2008 WQIP and describes management interventions for rehabilitation of priority habitats and reduction of pollutant loads from diffuse and point sources. Implementation of the plan is intended to improve the water quality and ecological health of waterways, wetlands and Great Barrier Reef waters within the Mackay Whitsunday region.

The contents of the plan include a regional overview, description of key pollutants and sources, environmental values, water quality objectives and targets, ecosystem health issues and targets, regional intervention and investment priorities, monitoring and management needs and a prioritisation and intervention summary.

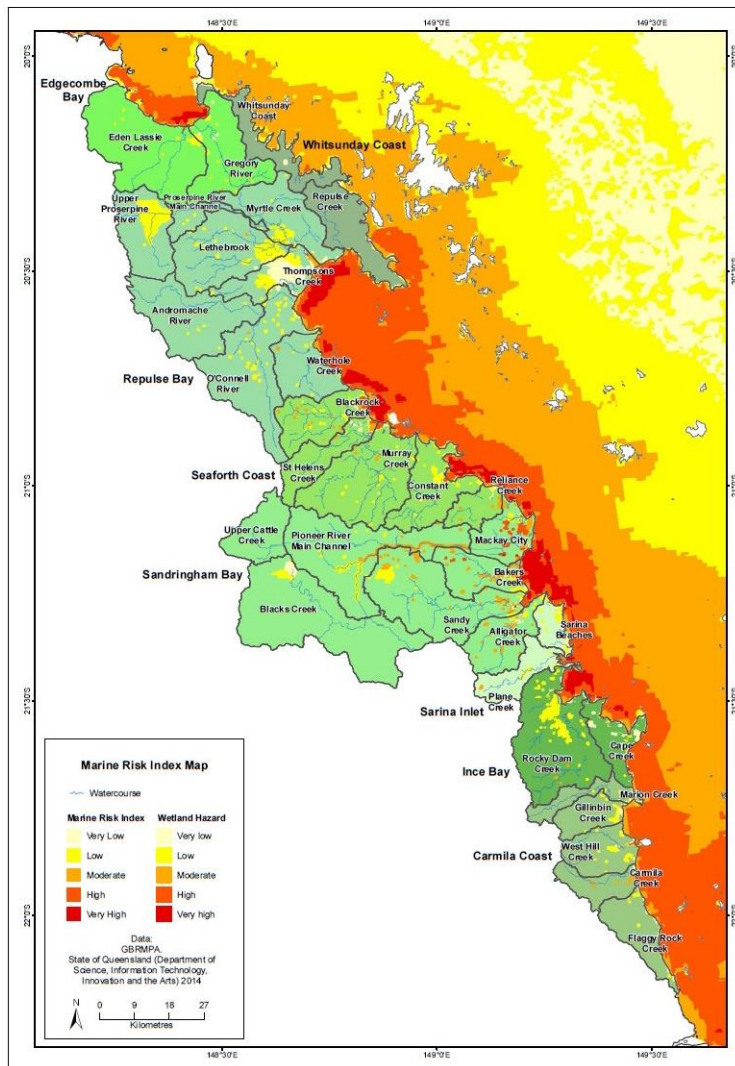
Much of the information presented within the 2014-2021 WQIP provides useful context for identifying suitable candidate areas for investment in wetland management works for both Reef Trust Outcomes 1 and 2. Small individual catchment management areas (CMAs) form the primary reporting template, though the resolution of described features includes reach scale riparian vegetation condition and individual fish passage barriers.

Descriptions of CMA land use characteristics and modelled pollutant loads and an associated marine risk index for receiving marine water assets (figure below) highlight areas with catchment management needs including ecosystem restoration to serve improved water quality. Descriptions of CMA environmental values (EVs) and Matters of State Environmental Significance (MSES) covered under State Planning Policies identify where EVs and/or MSES may be subject to water quality risks associated with the modelled pollutant loads of the CMA, a strategic context for management works investment.

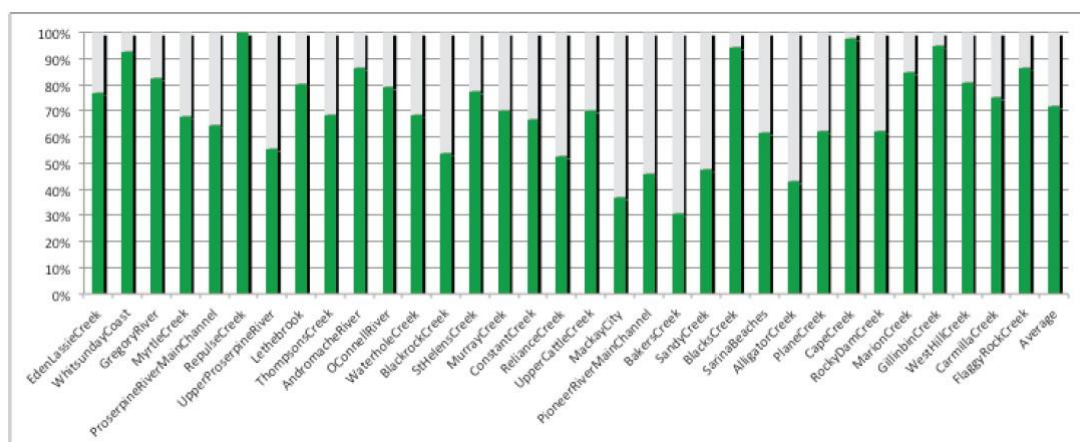
The WQIP's use of ecosystem health indicators for the derivation of CMA ecosystem health scores and the setting of Freshwater Ecosystem Health Targets provides even more relevant guidance for wetland management works investment. The indicators assessed include:

- Riparian vegetation;
- Fish community health;
- Barriers to fish movement; and
- Flow.

Performance against these targets provides input into an overall ecosystem health condition score calculated for each CMA and Receiving Water. Thematic data supporting each of these indicators (e.g. riparian vegetation cover, fish community health rating, fish barrier prioritisation – see figures below) as well as the overall ecosystem health condition score calculated for each CMA and receiving water indicate specific areas requiring management investment.



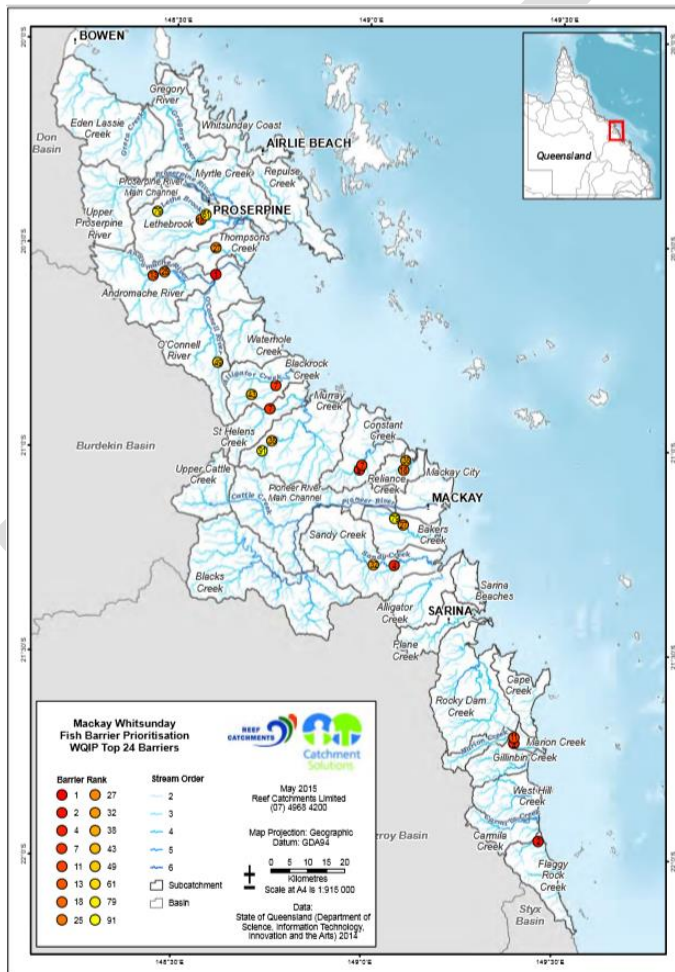
Regional Water Quality Marine Risk and Wetland (condition) Hazard for Modelled Contaminant Loads



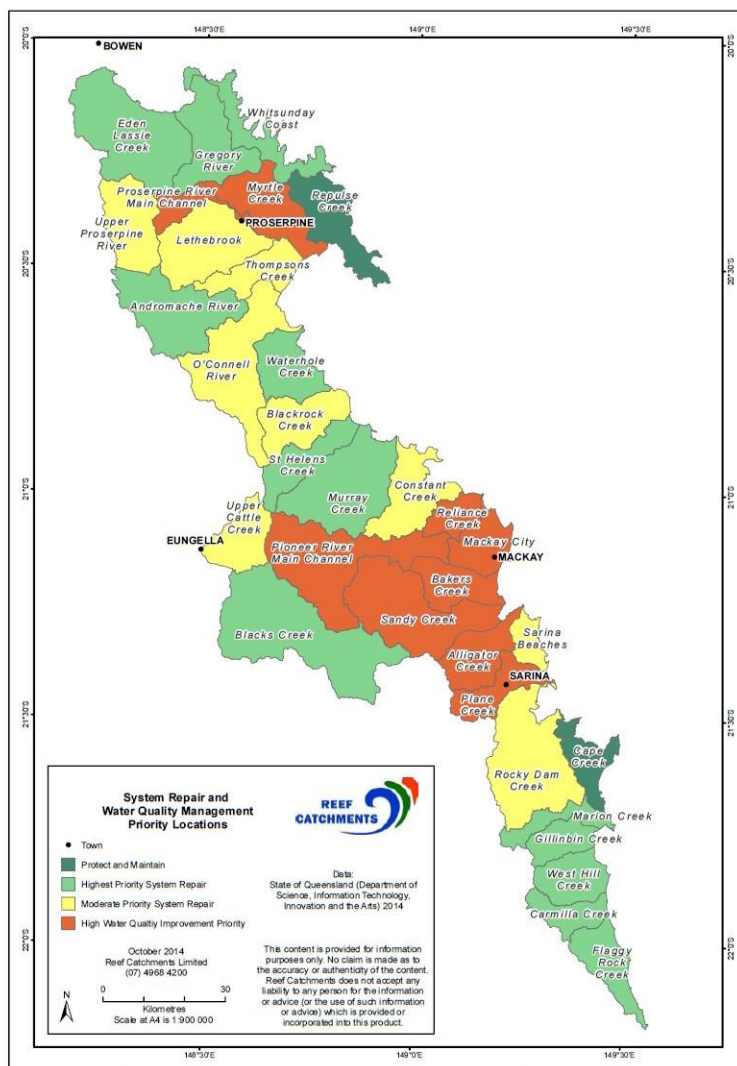
Percentage of Riparian Vegetation remaining for Each Catchment Management Area (CMA)

Catchment	Stream Order	CPUE (fish/min)	Total Species Diversity	Pest Fish Species	Fish Community Health Rating
Repulse Creek	4	29.55	11	0	Very Good*
Upper Cattle Creek	4	32.87	14	0	Good
St Helens	4	46.08	21	1	Good
Gillinbin Creek	4	15.49	11	0	Moderate
Blacks Creek	5	31.24	17	0	Good
Plane Creek	4	16.17	20	1	Moderate
Carmila Creek	5	32.14	16	0	Good
Andromache River	6	23.76	22	1	Moderate
O'Connell River	6	22.63	28	1	Good
Rocky Dam Creek	4	8.31	15	0	Moderate
Pioneer River	6	19.69	21	0	Moderate
Sandy Creek	5	9.69	25	2	Moderate
Bakers Creek	4	11.86	15	2	Moderate
Myrtle Creek	4	9.93	19	3	Poor
Average		22.10	18	0.8	Moderate

Overall Fish Community Health Rating for Each CMA



Regional Top 24 Prioritised Fish Passage Barriers



Mackay Whitsunday System Repair and Water Quality Management Locations

Beyond a spatial focus, the 2014-2021 WQIP also provides a regional intervention and investment prioritisation that addresses the types of management actions required to achieve the Freshwater Ecosystem Health Targets presented in the Plan.

For agricultural dominated landscapes an ABCD management practice framework principally addressing on-farm production practices is promoted as the key investment area toward reducing catchment pollutant loads. For grazing land uses riparian zone management (=wetland management) is included. For urban landscapes improved storm water management for water quality improvement is promoted for mature urban areas. This is based principally on 'regional' solutions in public open space involving the investigation of potential retrofit options for combined water quality improvement and flood amelioration measures in the Mackay City and represents another avenue for strategic investment in wetland restoration for water quality outcomes.

Considering the current ecosystem health condition within the region the WQIP identifies a range of specific management interventions that can address identified threats and achieve the Freshwater Ecosystem Health Targets (FEHT) set by the plan. Management interventions (presented in table below) are nominated for the significant benefit they provide to ecosystem health and to guide investment for the improvement of ecosystems in the region. These recommendations provide specific guidance for wetland management works that may be pursued by the current project.

For prioritisation of where particular ecosystem repair interventions are most appropriate a range of prioritisation tools are utilised. The four main tools used are:

- System Repair and Water Quality Management Priority Locations;
- Reef Catchments Water Quality Prioritisation Database; and
- GBRMPA Blue Maps;
- GBRMPA EcoCalc Scores.

These tools (described separately below) identify issues impacting water quality and ecosystem health and identify the most effective and efficient ways to address these issues. The tools are used to prioritise the type and location of management actions and assess their cost effectiveness.

Riparian Management	<ul style="list-style-type: none"> Restoration of actively eroding banks through stabilisation works and vegetation restoration Restoring riparian vegetation through planting pioneer riparian species Riparian vegetation rehabilitation through weed and pest animal control activities Waterway restoration including control of water weeds
Fish Community Health	<ul style="list-style-type: none"> Restoration of actively eroding banks through stabilisation works and vegetation restoration Restoring riparian vegetation through the establishment of pioneer riparian plantings Riparian vegetation rehabilitation through weed and pest animal control activities Improvements to fish habitat by controlling waterweeds and re-introducing aquatic habitats including lunken structures and large woody debris. Removal of barriers to fish migration through implementation of fish ways and the modification of culverts and road crossings Improve water quality (Nutrients, TSS and Herbicides) through the implementation of B & A class Sugarcane, Grazing & Horticulture management practices.
Flow	<ul style="list-style-type: none"> Provide information to irrigators and water extractors on ecological drawdown levels on non WRP regulated waterways.
Seagrass	<ul style="list-style-type: none"> Restoration of actively eroding banks through stabilisation works and vegetation restoration Improve water quality (Nutrients, TSS and Herbicides) through the implementation of B & A class Sugarcane, Grazing & Horticulture management practices.
Inshore Coral	<ul style="list-style-type: none"> Restoration of actively eroding banks through stabilisation works and vegetation restoration Improve water quality (Nutrients, TSS and Herbicides) through the implementation of B & A class Sugarcane, Grazing & Horticulture management practices.
Ambient & Event Water Quality	<ul style="list-style-type: none"> Implementation of B & A class Sugarcane, Grazing & Horticulture management practices.

Priority Management Interventions to Improve Ecosystem Health Identified by the 2014 – 2021 WQIP

System Repair and Water Quality Management Priority Locations

System Repair and Water Quality Management Priority Locations map (figure above) provides a level of regional prioritisation to focus water quality and ecosystem health implementation activities in CMAs that will provide the greatest benefit. The map identifies water quality management priority CMAs - those with the poorest water quality that are not a priority for ecosystem health improvement but are a high priority for activities that improve water quality. The map also identifies catchments with waterways of greatest ecological value in the region. These are the primary priority areas for the implementation of ecosystem health maintenance and improvement activities.

Reef Catchments Water Quality Prioritisation Database

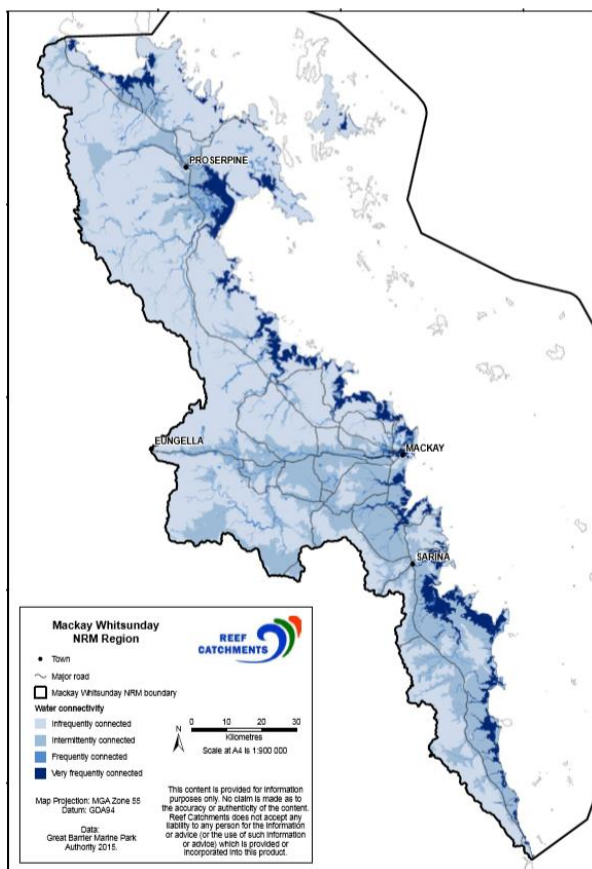
The Reef Catchments Water Quality Prioritisation Database has been applied via a Microsoft Access programme for over 10 years playing a pivotal role in prioritising sugarcane, horticulture, grazing, and ecosystem health improvement projects using complex equations that take into account a large range of factors, including soil type, project area, surrounding biodiversity status, cost of project, ABCD framework improvements, and land class for riparian zones.

GBRMPA Blue Maps

The Mackay Whitsunday Blue Map developed by GRMPA (see below) breaks up the region according to the blue score attributed which identifies the extent to which areas in the region connect coastal ecosystems to the marine environment via geomorphic and/or hydrological processes. The darker the mapped area, the more connected (frequency) the area is to the marine environment. The Blue Map is used to prioritise locations of management actions that will have an increased beneficial outcome due to being within a hydrological connected location.

GBRMPA EcoCalc Scores

The GBRMPA EcoCalc provides scores for different ecosystem services provided by CMA coastal ecosystems, according to the post-clearing status of coastal ecosystems and their level of connectivity determined by the Blue Map (below). The resulting EcoCalc Score is relative to the ecological processes that would have existed in the same area pre-development. The EcoCalc scores and outputs guide where to focus investments to gain most improvement in ecological function based on the connectivity to the marine environment. Results help determine the types of works that are required on what type of land to improve impaired ecological processes.



GBRMPA Applications of Whole of Systems (WOS) Management Framework (2016)

These are a series of eight documents covering the Mackay-Whitsunday region divided up based on defined receiving waters and their contributing catchment areas including: Edgumbe Bay; Whitsunday Coast; Repulse Bay; Seaforth Coast; Sandringham Bay; Sarina Inlet; Ince Bay and Carmila Coast. The whole of systems management framework (figure below) is detailed in the Queensland government publication *Wetlands in the Great Barrier Reef Catchments Management Strategy 2016* (Queensland Wetlands Program 2016). These publications bring together information at a fine scale for applying the framework to sub-catchments in the Mackay-Whitsunday natural resource management region.

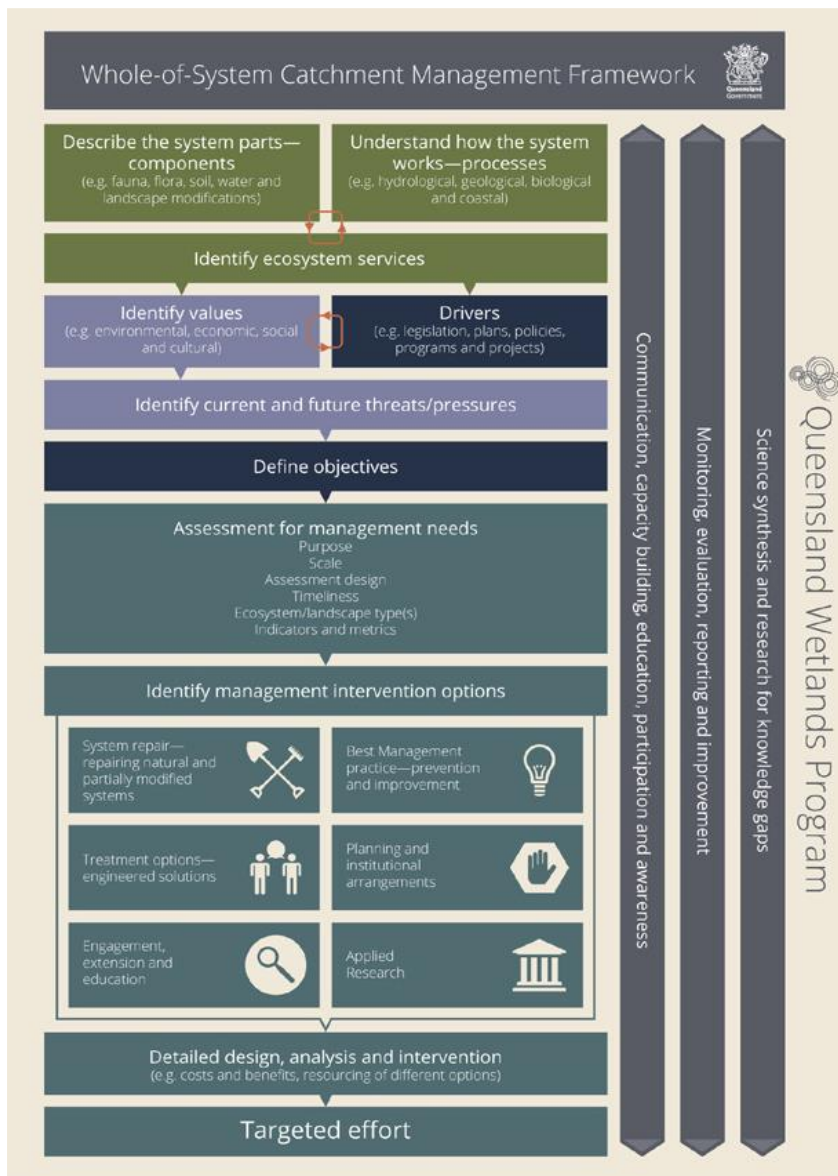
Following the illustrated structure of the WOS framework (below) the documents provide a mapped biophysical description of each contributing catchment area's ecosystem components and operating processes that underpin how it works or doesn't work in the case of system impairment.

Described ecosystem components include:

- Waterways
- Receiving waters and marine ecosystem assets
- Groundwater Dependent Ecosystems
- Geology and land zones
- Soil – permeability, drainage and surface texture
- Coastal Ecosystems pre-clear and current status.

Described ecosystem processes include:

- Overland flows and hydrological connectivity frequency (Blue maps)
- Groundwater hydrology
- Land use patterns, condition impacts and change (1999 – 2009)
- Drainage system fluvial geomorphology and sediment transport including descriptions of
 - Stream character,
 - condition and trajectory
 - river bank substrate
 - in stream water
 - in stream habitat
 - riparian condition
- Coastline and coastal processes
- Associated ecosystem services
- Status / level of impairment of ecosystem processes



Qld Wetland Program – “Whole of System Catchment Management Framework”

Following the WOS framework (above) each study area’s ecological values and associated threats and pressures operating on these values are identified. For the Edgecumbe Bay example these include: Fish habitat Areas, National Directory Wetlands, Dugong Protection Areas, Seagrass beds, Inshore reefs, existing reserves and protected areas, listed species and communities, remnant vegetation conservation status, resilient reef systems and functional connectivity between terrestrial, aquatic and marine systems. Identified threats and pressure include: Changing land use, barriers, climate change, point source pollution, degrading water quality and cyclones.

Following the examination of each study areas ecosystem components, processes and underpinned values and threats to these values the WOS framework seeks to define management objectives, in terms of management needs, processes targeted for restoration, intervention options and specific actions (see table below). Existing research and monitoring programs within the study area are also described as a basis for identifying collaboration and/or gap filling opportunities.

The outputs of the WOS framework assessment for each study area in the Mackay – Whitsunday region is exceptional for prioritising wetland management investment. It identifies wetland and catchment ecosystem management needs including specific actions using a logical biophysical causal linkage approach. While it stops short of nominating individual management investment sites the context it provides is a robust basis for assessing the merits and needs of individual wetland sites, candidates for which can often be interpreted from aerial photo interpretation. Non-biophysical information e.g. landholder engagement willingness and finer site scale condition data required for identifying specific works opportunities is required to scope such candidate sites toward actual project proposals.

What can be done?	What do these actions hope to achieve?	What are the potential additional benefits to the receiving waters and the Great Barrier Reef?
<ul style="list-style-type: none"> Improve Best Management Practice uptake in the upland areas. By improving groundcover and protecting riparian areas in areas of porous soils, water loss from these areas can be slowed allowing percolation into groundwater Increase riparian vegetation and in-stream structures in upland areas to slow flows Maintain groundcover in areas with erosive soils Construct wetlands in upland areas to capture runoff Consider terracing and revegetation of cleared sloping land Modify or remove barriers (Moore 2015, De'ath, Fabricius 2008) restricting movements of migratory fish species in floodplain areas (VFC and FC areas) 	<ul style="list-style-type: none"> Increases groundwater reserves for future use Improves water residence time to allow greater uptake of nutrients by remnant vegetation Reduces the severity of event-based flooding by slowing run-off from property to property Reduces erosion and increases sediment deposition and soil formation Improves water clarity in waterways Allows seasonally dry waterways to retain water in pools as refugia for fish during the dry season 	<ul style="list-style-type: none"> Reduction in the size and impacts associated with flood plume 'events' Water quality improvements Improved water clarity benefiting local seagrass health (and other species) Increased coral cover where cover is limited by light and poor water quality Increased biodiversity of coral (and other) species. Reducing sediments reduces bleached corals mortality Improved carbon sequestration and localised shading of waterways Increased productivity in Reef waters, with flow on effects up the food chain to higher order predators such as dolphins

Table - "Whole of System (WOS) Catchment Management Framework" nominated actions that can be applied to enhance the capacity of the catchment to provide regional scale processes, if delivered at appropriate scales for Edgercumbe Bay

Stream type assessment of the Mackay-Whitsundays region (Alluvium 2017).

Alluvium were engaged by Reef Catchments to undertake a stream type assessment of waterways across the Mackay-Whitsundays region. This was done on the basis that channel erosion and degraded riparian vegetation within these waterways are factors that contribute to significant sediment and nutrient loads to the GBRMP. Understanding of the fluvial geomorphology, stream physical form and riparian condition can help inform broader catchment management responses to protect the Great Barrier Reef and improve river health.

Waterways across the region were found to be dominated by macro channel systems and many of the smaller systems, maintain excellent riparian vegetation within the channel. However, many of the larger macro-channel systems have relatively degraded riparian vegetation

Channel erosion is most prevalent in reaches which are only slightly confined by either terraces or bedrock. Erosion primarily occurs in reaches with extensive inset floodplains and degraded riparian vegetation. This assessment identified that major sediment loads from channel erosion are likely to be derived from a limited number of systems and reaches.

In many locations inset floodplains retain remnant riparian communities and are likely to capture significant volumes of fine sediment. Management of inset units can play an important role in limited sediment loads to the GBRMP.

The assessment identified significant physical form values in many waterways which provide valuable habitat for many freshwater and marine species including species critical to the health of the Great Barrier Reef. Given the small coastal catchments, the Mackay-Whitsundays region is assessed to present excellent opportunities for system repair as in many cases isolated works (i.e. fish barrier removal, reach scale riparian restoration etc.) can substantially increase the connectivity and habitat availability from the coast to the headwaters.

Early outputs from this study were used to inform the WOS framework-based assessments of sub-catchments in the Mackay-Whitsunday / Reef Catchments RNRM Region (described above). Outputs from this study provide invaluable information for prioritising catchment and reach scale works investment in riverine wetland systems within the region.

Previous Wetland Management Works Prioritisations (Wetlandcare Australia 2005, Greening Australia 2016)

The CWPP (2005) prioritisation consider 16 Sites nominated by local stakeholders (see below) which were reviewed by a technical consortium including external wetland management consultants associated with WetlandCare Australia. From this list 6 proposals were developed and 5 ultimately implemented

Wetland sites Nominated by GBR CWPP 2005	Criteria Used to Review / prioritise																		
<table><tr><th>Nominated Site</th></tr><tr><td>Goorganga (previously submitted)</td></tr><tr><td>McCready's Creek*</td></tr><tr><td>Tedlands Wetlands Complex*</td></tr><tr><td>McEwans Beach</td></tr><tr><td>Slade Point</td></tr><tr><td>Padaminka*</td></tr><tr><td>St Helens Creek Estuary</td></tr><tr><td>Murray Creek</td></tr><tr><td>Bakers Creek / Walkerston</td></tr><tr><td>Shellgrit (Airport expansion)</td></tr><tr><td>Northern Pioneer floodplain*</td></tr><tr><td>Southern Pioneer Floodplain*</td></tr><tr><td>Sandringham Lagoon</td></tr><tr><td>Orphanage Swamp</td></tr><tr><td>Vanholme Lagoons</td></tr><tr><td>Mooyland Lagoon</td></tr><tr><td>The Lagoons (Botanic Gardens)*</td></tr></table>	Nominated Site	Goorganga (previously submitted)	McCready's Creek*	Tedlands Wetlands Complex*	McEwans Beach	Slade Point	Padaminka*	St Helens Creek Estuary	Murray Creek	Bakers Creek / Walkerston	Shellgrit (Airport expansion)	Northern Pioneer floodplain*	Southern Pioneer Floodplain*	Sandringham Lagoon	Orphanage Swamp	Vanholme Lagoons	Mooyland Lagoon	The Lagoons (Botanic Gardens)*	<ul style="list-style-type: none">• Water quality / biodiversity gains• Match NRM/RIS priorities• Stakeholder involvement• Address cause c/f symptoms• Avoid adverse consequences• Focus spatially• Public more than private benefit• Include co-investment• Complement other NRM programs• Strategic investment• Permanency of agreements• Flexibility / Contingency
Nominated Site																			
Goorganga (previously submitted)																			
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Sandringham Lagoon																			
Orphanage Swamp																			
Vanholme Lagoons																			
Mooyland Lagoon																			
The Lagoons (Botanic Gardens)*																			

Nine wetland sites (below) were nominated by regional wetland managers for the 2016 preliminary prioritisation conducted for the Current GA project.

Wetland Site	Score	Decision
Goorganga Plains	74	?
Sandringham Lagoons	88	?
Tedlands / Llewlyn Bay complex	80	?
Keeley's Road Wetland	87	no
Goosepond Lagoons	86	no
Fursden Creek	87	no
Gregory River (combined with Eden Lassie/Edgecumbe)	0	
Eden Lassie / Edgecumbe Bay	0	
Carmila Coast		

These were each scored on a scale to 1-5 for seven criteria including:

1. High Ecological Value
2. Aligned to Reef 2050 and NRM water quality priorities
3. Community Interest / Landholder Support for project site
4. Significant (measurable, long term) impact achievable within project timeframes and budget
5. Management issues and proposed responses are representative of the key GBR wetland and water quality issues - Replicable and scalable
6. Site provides good opportunity to attract additional investment and community interest into wetland restoration
7. Acceptable level of project risk

Total scores were assessed along with consideration of regional NRM prioritisation and summary comments from regional managers in deciding to progress the site for further consideration. Only two of the nine sites were assessed as unsuitable candidates for further project development.

- Reviewed wetland management strategies in Mackay, Whitsunday, Isaac Natural Resource Management Plan 2014-2024
- Identified key features of region relevant to wetland management prioritisation

- Reviewed aquatic ecosystem management and restoration priorities identified in Catchment Management Area (CMA) WQIP assessments and regional studies e.g. fish community health, stream type channel stability and fish passage barrier prioritisation assessments
- Reviewed outputs of past wetland prioritisation processes (CWPP 2005, GAQ 2016)
- Consulted with regional wetland managers
- Employed personal experience in reviewing wetland mapping and aerial imagery
- Past site nominations reviewed and most higher priority sites (including some with past investment) included in current candidate list
- Some higher priority sites excluded in following review with regional wetland managers due to being sites cf. works projects (some still included)
- Some lower priority ecosystem repair CMA sites also considered on basis of potential alignment with current project water quality objectives & WQIP priority water quality management CMAs (& water quality linked restoration actions)

Candidate Project Sites

The selection of Mackay, Whitsunday, Isaac region candidate wetland project sites was heavily informed by the review of past regional NRM planning and investment prioritisation processes described above. The key guidance taken from the reviews included:

1. Reference to sub regional 'landscape' defined wetland management priorities e.g. Goorganga Plains for the Proserpine and Bloomsbury Landscape and the location of HEV assets;
2. Regional prioritisation of the urban stormwater / flood management issues associated with Mackay city urban and industrial encroachment into low-lying coastal wetland areas;
3. The correlation between poor riparian system condition and some of the worst regional water quality outcomes (e.g. Sandy, Baker's, Alligator Creek CMAs);
4. Stream reaches strategically defined by the stream type fluvial geomorphology and sediment transport study as being primary areas of sediment load generation and strategic investment areas;
5. The rationale underpinning CMA *System Repair and Water Quality Management* prioritisation and further biophysical insights provided by the GBRMPA Whole of System (WOS) catchment management framework publications for regional sub catchments (discussed further below);
6. Specific ecosystem health and process re-instatement management actions nominated by both the WQIP and the WOS studies.

Using these insights, wetland sites previously prioritized as areas suitability for NRM investment particularly those that had been nominated in more than one assessment, were reviewed in terms of their compliance with regionally defined priorities. To conduct this review other sources of information were also employed including:

1. Consultation with regional wetland managers,
2. Google Earth explorations of prioritized Catchment Management Areas (CMAs) informed by WQIP and WOS outputs, and
3. Author's own experience of regional wetlands particularly areas of prior GBR CWPP investment (often investigated via 2 above).

Consultation with regional wetland managers (1), was primarily employed to reappraise past site nominations, to gain currency in understanding the status and success of any NRM investment at previously prioritized sites (dropping from contention sites where works had been implemented to completion), to ask for any personal site nominations they felt had merit particularly on the basis of unpublished information such as landholder engagement capacity, and to assess the validity of potential sites nominated by the author via (2) or (3). Outcomes from local manager consultation included re-instating sites dropped from consideration in the earlier Greening Australia (2016) prioritisation (Goosepond Lagoon, Fursden Ck) and the identification of a potentially valuable demonstration site (Myrtle Ck) tied to a BMP peer leading landholder's property. Another opportunity identified via local manager consultation was that associated with 2017 flood disaster recovery funding in the region. Bank erosion and channel break outs associated with the 2017 floods has lead to works being proposed at a number of regional stream sites and some of these were seen to present viable restoration co-investment opportunities (Oakly and Carmila Creeks).

Targeted Google Earth explorations of prioritised CMAs (2) was guided by *System Repair and Water Quality Management* priorities identified in in the WQIP and riparian system condition data presented in the GBRMPA WOS studies and the Alluvium Stream Type assessment. A departure from the WQIP prioritisation was the pursuit of system repair opportunities in CMAs defined as water quality management priority areas. This was done because it was recognised that similar to other regions (e.g. Fitzroy) system repair prioritisation had"

- been biased toward highly valuing existing biodiversity values including condition, and
- not differentiated between NRM investment opportunities associated with targeting protective management of existing higher value sites versus NRM investment in restorative management where the potential water quality and biodiversity return may be high at a site where they are currently poor.

Ecosystem service / impairment type assessments provided by the GBRMPA eco-calculator and the WOS catchment management framework analyses of sub catchment areas identify that slowing down catchment surface flows via reinstatement of riparian vegetation and wetland/detention areas is a key need for intensive production areas where riparian systems have essentially been modified to agricultural drains. Such riparian conditions characterise most of the poorest water quality performing CMAs of the region and therefore the need to establish demonstrative restorative works that can address this issue and help cultivate cultural change has been prioritised targeting areas where remnant floodplain habitat connectivity can also be served (e.g. Bakers, Sandy and Alligator Creek sites).

Conforming with the regional WQIP *System Repair and Water Quality Management* prioritisation of system repair of higher integrity systems, WOS study outputs, Google Earth aerial imagery interpretation and local manager endorsement both the Gregory River and St Helens Creek catchment were identified as good candidate sites.

Google Earth aerial imagery interpretation was also used to review sites of past wetland management investment following the rationale of building on past investment and extending site boundaries and works types at sites previously selected for their investment return. Candidates pursued following this line of assessment and local manager endorsement included Sandringham Lagoon, Tedlands, Benholme Lagoon and Orphanage Lagoon.

In terms of a process this methodology can be thought of as a 'gate keeper' approach. As described for the Fitzroy region, to pass through the gate to candidature a site must meet criteria No. 1 and at least two or more other of the following criteria 'passwords' (see below).

Site Candidature 'Gate Keeper' Password Questions – need >3 yeses to pass.

1. Does the site have readily identifiable restoration needs that can be delivered within the context of the current project that will deliver for Reef Trust 1 and/or 2 outcomes?
2. Has the wetland site previously been prioritised for NRM investment in wetland specific prioritisations?
3. Does the site concern a CMA prioritised for wetland NRM investment and/or priority actions promoted in regional planning?
4. Does the site have high biodiversity and/or water quality functional values?
5. Does the site present the opportunity to build upon or maintain past investment?
6. Does the site have notable good works capacity associated with: landholder and/or community support; co-investment potential; proximity to project service centre?
7. Does the site present a high value demonstration site related to it's: public profile, representativeness of required works to regional needs; and/or opportunity to demonstrate highly innovative works?

For the Mackay Whitsunday Isaac /Reef Catchments Region 17 candidates wetland sites (see table below and Appendix 4) were ultimately nominated for presentation at the regional stakeholder meeting to be culled, refined and added to in terms of detail or additional sites as part of the prioritisation toward fully scoped works proposal. In general terms these sites included:

- 6 cane land catchment drainage line riparian revegetation and constructed/rehabilitated wetland 'chain of ponds' proposals (some including remnant floodplain forest and lagoon systems) –RC5, RC6, RC7, RC10, RC12, RC15b-j
- 4 ~whole of catchment scale works programs for High – low condition systems retaining coast to ranges riparian systems - RC1, RC14, RC15, RC16
- 2 flood damaged creeks stabilisation and riparian rehabilitation proposals – RC13, RC17
- 2 water sensitive urban design management proposals for Mackay Estuaries – RC8, RC9
- 1 catchment scale riparian revegetation proposal for a high value perennial creek and regional sediment source – RC4
- 1 rural beach estuarine swamp grazing and drainage management proposal – RC11
- A farm runoff, grazing burning regime management proposal for a high value grazed floodplain wetland complex – RC3
- Demonstration riparian revegetation / fish passage provision for a constructed wetland on a BMP cane farm – RC2

Wetland Site	'Gate Keeper' Password Questions Passed	Comments
RC1_Gregory River	1, 2, 3, 4, 7	System Repair Priority
RC2_Myrtle Creek / Borellini Rd	1, 3, 4, 6, 7	Landholder Capacity
RC3_Goorganga Plains North	1, 2, 3, 4, 5, 6,	Regional Landscape Priority
RC4_Calen / St Hellens Creek	1, 2, 3, 4, 7	System Repair Priority
RC5_Goosepond Lagoons Catchment	1, 2, 3, 4, 5, 6	Past/Current Investment
RC6_Fursden Creek Catchment	1, 4, 5, 6	Past/Current Investment
RC7_Benholme Lagoons	1, 2, 4, 5, 7	Past Investment
RC8_McCreadys Creek	1, 2, 3, 4, 5, 6, 7	Urban Stormwater Management
RC9_Lower Bakers Creek - Paget	1, 3, 4, 6, 7	Urban Stormwater Management
RC10_Upper Bakers Creek	1, 2, 4, 7	Water Quality System Repair
RC11_McEwans Beach	1, 2, 4	Regionally Representative
RC12_Sandy Creek Catchment – Orphanage Lagoon – Mirani	1, 2, 4, 5, 6, 7	Water Quality System Repair
RC13_Oaky Creek	1, 3, 4, 6, 7	Co-investment
RC14_Sandringham Lagoons & Catchment	1, 2, 4, 5, 6, 7	Past/Current Investment
RC15_Alligator Creek Catchment	1, 4, 7	Water Quality System Repair
RC16_Tedlands	1, 2, 3, 4, 5, 6	Past Investment
RC17_Carmila	1, 3, 4, 6, 7	Co-investment

> Burdekin Basin / NQ Dry Tropics Region

Key Regional Wetland Management Features

The Burdekin Basin / North Queensland Dry Tropics Region is primarily defined by the drainage of the Burdekin River one of Australia's largest in peak discharge. However, the defined region also includes smaller coastal river and creek basins extending south from the Burdekin to include the seasonal Don River which hosts intensive horticulture around the township of Bowen and north including Queensland's second largest city Townsville on the dispersive floodplain soils of the highly regulated Ross River and further north to perennial streams on the margin of the Wet Tropics bioregion.

Other than some high coastal ranges which enjoy a wet tropical climate most of the region falls within the seasonal dry tropics with rainfall concentrated into a short and sometimes monsoon / cyclone influenced intensive summer wet season which generates annual flood events. While closed canopy rainforest communities occur in some wetter upland and fertile fire protected levee soil areas, the majority of the region is characterised by grasslands, woodlands and open forests. Seasonal aridity across the region and the continued practice of sugar cane pre-harvest burning in floodplain areas ensures that fire remains a key arbitrator for vegetated habitat outcomes.

The lower Burdekin River floodplain is one of the largest on the Australian east coast and also host one of the greatest concentration of wetlands on the east coast. It is also an area that have been intensively modified by irrigated sugar cane agriculture and now supports one quarter of the nation's sugar cropping. Modification of the floodplain has included historically high levels of clearing or riparian and wetland vegetation and water resource infrastructure development and use.

A major dam (Burdekin Falls) in the upper Burdekin Basin along with floodplain levees has altered the magnitude and frequency of within channel and overbank flood events and retains turbid wet season flood event water throughout the year. Regulated releases of this water via several weir systems maintain a perennial turbid river system in the lower Burdekin basin in contrast to the historically seasonal and clear base flowing system that predated the dam. Large river pumping stations lift water from the river and distribute it across the irrigation areas of the river delta via natural floodplain distributary and constructed channel systems to artificially recharge shallow groundwater aquifers and/or to provide surface water supplies to irrigated farms. Weirs occurring on the lower reaches on most larger River systems (Burdekin, Haughton and Ross) in the region represent major fish passage barriers.

Drainage and irrigation water infrastructure and practices have resulted in high levels of hydrological modification of wetland systems including groundwater across the lower Burdekin floodplain. Water quality in floodplain wetlands receiving irrigation supplies or tailwater has changed from historically clear to turbid. The seasonality of systems including dry season water level drawdown or drying has been impacted by perennial wetness which has promote extensive chronic weed infestations including submerged, emergent and floating aquatic and grass and woody terrestrial weeds. This has driven major ecosystem process impacts including water quality decline, hot fire regimes, competitive exclusions of overstory vegetation and loss of hydrological and biological connectivity.

The high volume of irrigation water used by the dominant irrigation practices in the region combined with regional soil type characteristics and/or farm layouts results in a high leakage of nutrients, pesticides and suspended sediments from farm productions systems particularly as dry season irrigation tailwater flows and via groundwater accessions and discharge. Rising groundwater and irrigation associated soil salinisation is a major concern in some of the newer irrigation areas of the region.

On the coastal non-agricultural margins of the Burdekin floodplain and regional coastal plain there has been historically extensive bunding of seasonal drainages and intertidal habitat to exclude saltwater from utilised groundwater aquifers, and to create exotic ponded pasturage and water points for pastoral production.

Despite the intensive nature of land and water resource development in the near coastal areas of the region, it retains significant areas of remnant floodplain vegetation, host many nationally important directory listed wetlands and has numerous High Ecological Value (HEV) assets in receiving coastal and near shore environments include a Ramsar Wetland, several declared fish habitat areas and GBRWHA assets including seagrass beds and EPBC listed species.

Relevant Wetland Management Considerations

- Transport of a significant proportion of the basin's sediment loads occurs during wet season floods and often via basin scale events with limited opportunity for interception by wetland habitats between source and discharge area.
- Ecosystem service provision and restoration opportunities at individual wetland site may be impacted by floodplain scale vegetation status and/or landscape water balance.

- Seasonal aridity, fire risks and cultural practices are all likely to present challenges for wetland revegetation needs.
- Condition resetting benefits of large flood events still occur in most floodplain and coastal plain areas but have been lost on the Ross River floodplain and reduced in terms of magnitude and frequency on the Burdekin floodplain by upper catchment dams and/or floodplain levees.
- The highly modified hydrology and water quality of much of the Burdekin Floodplain places a premium value on any remnant wetland systems that retain baseline characteristics and highlights the need for protective management initiatives.
- The systemic, industry linked and floodplain scale drivers of the highly modified status of Burdekin floodplain wetlands present a challenging management need to deliver ecosystem services and values working with modified systems where there are limited opportunities to restore baseline characteristics.
- Some of the greatest opportunities for site restoration works to contribute toward desired Reef Trust Outcomes may be associated with restoring wetland ecosystem functions to some of the most modified landscapes in the basin including intensive production areas.
- Where drivers of systemic changes in ecosystem process drivers cannot be addressed in the short to medium term, investment in wetland condition maintenance management regimes needs to be considered as part of the dues paid for the industrial use of wetland ecosystems.
- As irrigation losses and tailwater flows represent a primary conduit for contaminant (nutrients, pesticides) loads to receiving aquatic environments there is a need to develop wetland restorative management options that can provide interception and processing of these loads.
- Restoring hydrological (incl tidal) connectivity and seasonality and water quality within bunded wetland systems particularly those receiving tailwater inflows and dominated by exotic ponded pastures is a key regional management challenge
- The benefits of fish passage works in the upper Burdekin or Haughton basin will be limited for catadromous species due to lower basin passage constraints and will return relatively greater dividends in lower reaches, coastal or floodplain catchments downstream or outside of such constraints.
- Water sensitive urban design including the use of constructed wetland systems to provide floodwater detention prior to discharge to the receiving marine environment is a key need for Townsville and surrounding expanding urban sprawl areas where large capacity areal drainage networks have been established on floodplains with dispersive soils that experience seasonally intense rainfall events.

Regional Planning and Prioritisation Processes

NQ dry tropics is the community based Natural Resource Management (NRM) body covering the Burdekin River basin and adjoining coastal drainages south to and including the Don River Basin at Bowen and north to the boundary of the Wet Tropics region including the Black and Ross River Basins the latter of which hosts Queensland's second largest city Townsville. NQ Dry Tropics and its predecessor 'Burdekin Dry Tropics NRM' has a near twenty-year history of planning and implementing natural resource management strategies and projects in the region including those targeting aquatic ecosystem and wetland management.

NQ Dry Tropics NRM planning including strategic works investment prioritisation processes were reviewed to help inform the selection of suitable candidate wetland restoration sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. Only more current operating plans and supporting documents were reviewed for this exercise although past prioritisation exercises conducted specifically for wetland ecosystems as far back as 2007 were also reviewed. The reviewed plans and documents included:

1. Burdekin Dry Tropics Natural resource Management Plan 2016-2026
https://drive.google.com/file/d/0B2eYGb5_I-adVXJVOVN2bWcyOFE/view
2. Burdekin Region Water Quality Improvement Plan 2016 https://drive.google.com/file/d/0B2eYGb5_I-adNGY0RERCWFB2aDQ/view
3. Coastal Ecosystem Management – Lower Burdekin Floodplain (GBRMPA 2013)
http://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/2901/2/Case_study_water_planning_Burdekin.pdf
4. Draft Environmental Values and Water Quality Objectives for the Estuarine and Coastal areas of the Lower Burdekin region (Burdekin Dry Tropics NRM)
5. Freshwater wetlands of the Barratta Creek catchment management investment strategy (Tait and Veitch 2007)
https://researchonline.jcu.edu.au/cgi/users/login?target=https%3A%2F%2Fresearchonline.jcu.edu.au%2F29261%2F1%2F29261_Tait_2007.pdf

Contributions of these information sources toward the selection of candidate sites for Greening Australia's current "Repair and Restoration of Priority Coastal Habitat and Wetlands" project are discussed in turn below. Only brief references are made to documents 3 – 5 as their outputs are largely captured in the current WQIP.

Regional NRM Plan 2016-2026

The Burdekin Dry Tropics Regional NRM Plan 2016-2016 seeks to manage challenges posed to the region's natural resource base by changes in climate, industry, technology, community and land use by outlining high-level strategies to protecting the region's rich biodiversity, including wetlands, beaches and the iconic Great Barrier Reef, while improving long-term productivity for graziers, sugarcane farmers and horticulturalists.

Like most regional NRM plans it provides a description of the regional context in which NRM operates including biophysical descriptions of sub regional areas, the makeup of the regional community, the emerging pressures driven by climate change, land and water resource use and existing planning frameworks, regional biodiversity values and threats and the community based NRM planning framework.

Sections of the plan most relevant to informing wetland management prioritisation in the region include the Water resource and Biodiversity sections. The water resource section includes a description of aquatic ecosystems and threats posed by water resource use including modified surface and groundwater interactions and water quality condition impacts. Water management objectives and strategies also include specific references to wetland ecosystem outcomes (see below). The biodiversity section of the NRM plan includes a more detailed description of wetland and coastal ecosystem types and describes associated values including Nationally Important Directory listed wetlands which are presented in an appendix along with listed threatened fauna and flora species. Generic threatening processes and formal management arrangements including international agreements governing the protection of wetland associated values are also identified. As for the water section, biodiversity management objectives and strategies include specific references to wetland ecosystem management outcomes (see below).

Strategic Directions Water



Water Management Objectives and Associated Strategies with Specific Wetland Ecosystem References

Environmental flow characteristics are maintained for the health of natural ecosystems.	a) Investigate and manage the effects of excess drainage water travelling through water supply systems.
	b) Manage environmental flow allocations in a way that provides for necessary drying and wet seasonal flushes, as required by dry tropical wetland ecosystems. <i>For example: allocate supplemented water so that it is delivered in a manner that is sustainable to receiving environments.</i>

Water Management Objectives and Associated Strategies with Specific Wetland Ecosystem References (cont.)

Water Quality	
Suspended sediment and nutrient loads, pesticide concentrations and other contaminants are managed to meet the WQIP ecologically relevant targets and Reef 2050 Plan targets.	a) Coordinate and maintain a network to share information between those involved with researching, monitoring, managing and using water resources, including: <ul style="list-style-type: none"> land holders; industry; NRM groups; researchers; and state and local government officers.
	b) Support the development of, and promote, innovative technology and methods for improving the quality of water entering and leaving waterways and wetlands.

Suspended sediment and nutrient loads, pesticide concentrations and other contaminants are managed to meet the WQIP and Reef 2050 Plan targets (cont.).	d) Develop, adopt and continually improve best practice methods for avoiding and mitigating point source and diffuse water contamination.
	e) Support land managers to implement best management practices to conserve water resources and incorporate environmental outcomes into their management systems. <i>For example: capturing nutrient and herbicide runoff from crop land and adopting sustainable grazing land management practices to reduce runoff and increase infiltration.</i>
	f) Establish a systems repair and prevention approach for the wider NRM community to address holistic sub-catchment issues, and what is needed to restore and maintain healthy coastal wetland ecosystem function. <i>For example: managing black water events to prevent fish kills, fish barrier remediation, and wetland rehabilitation.</i>
	g) Maintain a coordinated multi-stakeholder water quality monitoring programme for our region, which includes the monitoring and assessment of: <ul style="list-style-type: none"> water quality (including nutrients, sediments, pesticides and salinity); geomorphologic processes; and wetland and riparian condition, and aquatic biodiversity. <i>For example: regional partnerships investigate low-cost sensing opportunities for fine grade data on water quality.</i>
Health of freshwater aquatic ecosystems are known and protected.	a) Conduct catchment scale land capability and in-stream health monitoring and planning.

Strategic Directions Biodiversity

“Regional Goal: The unique biodiversity of the Burdekin Dry Tropics Region is protected and enhanced to increase the resilience of native species, ecosystems and ecological processes.”

Biodiversity Management Objectives and Associated Strategies with Specific Wetland Ecosystem References

<p>Riparian vegetation is maintained in a way that protects:</p> <ul style="list-style-type: none"> • habitat connectivity throughout a catchment; • bank stability; • stream processes; and • water quality. 	a) Identify critically fragmented riparian corridors for rehabilitation.
	b) Provide extension and encourage the community to implement land management techniques that rehabilitate riparian habitat corridors such as: <ul style="list-style-type: none"> • riparian fencing; • rotation wet season spelling; and • planting vegetation.
	c) Maintain existing partnerships and networks between parties undertaking works and rehabilitative measures within waterways including landholders, government, river improvement trusts, NRM groups, researchers and industry.
	d) Include appropriate watercourse buffers in land use planning and development design decisions.
<p>Natural wetlands' conservation values and ecological processes are protected, including their water quality, aquatic and terrestrial habitat, naturally-occurring aquatic species and hydrological cycles.</p> 	a) Identify priority systems and, where required, implement waterway/wetland rehabilitation/conservation programmes.
	b) Provide extension and encourage the community to employ land management techniques that improve wetland ecosystem processes and habitat such as: <ul style="list-style-type: none"> • maintaining buffers; • water management practices that allow for natural seasonal drying; and • managing pest species within the wetland.
	c) Include appropriate wetland buffers in land use planning and development design decisions.
	d) Remove unnecessary barriers to allow natural flow regimes.
	e) Conduct fishway and fish passage design, monitoring and rehabilitation to ensure native fish can move along watercourses and between freshwater wetlands and lagoons.
	f) Re-establish connections between freshwater wetlands and lagoons so they are able to support native aquatic species expected for that system.
	g) Identify groundwater-dependent ecosystems and determine their requirements to maintain their health and sustainability.
	h) Manage the Bowling Green Bay wetland in a way that maintains its ecological character.

Objectives	Strategies
<p>Estuarine, coastal and Great Barrier Reef environments (and the quality of water entering these environments), are improved through enhanced land and coastal marine management practices.</p>	a) Implement strategies to improve the ecosystem processes, connectivity and condition of estuarine, coastal and marine environments, including: <ul style="list-style-type: none"> • identifying and rehabilitating priority areas where connectivity between fragmented coastal and marine ecosystems can be achieved; • removing impediments (either by complete removal, or modifying structures) between marine and freshwater environments; • removing and monitoring marine debris, and implementing appropriate strategies to prevent it; • promoting land and water techniques that improve the quality of water entering coastal and marine environments; • closely managing activities that occur in marine environments and directly impact the GBR, including dredging, ship movements and fishing; • rehabilitating degraded marine ecosystems; and • quantifying and protecting Indigenous cultural fishing.
	b) Promote opportunities and support the community, including schools, businesses and councils, to build capacity to protect reef-connected ecosystems. <i>For example: the 'Reef Guardians' programme and the Australian Marine Debris Initiative.</i>
	c) Specify benchmarks for the maintenance, monitoring and improvement of coastal and marine assets in statutory planning instruments.
	d) Facilitate agreements with communities and local governments to effectively maintain natural coastal processes and coastal zones, by maintaining connectivity, and buffering from inappropriate land use through land tenure options, as well as planning and development decisions.

While the water and biodiversity management strategies presented in the NRM plan do not identify specific candidate sites they do define the key resource use pressures and impacting processes affecting wetland ecosystems and the types of wetland management approaches that represent strategic priorities within the region. High value wetland assets identified in the biodiversity section including Ramsar and National Directory listed wetlands also present strategic areas for wetland management investment. Importantly the types of wetland management commitments presented within the Burdekin Dry Tropics Region NRM plan highlight the complimentary alignment of the current Greening Australia project's objectives with regional NRM planning.

Burdekin Region Water Quality Improvement Plan 2016

Like most regional water quality improvement plans this document seeks to establish priorities and strategies for managing water quality in the region; starting with an overview of the region's water resource, aquatic and wetland assets followed by analysis of the pressures which influence the quality of natural waters. This lays the foundation for development of pragmatic water quality targets based on objective ecologically relevant criteria. Modelling benefit cost analysis then provides economic assessment and informs priority setting with respect to water quality improvement strategies and actions. The plan concludes with analysis and statement of what assurances can be given that investment in the actions will ultimately lead to the targeted water quality outcomes over approximately the next 30 years.

The Burdekin Region WQIP 2016 builds upon the work of two earlier WQIPs (2009 & 2010) that covered the region. Updated assessments and new analyses contributing to the current WQIP are listed in the tables below. The Burdekin Region WQIP 2016 is structured as follows:

1. Why do we need a Water Quality Improvement Plan?
2. What are the values of the Burdekin Region and what is their status?
3. What are the water quality issues in the Burdekin region?
4. What management goals and targets do we need to achieve water quality outcomes?
5. What are the priority management options for meeting the targets?
6. How are we going to achieve the targets?
7. What challenges do we face in the future?
8. How will we measure success?

Sub component	Description	Project Lead and team
Regional context, system understanding, status and values		
1. Regional context	Collation of existing information on regional characteristics including natural and anthropogenic systems (agriculture, infrastructure, population etc).	Jane Waterhouse, C ₂ O Consulting Alastair Buchan, NQ Dry Tropics
2. Understanding system functions and interactions – 'Walking the Landscape'.	The 'Walking the Landscape' process, developed and facilitated by the Queensland Wetlands Program, was used to capture a whole-of-landscape understanding of catchment/sub catchment function in the Lower Burdekin catchment. Using available data sets and key experts, catchments were assessed in detail and an understanding of how they function was documented e.g. in terms of hydrology, geology etc. The findings from the process were compiled into data tables, maps and schematics. The GBRMPA Blue Maps and Eco-calculator were used to inform this assessment.	Mike Ronan, Amelia Selles, DEHP Jim Tait, Econcern Donna Audas, Paul Groves, GBRMPA
3. State of freshwater ecosystems and conceptual understanding of agricultural impacts.	Synthesis of existing knowledge of freshwater ecosystems in the region, and articulation of the conceptual understanding of the influence of agricultural pollutants on these assets. The Queensland Wetlands Program wetland mapping was used to identify wetland extent.	Aaron Davis, Jon Brodie, TropWATER JCU Richard Pearson Davis et al. (2015) Queensland Wetlands Program
4. Riparian condition assessment.	The 2009 WQIP included information from a report undertaken by the Australian Centre for Freshwater Research (ACTFR) in 2007, which assessed the condition of riparian vegetation in the Burdekin catchment using satellite imagery and field surveys (Lymburner and Dowe, 2007). The Paddock to Reef Program now includes a component which reports riparian condition in the GBR catchments, which is being used to inform the update (included in the Catchment Atlas).	Paddock to Reef Program
5. Status and values of the coastal and marine environments in the Burdekin Region.	Review and synthesis of the current status of coastal and marine assets in the Burdekin Region. Includes all coastal and marine assets including coral reefs, seagrass meadows, mangroves, turtles, dugong, seabirds, whales, fish, coastal wetlands, shorelines and estuaries.	Caroline Coppo, Jon Brodie, TropWATER JCU Coppo and Brodie. (2015)

Sub component	Description	Project Lead and team
6. Ecosystem services and economic values of the Burdekin marine region.	Collation of comparative regional industry statistics and summarised data on economic values of ecosystem services and industries in the Burdekin NRM region.	Colette Thomas, Jon Brodie, TropWATER JCU Thomas and Brodie (2015)
7. Climate Change.	Climate Change implications for water quality management in the Burdekin Dry Tropics.	Alastair Buchan, NQ Dry Tropics Buchan (2015)
Goals and Targets		
8. Setting ecologically relevant pollutant load reduction targets for the Burdekin Region	Definition of individual end of river pollutant load reduction targets for all of the coastal basins in the Burdekin Region based on the Reef Plan 2013 targets. The study also set ecologically relevant targets for end-of-catchment pollutant loads in the Burdekin Region.	Jon Brodie, Steve Lewis, Zoe Bainbridge, Jane Waterhouse, TropWATER, JCU Scott Wooldridge, AIMS Carol Honchin, GBRMPA Brodie et al. (2016)
Management options		
9. Update management practice synthesis for grazing, sugarcane, horticulture and urban land uses.	Update of the 2009 WQIP guidelines for management practice in grazing and sugarcane (Coughlin et al. 2007, 2008; Davis 2006). A regional analysis of urban and special site pollutant sources and recent guidance for incorporation of urban issues into WQIPs (Gunn, 2014) is also incorporated. Paddock to Reef Water Quality Risk Framework.	NQ Dry Tropics with input from external experts. Alastair Buchan, NQ Dry Tropics Buchan (2016)
10. System repair options	Identification of issues and priorities for system repair actions in the region. Primary inputs: 1. GBRMPA Blue Maps and Eco-calculator; 2. Qld Wetlands Program mapping and 'Walking the Landscape' process; and 3. Existing priorities identified for system repair in the Lower Burdekin.	NQ Dry Tropics with input from external experts. Jim Tait, Econcern Paul Groves, Donna Audas, GBRMPA Queensland Wetlands Program

Spatial prioritisation		
11. Burdekin sediment story.	Synthesis of current knowledge of the sources, delivery and fate of sediments in the coastal and marine environment in the Burdekin Region.	Steve Lewis, Zoe Bainbridge, Jon Brodie, TropWATER JCU Rebecca Bartley, Scott Wilkinson, Elizabeth Lui, CSIRO Jo Burton, DSITI Lewis et al. (2015)
12. Water quality relative risk assessment in the Burdekin Region – pollutant sources, dynamics, impacts.	Assessment of the relative risk of degraded water quality on Burdekin coastal and marine ecosystems and makes recommendations for regional management priorities considering the types and range of pollutant sources in the region.	Jane Waterhouse, Steve Lewis, Jon Brodie, Michelle Devlin, Caroline Petus, Eduardo da Silva, Dieter Tracy, TropWATER JCU Cameron Dougall, DNRM Jeff Maynard, Maynard Marine Waterhouse et al. (2015) Maynard et al. (2015) Petus et al. (2015)
13. Economics of sugarcane management practices.	Analysis and evaluation of financial-economic data for sugarcane production systems. Identifies the weighted benefit-cost of shifting between various management practice classes at different farm sizes and land types for nutrients and pesticides, presented in a spreadsheet tool including individual management practice scenarios. <i>Note that inputs on economics of other land uses was collated through direct interaction with experts through the INFER process.</i>	Marcus Smith, JCU Smith (2015) A number of industry specific experts were also engaged to assist in deriving estimates of the cost effectiveness of management practice shifts in other industries.
14. INFER analysis of management options and costs for meeting targets.	Integrated assessment of the benefits and costs of achieving water quality targets using the INFER (Investment Framework for Environmental Resources) analysis. The framework aims to help people determine whether the environmental/natural resource projects they are investing in will deliver tangible results within budget; whether the tools and technical capacity needed to attain those results will be available to the project; and whether the people who need to come on board to make it happen will be there when the time comes for action. www.infer.com.au .	Anna Roberts, Geoff Park, Michelle Dickson, Natural Decisions Roberts et al. (2016)

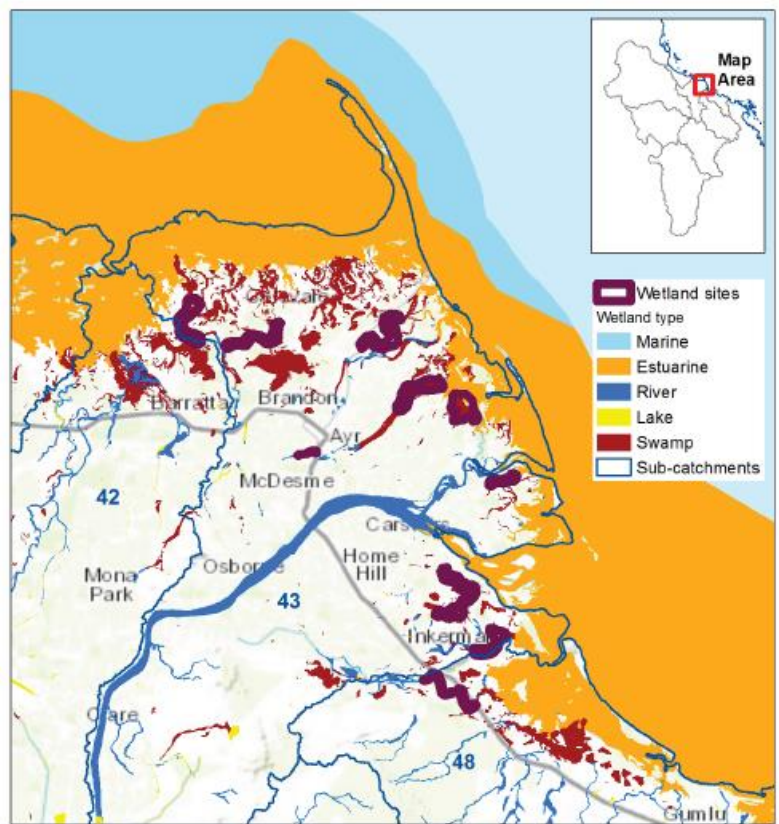
Much of the current Burdekin region WQIP is focussed on the main sources of contaminants impacting regional water quality condition particularly that exported from the basin to the GBR lagoon. The differentiation in contaminant loads contributed by grazing and agricultural land uses including sugar, horticulture and grains is identified and changes in farm and land management practices that can reduce these loads identified and costed.

Grazing lands contribute by far the largest proportion of the TSS and particulate nutrient loads to the end of catchment loads in the Burdekin Region. Improvement in riparian zone condition is the only wetland management associated action nominated for grazing water quality impacts with most emphasis on ground cover and gully erosion mitigation.

Sugarcane contributes the majority of the DIN and PSII herbicide loads within the region. While on farm practices constitute the main focus for reducing canelands water quality impacts, restoring ecosystem function and coastal ecosystem health on the floodplain landscapes hosting irrigated sugar agriculture is also promoted as a water quality management target. Descriptions of regional Environmental Values and Water Quality Objectives pursued under the EPP (water) also provide useful context for guiding wetland ecosystem restoration. Application of the Water Quality Guidelines defined under the EPP (Water) and scheduled EVs and WQOs for the Black, Ross, Haughton and Don Basins represents one of the most obvious management actions for addressing water quality issues in the region's aquatic ecosystems.

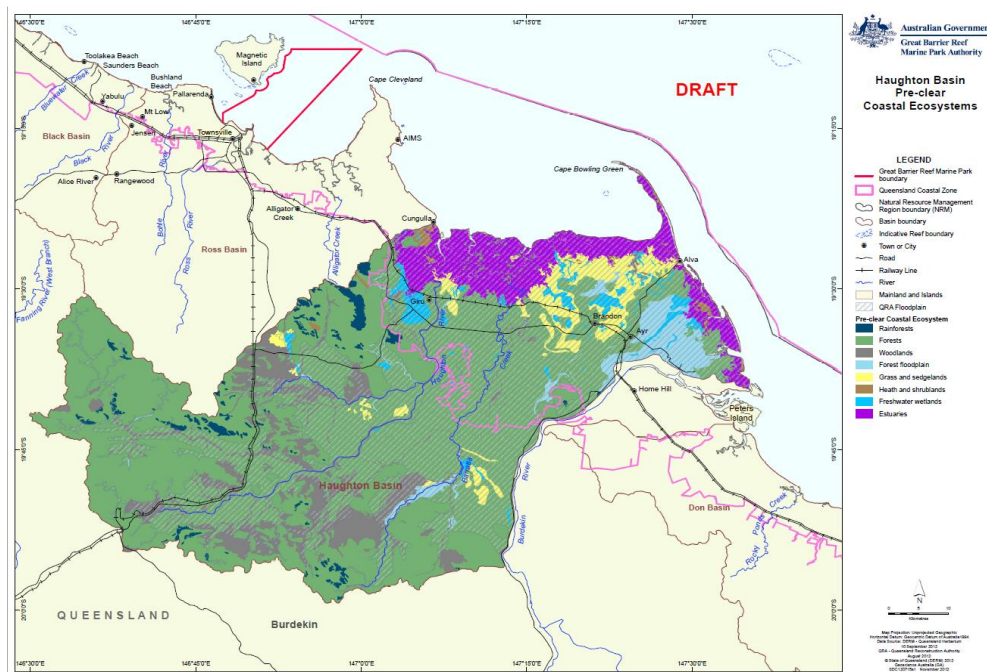
Of most direct relevance to the GA project is the priority management options section details priorities for restoring ecosystem function and remnant coastal ecosystem health. Using a whole of system approach the WQIP identifies the receiving systems between sugar production areas and coastal estuaries as the priority areas for wetland management. Key focal issues include the impact of irrigation tailwater flows, resulting altered floodplain hydrology, aquatic weeds, and hot fire regimes in fire sensitive riparian communities. Management strategies that have been implemented and/or considered include restoring seasonal hydrology including drying down, the modification of irrigation supply infrastructure, water delivery and farm practices to reduce tailwater volumes and consideration of retirement for marginal and unproductive agricultural land.

The WQIP employs a spatial prioritisation exercise including wetland extent, condition and threats particularly weediness which is related to both land type and exposure to extended wetting periods. This spatial prioritisation is used to identify where investment in water infrastructure modification and irrigation delivery practices may most successfully reduce excessive tailwater flows and promote recruitment of native wetland communities (e.g. bulkuru sedge) associated with baseline hydrological and water quality conditions. A range of wetland sites currently receiving perennial tailwater flows including both bunded shallow coastal swamps and deepwater lagoons were prioritised for management action (see below). Management options nominated included: improved control of irrigation delivery, bund removal, installation of diversion channels and improvement in irrigation management on farm.

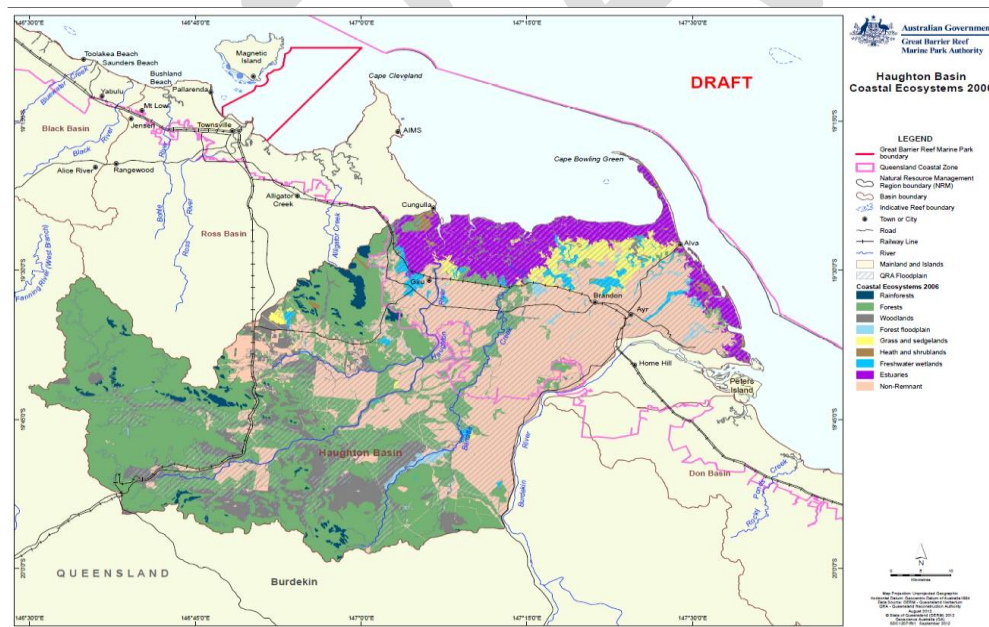


Fish passage barrier prioritisation presented in the WQIP provides another key source of information for prioritising wetland management investment sites in the region. Reporting against priorities established by a regional study conducted in 2007 (Carter et al.) the WQIP identifies that many of the previously identified fish passage barrier priorities have been rectified. All of the outstanding top ten priorities identified by that study are larger weirs on State and Local Government owned infrastructure e.g. Clare Weir (Burdekin River), Val Bird Weir (Haughton River), Aplins Weir (Ross River), and Giru Weir (Haughton River).

Another key piece of ecosystem repair prioritisation presented in the Burdekin Region WQIP is that provided by the application of GBRMPA blue maps, analyses of basin coastal ecosystem extent and the ecological process calculator.

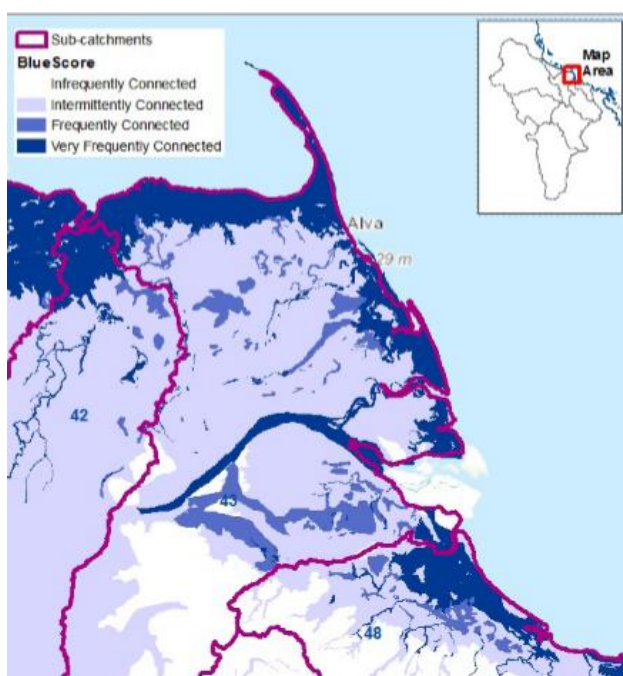


Lower Burdekin Pre-clear Coastal Ecosystem Extent



Lower Burdekin Post-clear Coastal Ecosystem Extent

By assessing the ecological functions provided by different coastal ecosystems under different hydrological connectivity regimes (see Blue Map below) and by examining the pre and post clear extent of coastal ecosystems (see above), the GBRMPA eco-calculator compared the ecological functions and associated ecosystem services provided by the modified and pre-development landscape. Identified changes in ecosystem process provision within each drainage basin (see table below) helps identify what types of management action are required in terms of maintaining, restoring or managing ecological functions. Specific management actions can also be targeted at different landscape blue zones (see below).



GBRMPA Blue Map for the Lower Burdekin Indicating Frequency of Hydrological Connectivity to The GBR Lagoon

Basin	Recharge discharge processes	Physical processes	Biogeochemical and biological processes
Black	Moderate	Good	Good
Ross	Moderate	Good	Moderate
Haughton	Moderate	Moderate	Moderate
Burdekin	Poor	Moderate	Moderate
Don	Moderate	Moderate	Moderate

Results of the Ecological Process Calculator Assessment of Changes Since European Settlement

Frequency of Hydrological Connection	Target
Very frequent connection	<p>Improve the capacity of these areas to manage biological and biogeochemical processes through:</p> <ul style="list-style-type: none"> • priority barrier modification or removal; and • weed control.
Frequently connected	<p>Improve the capacity of these areas to manage physical and biological processes through:</p> <ul style="list-style-type: none"> • priority barrier modification or removal; • application of innovative technologies such as algal farms; • ongoing improvements to water quality; and • weed eradication or control.
Intermittently connected	<p>Improve the capacity of these areas to manage physical, biological and biogeochemical processes through:</p> <ul style="list-style-type: none"> • priority barrier modification or removal; • application of innovative technologies such as algal farms; • ongoing improvements to water quality; • weed eradication or control; • restoring riparian and catchment vegetation on areas of highly erosive soils; and • installing in-stream structures to reduce water flow velocities and streambank erosion, where assessed as appropriate.
Infrequently connected	<p>Improve the capacity in these areas to manage physical and biogeochemical processes through:</p> <ul style="list-style-type: none"> • addressing erosion in areas of highly erosive soils; and • slowing stream flows through installation of in-stream structures, where assessed as appropriate.

Management Targets for Improving Ecological Function within Different Blue Map Zones

Beyond the prioritisation of sites and management actions detailed, the final section of the Burdekin Region WQIP examines strategies for delivering water quality improvement in the Burdekin region. These include a commitment to addressing water quality issues associated with urban areas with a priority focus on runoff control through construction site regulation and Water Sensitive Urban Design.

A suite of strategies associated with Reef Plan 2050 are nominated for restoring catchment waterways and ecological function of coastal ecosystems, highlighting comparability between the WQIP and the current GA project. More specific nominated actions associated with targeting and conducting restoration of wetland sites and ecological functions in the Lower Burdekin catchment include:

1. Agreement of priority areas for protection and restoration (building on Tait 2013 and GBRMPA 2013) including significant areas of remnant floodplain coastal ecosystems set aside during the development of the BHWSS, intact riparian systems, remnant delta habitats on the coastal fringe, coastal wetland buffers, remnant coastal ecosystem landscape corridor linkages and nodes, wetlands that have retained predevelopment ecological character and remnant floodplain habitats representative of areas developed to agriculture and potentially suitable for future development. Coastal ecosystem restoration priorities nominated include revegetation of functional landscape elements, restoration of bunded coastal wetlands and addressing major fish passage barriers.

2. In irreversibly modified landscapes reinstate ecosystem functions and values that are important to the health of the World Heritage Area within the modified landscape.
3. Reconfiguring the layout of agricultural production systems to emulate coastal ecosystem function outcomes (particularly interception and detention of run-off, and nutrient uptake);
4. Sustaining and expanding control programs for aquatic weed infestations in hydrologically modified stream systems. For example, establishment of Riparian Management Agreements with land holders.
5. Adopting ecosystem restoration targets that suit modified floodplain conditions (e.g. the establishment of riparian rainforests on hydrologically modified drainage reaches);
6. Using seasonal distributary channels to bypass wet season flows around anoxic (low dissolved oxygen) stream reaches to facilitate fish movement and recruitment;
7. Restoring seasonal hydrological regimes in impacted high value wetland systems using hydrological isolation of selected wetlands or sub-catchments from irrigation tailwater base flows to reinstate hydrological seasonality at micro- or meso-scales;
8. Using pumped 'environmental flows' to replicate wet season river overbank flows down distributary creek systems to avoid critical wet season water quality "crashes" and enhance fish passage opportunities in floodplain distributary stream systems which have been hydrologically modified by upper catchment dams, river levees and non-seasonal flows;
9. Establishing biodiverse plantings and enhancement of existing native vegetation,
10. Returning or mimicking seasonal dry down for management of riparian vegetation,

Collectively the information and strategies presented in the Burdekin Region NRM Plan 2016-2026 and WQIP 2016 provide substantial guidance for investment in wetland management in the region. It identifies management needs associated with operating threats, proposes specific management actions to address threats and restore particular wetland ecosystem functions, identifies high value wetland assets and associated ecological values including National Directory Listed Wetlands and spatially prioritises specific wetland systems for management actions.

The GBRMPA document *Coastal Ecosystem Management – Lower Burdekin Floodplain* (GBRMPA 2013), which provided input to the WQIP 2016 also contains additional site information on nominated priority areas for protection and restoration. Likewise, the *Freshwater wetlands of the Barratta Creek catchment management investment strategy* (Tait and Veitch 2007), provides more specific site information in terms of values and management needs for a key wetland system (Barratta Creek Habitat Corridors) identified as a priority area within both the Regional NRM plan and WQIP.

Candidate Project Sites

The approach ultimately adopted for selecting Burdekin region candidate wetland project sites followed on from the review of wetland management strategies in the Burdekin Region NRM Plan 2016-2026, Water Quality Improvement Plan 2016 and supporting documents.

In keeping with regional strategic priorities nominated by the WQIP, wetland systems within the agriculture production dominated Burdekin floodplain were targeted as a priority. Wetland systems spatially prioritised within the WQIP were considered a rational starting point for consideration. These included the Saltwater Creek, Plantation creek and SheepStation Creek systems. Wetland systems that had been the target of past management investment were also reviewed in terms of outstanding management needs and opportunities to build upon past investment. This included the freshwater wetlands of the Barratta Creek catchment, Crooked Creek and the Healy Lagoon - Reed Bed System and Horseshoe Lagoon. Sites adjacent to or in close proximity to past investment sites that had some level of biophysical equivalency were also considered such as the co-joined Crooked Creek and Healy Lagoon - Reed Bed Systems. Specific sites nominated as protection and restoration priorities identified in GBRMPA (2013) and/or recognised as having high values and being subject to surrounding land use pressures i.e. DIWA listed wetlands upon the floodplain were also assessed for potential candidature. These included Cassidy Creek, Stokes Creek, Major's Creek and high value wetlands within the Barratta Catchment such as Woodhouse Station and Barratta Channels.

In reviewing these potential candidates, sources of information used to assess their suitability included:

1. Consultation with regional wetland managers,
2. Targeted and opportunistic Google Earth explorations of catchment and site conditions, and
3. Reference to strategic and regionally prioritised wetland management actions detailed in the WQIP to assess if site characteristics provided opportunities for such actions.

Consultation with regional wetland managers (1), was primarily employed to gain currency in understanding the status and success of current and past wetland management investment programs (dropping from contention sites where works had been implemented to completion), to ask for any personal site nominations they felt had merit but may have missed recognition in past nominations, and to assess the validity of potential sites nominated by the author via (2) or (3).

Strategic priorities considered from the WQIP included references to the importance of managing and restoring coastal bounded systems, the need for floodplain scale restoration of riparian corridors, the need to reinstate recharge/discharge processes, the need for innovative water quality treatment of tailwater discharged from irrigated production systems to receiving floodplain wetlands and the commitment to pursue Water Sensitive Urban Design as a strategy for urban catchment water quality management.

Opportunities to pursue priorities identified in the WQIP were explored using Google Earth imagery and resulted in the nomination of some speculative (unknown capacity) sites proposed to garner recognition of locations or assess support for innovative proposals. These included a number of bioreactor/ water quality treatment train site proposals, the identification of breached coastal bund systems (Rita Island, Seaforth) that could lend themselves to targeted restoration and a host of urban water quality impacts operating within the Bohle River catchment suited to WSUD responses. Extensions of the surveyed area to the south of the region also identified a number of coastal wetlands of variable condition within the agriculture dominated floodplain of the Don River basin.

In terms of a process this methodology can be thought of as a 'gate keeper' approach. As described for the previous regions, to pass through the gate to candidature a site must meet criteria No. 1 and at least two or more other of the following criteria 'passwords' (see below).

Site Candidature 'Gate Keeper' Password Questions – need >2 yeses to pass.

1. Does the site have readily identifiable restoration needs that can be delivered within the context of the current project that will deliver for Reef Trust 1 and/or 2 outcomes?
2. Has the wetland site previously been prioritised for NRM investment in wetland specific prioritisations?
3. Does the site concern a system prioritised for wetland NRM investment and/or priority actions promoted in regional planning?
4. Does the site have high biodiversity and/or water quality functional values?
5. Does the site present the opportunity to build upon or maintain past investment?
6. Does the site have notable good works capacity associated with: landholder and/or community support; co-investment potential; proximity to project service centre?
7. Does the site present a high value demonstration site related to it's: public profile, representativeness of required works to regional needs; and/or opportunity to demonstrate highly innovative works?

For the Burdekin Region 31 candidates including nested multiple wetland sites (see table below and Appendix 4) were ultimately nominated for presentation at the regional stakeholder meeting to be culled, refined and added to in terms of detail or additional sites as part of the prioritisation toward fully scoped works proposal. In general terms these sites non-exclusively included:

- An urban floodplain with 10 nested site examples of storm water, soil erosion management and remnant wetland value issues (NQDT31);
- A floodplain scale remnant habitat matrix with 8 nested works proposals (NQDT20_28)
- 9 highly modified floodplain distributary systems with integrated works proposed (NQDT1, 2, 3, 8, 9, 10, 17, 18, 19)
- 6 tailwater treatment train / bioreactor proposals including: protective management of high value sites, use of degraded site and modification of built water infrastructure (NQDT4, 5, 24, 25, 26, 29)
- 5 protective management works proposal for high value wetland remnants (NQDT12, 13, 14, 15, 16)
- 3 bounded coastal system proposals including a subregional scale landscape (NQDT6, 7 & 11)
- 2 flow modifying engineered structures (NQDT22, 23)
- 1 catchment management plan for river sub catchment (NQDT30)

Wetland Site	'Gate Keeper' Password Questions Passed	Comments
NQDT1_MerindaGreenSwampWetlands	1, 3, 4, 7	Don Basin
NQDT2_EuriCk Anabranh Wetlands	1, 3, 4, 6	Don Basin
NQDT3_Saltwater_Iyah Cks Distributaries	1, 2, 3, 4, 5, 6	WQIP prioritised system
NQDT4_Cassidy Creek	1, 2, 3, 4, 6, 7	GBRMPA 2013 priority area
NQDT5_Stokes Creek	1, 2, 3, 4, 7	GBRMPA 2013 priority area
NQDT6_SeaForth	1, 2, 3, 4, 7	Priority action coastal bunds
NQDT7_RitalslandBunds	1, 2, 3, 4, 7	WQIP prioritised system
NQDT8_Plantation Creek Distributary	1, 2, 3, 4, 5, 6, 7	WQIP prioritised system

NQDT9_Kalamia Creek Distributary	1, 3, 4, 5, 6	Past investment
NQDT10_Lower Sheep Station Creek Connectivity	1, 2, 3, 4, 5, 6, 7	WQIP prioritised system
NQDT11_Alva to Lochinvar Bunded Swamps- The Good, the Bad and the Ugly	1, 2, 3, 4, 5, 6, 7	Priority action coastal bunds
NQDT12_Floodplain Periphery Lagoons - Inkerman Station	1, 2, 3, 4, 5	GBRMPA 2013 priority area
NQDT13_Floodplain Periphery Lagoons - Swans Lagoon Millaroo	1, 3, 4,	GBRMPA 2013 priority area
NQDT14_Floodplain Periphery Lagoons - 8 Mile Ck Lagoons Dalbeg	1, 3, 4	GBRMPA 2013 priority area
NQDT15_Floodplain Periphery Lagoons - Gladys Lagoon	1, 3, 4, 6	GBRMPA 2013 priority area
NQDT16_Hoey's Lagoon - Digeridoo	1, 3, 4,	WQIP Priority action interception tailwater
NQDT17_Pink Lily Lagoon - Crooked Ck Catchment	1, 2, 3, 4, 5, 6, 7	Past investment
NQDT18_Horseshoe Lagoon	1, 2, 3, 4, 5, 6	Past investment
NQDT19_Healy Lagoon-Reed Beds	1, 2, 3, 4, 5, 7	Past investment
NQDT20_Barratta Remnant Floodplain Habitat Matrix Mgt	1, 2, 3, 4, 5, 6, 7	GBRMPA 2013 priority area / DIWA
NQDT21_Brewster Rd Drain erosion	1, 2, 3, 4, 6	Barratta Investment Strategy 2007
NQDT22_Sayers Rd Tree swamp & Green Swamp - Highflowboys	1, 2, 3, 4, 6, 7	WQIP Priority ecosystem, process restoration detention
NQDT23_Green Swamp - Highflowboys	1, 3, 4, 5, 6	WQIP Priority ecosystem, process restoration detention
NQDT24_BHWSS Tailwater Drain Flowboy Bioreactors	1, 3, 4, 6, 7	WQIP Priority action interception tailwater
NQDT25_Woodhouse Lagoon -Tailwater Treatment Train_Recycle Basin1	1, 2, 3, 4, 5, 6, 7	WQIP Priority action interception tailwater
NQDT26_Woodhouse Lagoon -Tailwater Treatment Train_Recycle Basin2	1, 2, 3, 4, 5, 6, 7	WQIP Priority action interception tailwater
NQDT27_Mclain Rd Remnant	1, 2, 4, 5, 6, 7	Barratta Investment Strategy 2007
NQDT28_Barratta Bifucation Flow Control Structure	1, 2, 3, 4, 6, 7	WQIP Priority action diversion
NQDT29_West Haughton Back Levee Bioreactor	1, 3, 4, 6, 7	WQIP Priority action interception tailwater
NQDT30_Major's Creek Catchment Management	1, 2, 3, 4	GBRMPA 2013 priority area
NQDT31_Bohle Catchment Management	1, 3, 4, 6, 7	WQIP Priority action WSUD

> Wet Tropics / Terrain NRM Region

Key Regional Wetland Management Features

The Wet Tropics region is Australia's wettest and includes catchment areas that receive greater than 5m of annual rainfall. While wet tropics drainage systems (other than the Herbert River) are predominantly smaller, relatively short, steep and near-coastal relative to much larger basins in the seasonally dry regions of the GBR catchment they collectively contribute a disproportionate third of the annual run off to it.

A large proportion of the uplands of the wet tropics has high conservation values due to its high integrity being protected within the Wet Tropics World Heritage Area as is a substantial area of its coastal margin. Clearing, agricultural development and other forms of intensive land use such as settlement has largely been confined to a narrow coastal plain, the Atherton Tablelands and the floodplains of the larger river systems such as the Herbert, Tully, Johnstone, Russell – Mulgrave and Barron which have been highly modified toward monoculture. The lower Barron River floodplain and adjoining coastal plain also hosts the expanding city of Cairns one of Queensland's largest regional cities. Many threatened EPBC listed fauna and endangered regional ecosystems are associated with wet tropics lowlands. High Ecological Value (HEV) marine assets also occur in close proximity to the coast line of the wet tropics including sea grass beds and inshore reefs.

The extremely high rainfall of the region presents challenges for land development particularly agriculture. Lowland development suitability is limited by water logging and inundation while sloping uplands are susceptible to erosion. These constraints have seen more suitable areas intensively developed. In older agricultural landscapes there has been historically low levels of retention of riparian and wetland ecosystems. The historical clearing of riparian vegetation and generally high stream velocities also presents stream bank erosion and collapse risks with concomitant impacts to both suspended and bed sediment loads. In a region naturally characterised by closed canopy riparian vegetation assemblages clearing in a high rainfall environment has provided the stage for widespread weed infestations many of which act as inhibitors of successional recovery.

The extensive development of surface drainage networks has accompanied development of land for agriculture throughout the region. This has highly modified both surface and groundwater connected floodplain wetland ecosystems in terms of their hydrology and associated water quality. Hydrological modification of aquatic ecosystems has also accompanied the extension of agricultural and grazing production areas into the coastal margins of the wet tropics lowlands where bunding and tide gating of floodplain lowlands including intertidal habitats has occurred to create saltwater intrusion barriers.

While soil conditions vary across the region, high rainfall combined with a predominance of highly erodible and permeable soils and the impact of constructed surface drainage systems results in high leakage of nutrients, pesticides and suspended sediments from farm production systems via surface and groundwater systems.

Development pressure surrounding the regional city of Cairns is resulting in some urban and industrial land being developed in low lying floodplain areas including historically marginal cane lands which is presenting challenges for the management of flood risks and receiving wetland ecosystems.

Relevant Wetland Management Considerations

- The generally high integrity of upper catchment areas particularly in smaller basins provides a management front line for progressing downstream catchment and wetland restoration works.
- In many basins near coastal areas are also included in protected areas and/or retain good integrity. Restoration of catchment process integrity and functional buffer interfaces between developed floodplain areas and the receiving aquatic ecosystems of river basin lowland reaches represents a key focus for wetland management.
- Given the extensiveness of constructed drainage networks serving agricultural production areas and the concomitant impacts to catchment processes, improvement and redesign of drainage systems to convey surface rather than groundwater (ideally to a designed drainage modulus) and to incorporate constructed or natural detention areas is a key wetland management need.
- Transport of basin sediment /nutrient contaminant loads occurs throughout extended rainy periods (and not only in large basin scale events) often in association with individual storm events presenting opportunities for interception at the individual drainage line and subcatchment scale
- The restoration of riparian and wetland ecosystems (including constructed basins) particularly in older agriculture landscapes of the region are a key need with the potential to deliver on both of the desired Reef Trust Outcomes.
- Given high rainfall, revegetation plantings have a good capacity for high growth rates subject to the management of retarding weed infestations. Identifying means of promoting natural succession-based recovery of riparian and wetland vegetation on a broad acre scale represents a 'holy grail' for wetland restoration approaches.

- Restoring tidal connectivity and water quality within tide gated and/or bunded wetland systems presents the opportunity to facilitate broad acre natural succession-based restoration of coastal wetland systems.
- Some of the greatest opportunities for site restoration works to contribute toward desired Reef Trust Outcomes may be associated with some of the more disturbed and modified sub-catchments of the region though substantive investment and innovation will be required to address apparently intractable management issues.
- More recently developed agricultural areas in the south of the region may provide good opportunities for protective management and restoration works designed to retain existing assets.
- Water sensitive urban design including the use of constructed and natural wetland systems to provide floodwater detention prior to discharge to the receiving marine environment is an appropriate wetland management focus for this region.

Regional Planning and Prioritisation Processes

Terrain NRM is the community based Natural Resource Management (NRM) body covering the Wet Tropics NRM region which is comprised of nine north Queensland river basins including: Daintree, Mossman, Barron, Russell, Mulgrave, Johnstone, Tully, Murray and Herbert

It and its predecessor organisation 'FNQ NRM' have a twenty plus year history of planning and implementing natural resource management strategies and projects in the region including those targeting aquatic ecosystem and wetland management.

Terrain NRM's regional planning including strategic works investment prioritisation processes were reviewed to help inform the selection of suitable candidate wetland restoration sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. Only the most current operating plans and supporting documents were reviewed for this exercise. The reviewed plans and documents included:

1. Wet Tropics Plan for People and Country 2016 <http://www.wettropicsplan.org.au/>
2. Wet Tropics Water Quality Improvement Plan 2015-2020
<http://www.wettropicsplan.org.au/content/download/1403/11616/version/1/file/Terrain-WQIP-combined.pdf>
3. Wet Tropics Major Integrated 2017/2018 Project Plan Wet Tropics People - Steering the Course for the Reef <https://terrain.org.au/download/2075/>
4. Russel Catchment Story
<http://terrainnrm.maps.arcgis.com/apps/MapSeries/index.html?appid=85b6f348f55643e78240ce1a16c91062> Including priority action publications:
 - a. WTL-RC 1: Fluvial Assessment for Targeted Remediation Options – Mid-Russell River
 - b. WTL-RC 2: Rehabilitation of Babinda Swamp Drainage System
 - c. WTL-RC 3: Investigation of Catchment Repair Options – Babinda Creek
 - d. WTL-RC 4: East-West Riparian Connections – Russell River National Park to Bellenden Ker Range
 - e. WTL-RC 5: Fluvial Assessment for Riparian Rehabilitation – Russell River (East Russell)
5. Johnstone Catchment Story
<https://terrainnrm.maps.arcgis.com/apps/MapSeries/index.html?appid=636c8deb3b00483c9c51be43e8846038> Including priority action publications:
 - a. WTL-JC 1: Improved Water Quality in the North Johnstone River
 - b. WTL-JC 2: Showcasing Landscape-Scale Wetland Restoration
 - c. WTL-JC 3: Whole of Catchment Water Quality Improvement - Maria Creek
 - d. WTL-JC 6: Reconnecting and Restoring Wetland Systems - Ninds Creek
6. Tully Catchment Story
<https://terrainnrm.maps.arcgis.com/apps/MapSeries/index.html?appid=ef84598ac52a48d9821e133bc21f05ef> Including priority action publications:
 - a. WTL-TC 1: Tully Syndicate Catchment Repair Options
 - b. WTL-TC 2: Integrated, Innovative Treatment Systems – Boar, Brick, Michael Creeks
 - c. WTL-TC 5: Installation and Monitoring of Water Treatment Systems – Davidson Creek
 - d. WTL-TC 6: Enhancing Existing Wetlands – Lower Tully
7. Herbert Catchment Story
<https://terrainnrm.maps.arcgis.com/apps/MapSeries/index.html?appid=f10d789f31e245fc8fb5c634f27e8bac> Including priority action publications:

- a. WTL-HC 1: Rehabilitating Allingham Wetlands (Mandam, Fullers, Mungalla – Near Forrest Beach)
- b. WTL-HC 2: Restoration of Cattle Creek Wetlands and Associated Tributaries (Trebonne, Cattle and Francis Creeks)
- c. WTL-HC 3: Rehabilitating Ripple Creek Wetlands
- d. WTL-HC 4: Restoration of the Southern Herbert Coastal Waterway Aggregation (Easter Creek south to Byabra Creek)
- e. WTL-HC 5: Stone River Catchment Systems Repair

In comparison to other GBR catchment regions the Wet Tropics has progressed NRM planning for wetland management investment to a much more advanced level of prioritisation including to the nomination of priority management actions for specific sites and systems analysed via the DEHP 'Walking the Landscape' process used to develop the range of Wet Tropic's River Basin stories (documents 4 – 7). This recent work has been directly employed in the identification of candidate sites for the current Greening Australia project. However, broader regional NRM and Water Quality Improvement (WQIP) planning have provided the contextual basis for these finer level prioritisations and are briefly reviewed here.

Wet Tropics Plan for People and Country 2016

Like most regional NRM plans this document is a high-level management strategy that at best provides only contextual information for the purposes of wetland management investment prioritisation. Importantly the '5 Big Regional Goals' for the Wet Tropics (below) include specific reference to wetland ecosystems and ecosystem functions in the described goals, assumptions and performance indicators for Biodiversity, Water and Coastal Systems.

Our Wet Tropics Big 5 Regional Goals			
	Goal The difference we aim to make	Assumption Why we think this is important	Performance Indicators Signs that will help us track our progress
Biodiversity	The biodiversity values of our region are maintained through improving the condition and connectivity of our ecosystems.	The value of the biodiversity of the Wet Tropics is globally recognised through the WTWHA, and the maintenance and enhancement of these values is fundamental to building a resilient and diverse landscape.	<ul style="list-style-type: none"> - Total area of land with native vegetation (categorised by condition) - Area of new plantings - % of priority biodiversity corridors functional - progress against recovery plans (where applicable)
Biosecurity	Invasive species are managed to ensure the maintenance of the region's ecosystem health and the critical ecosystem services and functions provided to our community and industries.	Invasive species are one of the greatest threats facing the Wet Tropics biodiversity and industry assets. Without strategically tackling the issue of current and emerging biosecurity threats, there will be an ongoing decline in the health of the Wet Tropics natural resources.	<ul style="list-style-type: none"> - Area affected by key priority weeds/pests - No. invasive species of concern (e.g. transformers) - No. priority weeds/pests under control/eradicated - No. new invasive species of concern. - Progress against pest management plans
Water	The condition and resilience of catchments are enhanced, to ensure the maintenance of the critical services and functions they provide to our community and industries.	The health of the waterways and wetlands of our catchments is fundamental to our livelihoods and our lifestyle, as well as key assets such as the Great Barrier Reef.	<ul style="list-style-type: none"> - Change in pollutant loads - % of riparian zone vegetated/protected - No. aquatic weed species of concern - Extent/trend of human modification of drainage
Coastal Systems	The Wet Tropics coastal systems are well managed and resilient, and valued for their contribution to the region's economic, cultural, ecological and social wellbeing.	The iconic but contested landscape of the Wet Tropics coastal area is particularly vulnerable to inappropriate development and a changing climate. Special attention needs to be paid to appropriate management of these areas.	<ul style="list-style-type: none"> - Area of wetland disturbed VS rehabilitated/protected - Number and nature of interruptions to coastal processes - Total area of coastal land with native vegetation (categorised by condition)
Sustainable Industries	A culture of environmental stewardship and continuous improvement is the foundation of the industries of the Wet Tropics, delivering enhanced economic, social and environmental outcomes.	Key Wet Tropics industries such as agriculture and tourism are heavily dependent on a healthy natural resource base, and a culture of environmental stewardship is critical to ensure this base is protected and enhanced.	<ul style="list-style-type: none"> - Practice change trend - No. farmers with diversified production - No. farmers applying adaptive management - Profitability of farms - Demographics of farmers - No. tourism operators with environmental stewardship as core value

Within the Wet Tropics Region NRM plan, priority actions proposed to deliver strategic outcomes on the path toward regional goals also include many actions directly targeted wetland ecosystems management (see table below). Importantly wetland management expressed as a water resource planning priority i.e. "Water: We will enhance the quality of our water and the condition of our waterways." was included in the top three NRM priorities identified for eight of the nine subregional planning areas within the Wet Tropics region including: Hinchinbrook, Upper Herbert Catchment, Southern Cassowary Coast, Northern Cassowary Coast, Southern Tablelands, Russell & Mulgrave Catchments, Cairns & Douglas catchments. This is indicative of the current Greening Australia project's alignment with Wet Tropics regional NRM planning aspirations.

Wet Tropics Regional NRM Plan Wetland Associated Priority Actions Proposed to Deliver Strategic Outcomes on the Path toward Regional Goals

<p>PP 3: Urban Waterways Showcase solutions to improving urban waterways to build community understanding, leading to changes in approaches and policy on a broad scale.</p>	<p>Applying ‘green engineering’ solutions to urban drainage plans can showcase alternative options to achieve healthier, more aesthetic urban waterways. This approach will bring multiple social and environmental benefits, but importantly, can also help drive changes to policy, culture and attitude of developers and government to urban waterways.</p>
<p>CM 9: Restoring Priority Waterways Systematically and strategically conduct riparian restoration projects to improve the health of our region’s waterways, including the Great Barrier Reef lagoon.</p>	<p>Community support and involvement in waterway restoration projects is high, based largely on a history of successful projects delivered by well-respected community groups. We can capitalise on this support by building on existing projects and transferring successful methodology to additional areas. A systematic approach to waterway restoration, based on agreed criteria and priorities, will provide extensive benefits to the health of our waterways. The region’s waterways have a high significance to Traditional Owners, and waterway restoration projects provide opportunities for Traditional Owner involvement.</p>
<p>CM 10: Community Engagement Through on Ground Action Engage local communities to conduct small scale restoration activities around local creeks to increase involvement and provide a range of social and environmental benefits.</p>	<p>Many communities see their local waterways as special places. There is a strong connection by the community to these waterways – they are often high profile, visited or seen regularly and may be used for a variety of recreational purposes. All these factors combine to create the impetus to protect and restore local creeks. These areas provide the opportunity to be used as model projects, bringing cultural, social, environmental and economic benefits. Focussing on small scale activities in specific localities can make it easier for people to find a way to be involved which suits them, without requiring a huge commitment.</p>
<p>CM 11: Wetlands in the Wet Tropics Undertake restoration work in key wetlands across the Wet Tropics to restore their function and protect their value to aquatic and terrestrial species and ecosystems.</p>	<p>Many wetlands throughout the region have been heavily modified, reducing their level of ecosystem function. Wetland projects will help restore their value to aquatic species, as well as to migratory birds and other terrestrial wildlife. Properly functioning wetlands can significantly reduce sediment and pollutant loads in associated waterways, including the Great Barrier Reef lagoon. Many ecological communities associated with wetland habitats will also benefit from wetland restoration projects</p>
<p>CM 14: Improving Movement of Fish Removal of barriers and installation of structures to aid fish movement and provide expanded access to fish habitat and breeding grounds.</p>	<p>Many waterways in the Wet Tropics have been modified by urban or agricultural development. These changes have had huge impacts on the movement of fish throughout waterways, in many areas, severely restricting their access to important habitat or breeding areas. The removal of barriers, installation of fish passages and re-engineering roads and crossings can all contribute to improved fish movement and long term aquatic health within the Wet Tropics. Community involvement in these projects is vital to raise awareness and act as a catalyst for further projects</p>
<p>CM 16: Reducing Erosion and Improving Drainage Stabilise areas of significant erosion in the landscape, such as waterways and agricultural drains, using revegetation with native trees, shrubs and groundcovers, maintaining effective farm drains and installing detention basins.</p>	<p>Sediment runoff from terrestrial activities has a significant impact on the health of the region’s waterways. Significantly, a range of health problems on the Great Barrier Reef have been linked to land-based sediment and nutrient runoff. Areas of high erosion contribute significant sediment and nutrient loads to the region’s waterways. There are a range of effective techniques which could be used to stabilise these areas and reduce the impacts of erosion, as well as contribute to other benefits. Revegetation of unstable areas can bring added benefits to wildlife and connectivity, as well as providing shade and shelter for stock.</p>
<p>CV 10: Initiatives for Protecting Habitat Implement education, incentive and stewardship schemes to ensure long term protection of high value habitat – protecting what we already have.</p>	<p>There are significant areas of high value habitat on private land which are not currently protected. Investigating positive ways to protect what is already there provides a cost effective way of achieving strong conservation outcomes, while encouraging support from landholders. ‘Least effort’ approaches, such as protecting what we already have or encouraging natural regeneration, combined with education / incentives programs provide a range of mechanisms to achieve protection of significant areas of high value habitat.</p>
<p>CV 14: Showcasing Model Projects Establish and promote demonstration sites which showcase ‘model’ projects, to promote good natural resource management and encourage further uptake.</p>	<p>Promoting model projects across a range of areas is an excellent way to showcase success stories and encourage uptake on a larger scale. There is nothing like seeing the successes first hand to demonstrate to the broader community the value of good natural resource management. The demonstration sites can also be a powerful tool in showing how projects can be done, removing the perception that good NRM is too difficult or that certain approaches won’t work. Sites with a high level of community involvement and in highly visible locations provide opportunities for the message to spread even further.</p>

Wet Tropics WQIP 2015-2020

The Wet Tropics landscape has been heavily modified since European settlement, resulting in changes to hydrological connectivity and ecological functions like material trapping, filtering and drainage diversion. Modifications include large scale changes in land use to activities that generate greater pollutant loads, particularly in coastal areas. One of the main consequences of these changes is degraded water quality which poses a significant threat to the health of the Wet Tropics catchment waterways, coastal and marine ecosystems including the GBRWHA.

Like most water quality improvement plans the Wet Tropics WQIP seeks to identify key pollutants and sources and to prioritise areas for management efforts that can reduce pollutant run off to receiving aquatic ecosystems. Based on monitored and modelled loads the WQIP produces an assessment of marine asset (GBRWHA) risks and identifies and assess environmental values and targets.

Within the Wet Tropics region, the Johnstone and Herbert basins are the highest contributors of the total loads for all pollutant load constituents that have been modelled (TSS, DIN, PSII herbicides and particulate nutrients).

Grazing land use is the greatest source of TSS in the region (32% of the total TSS load). However, on a land use by area basis, cropping land uses tend to have a higher generation rate per unit area. The model estimates indicate that the Herbert basin contributes the greatest anthropogenic TSS load in the region and is almost double the amount contributed from any other basin.

Sugar cane land use is the greatest source of DIN (42% of the total DIN load and ~80% of the anthropogenic DIN loads) and PSII herbicides (>95%) in the region, and accounts for a large proportion of intensive land uses in the region. However, on a land use by area basis, it is estimated that bananas generate the highest areal load of DIN per hectare, but the amount varies considerably between basins depending on local characteristics such as management practices, slope and rainfall. Model estimates indicate that the Johnstone basin contributes the greatest anthropogenic DIN loads in the region, accounting for ~42% of the total regional load. The Herbert basin contributes the greatest PSII herbicide loads in the region at approximately 28% of the regional load.

The Russell-Mulgrave, Johnstone, Tully, Murray and Herbert basins are the highest priority areas for reducing pollutant loads to the GBR in the Wet Tropics region.

The Wet Tropics WQIP adopts two main management strategies:

1. Directly reduce pollutant runoff through BMP management practice improvements
2. Restore the ecological function of the landscape through 'system repair' actions

System repair actions are recommended where ecological functions such as water retention, sediment trapping and hydrological connectivity have been heavily modified. Changes to the management of agricultural and urban land to improve the water quality of runoff, and actions that restore coastal ecological function particularly improved interception and processing/storing of sediment and other contaminant loads is required across all basins.

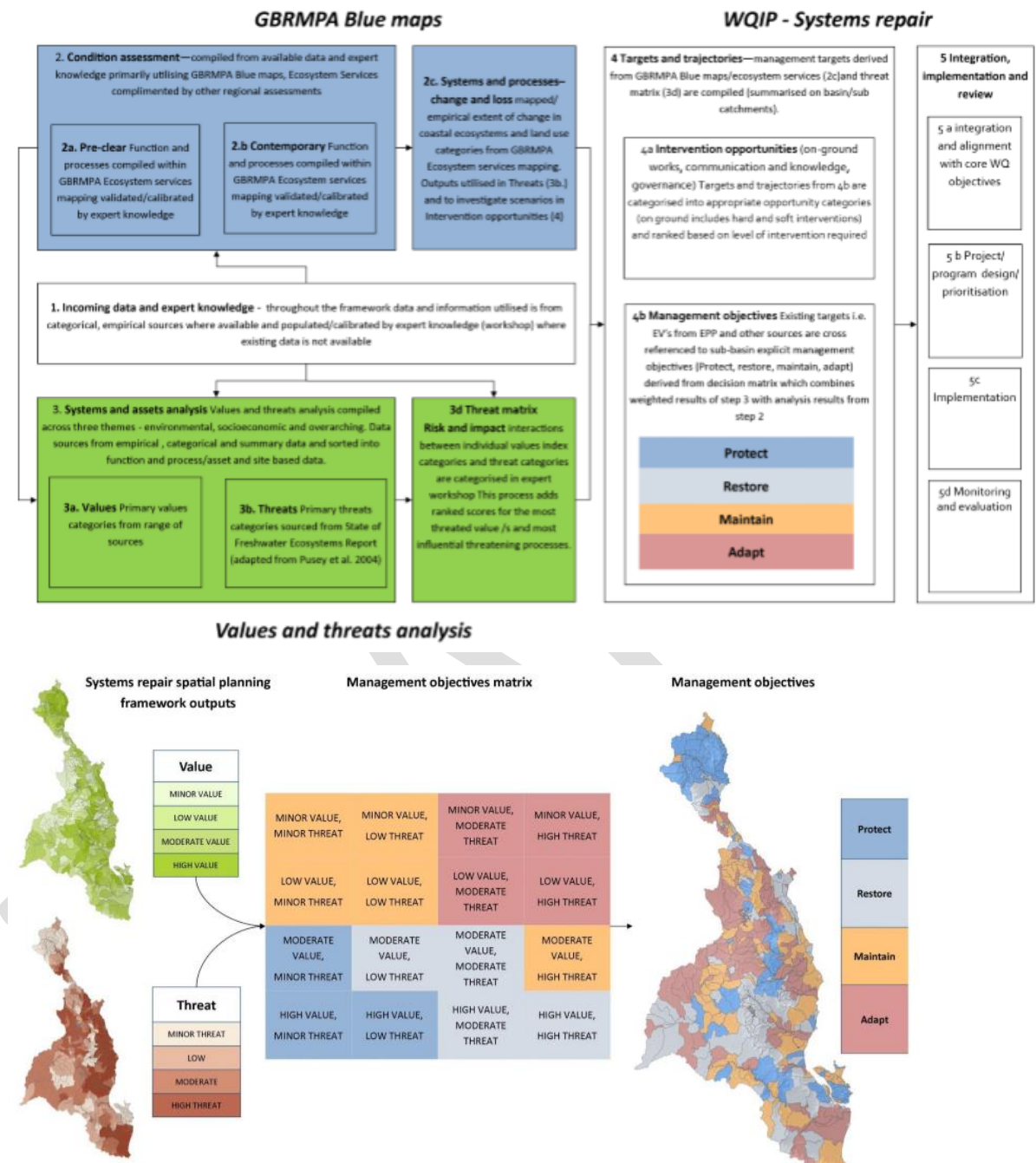
The Wet Tropics WQIP employs a range of advanced spatial prioritisation methods for defining priority areas for action on the basis of values, threats and functions.

The use of tools developed by GBRMPA to examine system connectivity and ecological function described for other regions has also been applied to the Wet Tropics. These include: 'Blue maps' examining frequency of landscape hydrological connectivity, assessment of the pre and post clear extent of coastal ecosystems and application of the ecological calculator to provide an understanding of the ecological functions provided by the baseline natural and modified coastal environment. As described for other regions a key output of this approach is the identification of catchment and ecosystem processes that need to be restored to serve improved water quality outcomes.

Terrain NRM have also developed a specific Wet Tropics System Repair Spatial Planning Framework (see figures below). The framework assesses ecosystem values and threats at a local catchment scale and has been constructed to inform at two levels. At a regional level, where the aggregate *Values*, *Threats* and the *Management Response* across the Wet Tropics are considered, and at the catchment level where impacts on one or more threats are interrogated in further detail and summarised within WQIP catchment Summaries. Landscapes included in the assessment extend from the coastline and estuarine ecosystems, freshwater wetlands and associated floodplain ecosystems and include the remaining catchment ecosystems.

The application, integration and outputs of both the GBRMPA and Wet Tropics System Repair Spatial Prioritisation Tool are presented in the figures below. These prioritisation processes provide a high level of

guidance for wetland management investment. While stopping short of identifying specific sites, sub-catchment resolution of prioritised areas and specific management recommendations nominated in WQIP catchment summaries provide the basis for scoping potential project sites using other sources of information including aerial images and wetland mapping.



Wet Tropics Major Integrated 2017/2018 Project

One of the key findings and recommendations of the Wet Tropics WQIP was the implementation of larger scale priority projects across the region. Both the Johnstone and Tully-Murray basins were found to be the highest priority basins for practical targeting of investment in sugar cane practice improvement that could serve water quality improvement. These basins have subsequently become the target for the Wet Tropics Major Integrated Project (MIP).

The objective of the multimillion dollar funded Wet Tropics Major Integrated Project (WTMIP) is to work closely with groups of landholders in priority areas within the Tully and/or Johnstone basins to trial a range of regionally tailored, coordinated actions that reduce nutrient and pesticide loads. It is proposed that by concentrating effort, using a combination of approaches and closely involving local landholders and communities in the design and

implementation of the WTMIP, a steeper trajectory in water quality improvement will be achieved than would otherwise occur. Throughout the next three-year delivery period of the WTMIP, land management practice changes, economic benefits for landholders and pollutant load reductions will be closely monitored and results will inform adaptive management. The strategic priority is to deliver enduring sustainable land management that also benefits local communities.

The WTMIP has been designed to deliver against the following key elements:

- To test combinations of actions across all catchment activities to increase the capacity to meet Reef water quality targets as set by the Great Barrier Reef Water Quality Protection Plan.
- To develop a local design to meet local conditions and circumstances.
- To reduce the level of nutrients and pesticides reaching the Great Barrier Reef (GBR) from the Tully and Johnstone River basins.
- To integrate water quality solutions across all activities in the basins with a focus on farm practice.
- To facilitate the integration of all activities in the basins to increase the effectiveness of all investments that can contribute to water quality outcomes.

Catchment repair trails for pollution reduction including treatment systems and ecosystem repair form part of the base logic (and investment focusses) for the Wet Tropics Major Integrated Project (see figure below).

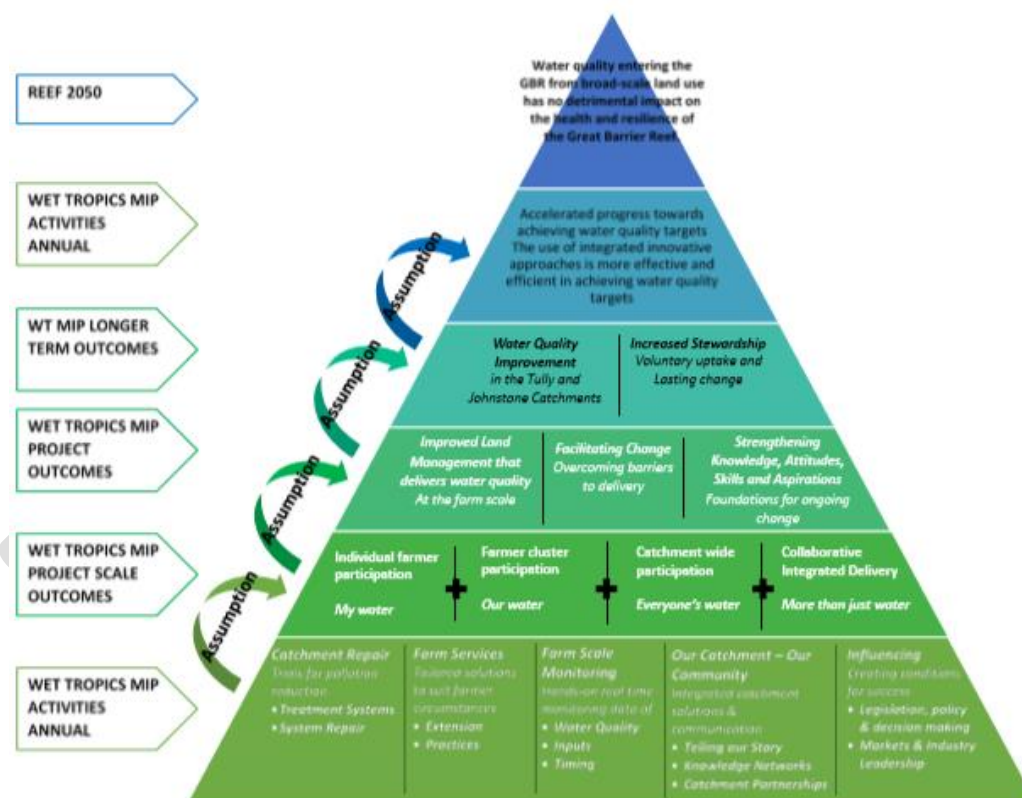


Figure 1 – Wet Tropics Major Integrated Project Logic

The WTMIP will trial and measure effectiveness and cost efficiency of a range of catchment repair options in the Wet Tropics. The WTMIP will invest up to \$4.7M across 20 different treatment sites including bioreactors, wetlands, high efficiency sediment basins and riparian buffer zones. These will be delivered in collaboration with farmers and landholders in optimal locations. Community groups, Traditional Owners, NGOs, Council and River Improvement Trust (RIT) will be delivery partners.

Russel, Johnstone, Tully and Herbert Catchment Stories

The web based 'catchment stories' produced for 4 of the Wet Tropics nine river basins provide information about how the catchments function as well as management priorities. The story maps sit under the Wet Tropics NRM Plan for People and Country and incorporate information from the Water Quality Improvement Plan (WQIP) and the DEHP 'Walking the Landscape' (WTL) processes. The website tabs provide information and

links to interactive maps for each basin's: (1) Overview (2) Exploring the Catchment (3) Catchment Management Units (4) Social & Cultural Values (5) Waterways Values & Threats (6) Priority Actions (7) WQ Monitoring & Modelling (8) Regional Report Card, and (9) Partners.

The section on priority actions nominates specific types of management actions for specific wetland systems and sites. Given that these catchment stories and priority action nominations incorporate all subordinate Wet Tropics Region NRM prioritisation including the regional NRM plan and WQIP they provide specific and current guidance for wetland management investment based on the best available regional knowledge including sub-catchment system understanding developed through the WTL process.

Candidate Project Sites

The approach ultimately adopted for selecting Wet Tropics region candidate wetland project sites was essentially to adopt and endorse the prioritisations developed by the regional community based organisation Terrain NRM, particularly priority action sites identified within the catchment stories generated in part by the 'Walking the Landscape' process.

In reviewing and scoping these potential candidates, sources of information used to assess their suitability and define potential project site boundaries included:

1. Consultation with regional wetland managers,
2. Targeted and opportunistic Google Earth explorations of catchment and site conditions, and
3. Reference to strategic and regionally prioritised wetland management actions detailed in the WQIP particularly within catchment summaries to assess if site characteristics supported opportunities for such actions.

Consultation with regional wetland managers (1), was primarily employed to gain currency in understanding the status of past wetland management investment programs and to identify if sites were currently being considered for new or ongoing funding including under the Wet Tropics Major Integrated Project Proposal. Regional managers were also asked to nominate any personal site nominations they felt had merit but may have missed recognition in past prioritisation exercises, and to assess the validity of site boundaries and works proposals nominated by the author via (2) or (3).

Eight sites in addition to those identified as priority action areas by WTL assessment processes were nominated by regional wetland managers. Two (Cattana sub-basin, Warrina Lakes) were nominated on the basis that they presented opportunities to work within urban catchments, a regional management priority identified within the NRM Plan and WQIP, two others were nominated as sites omitted from WTL priority actions but otherwise conforming with WQIP catchment and action prioritisation criteria (Bamboo Ck, Eubangee Swamp Inflow- Outflow Creeks), another was identified as a regionally significant basin /site (Cherrin Creek, Bellenden Plains Fish Highway) that had been overlooked due to a focus on the adjoining Tully Basin by WTL and WTMIP planning outputs, another was nominated as an opportunity to consolidate and value add to existing investment (Fig Tree Creek) and the final one (Palm Creek) was added on the basis of providing co-investment opportunities to trial highly innovative management techniques to a highly degraded system that is a catchment area for an existing major investment site (Mungalla).

While sites prioritised via the WTL process as priority actions had essentially passed regional strategic works prioritisation endorsement the 'gate keeper' approach as applied to other regions was still applied to confirm site candidature suitability including that of sites nominated by regional wetland managers. To pass candidature a site must meet criteria No. 1 and at least two or more other of the following criteria 'passwords' (see below).

Site Candidature 'Gate Keeper' Password Questions – need >2 yeses to pass.

1. Does the site have readily identifiable restoration needs that can be delivered within the context of the current project that will deliver for Reef Trust 1 and/or 2 outcomes?
2. Has the wetland site previously been prioritised for NRM investment in wetland specific prioritisations?
3. Does the site concern a system prioritised for wetland NRM investment and/or priority actions promoted in regional planning?
4. Does the site have high biodiversity and/or water quality functional values?
5. Does the site present the opportunity to build upon or maintain past investment?
6. Does the site have notable good works capacity associated with: landholder and/or community support; co-investment potential; proximity to project service centre?
7. Does the site present a high value demonstration site related to its: public profile, representativeness of required works to regional needs; and/or opportunity to demonstrate highly innovative works?

For the Wet Tropics Region 26 candidate sites (see table below and Appendix 4) were ultimately nominated for presentation at the regional stakeholder meeting to be culled, refined and added to in terms of detail or additional sites as part of the prioritisation toward fully scoped works proposal. In general terms these sites included:

- 10 cane land dominated floodplain sub catchments – TR3, 8, 9, 10, 11, 12, 14, 15, 22, 24
- 3 near coast - tidal wetland aggregation sites – TR5, 6, 13
- 3 linear riparian corridors (floodplain distributary, stream, river) – TR19, 21, 25
- 3 remnant floodplain habitat sites - TR7, 16, 26
- 2 coastal wetland aggregations and their contributing cane dominated catchment area – TR1, 2
- 2 floodplain swamp drainage systems - TR20, 23
- 1 river sub catchment - TR4
- 1 tide gated estuarine complex - TR18
- 1 urban wetland - TR17

Wetland Site	'Gate Keeper' Password Questions Passed	Comments
TR1_Southern Herbert Coastal Waterway Aggregation_Coolbie	1, 2, 3, 4, 5, 6, 7	WTL Process 'Priority Action'
TR2_Southern Herbert Coastal Waterway Aggregation_EasterCk-Bambaroo	1, 2, 3, 4, 5, 6, 7	WTL Process 'Priority Action'
TR3_Cattle Creek Wetlands and Tribs	1, 2, 3, 4, 5,	WTL Process 'Priority Action'
TR4_Stone River	1, 2, 3, 4, 7	WTL Process 'Priority Action'
TR5_Mungalla Wetlands	1, 2, 3, 4, 5, 6, 7	WTL Process 'Priority Action'
TR6_Mandam wetlands	1, 2, 3, 4,	WTL Process 'Priority Action'
TR7_Ripple Creek wetlands	1, 2, 3, 4, 5, 7	WTL Process 'Priority Action'
TR8_Bellenden Plains Fish Highway	1, 2, 3, 4, 5, 6, 7	Adjoins but overlooked by WTMIP
TR9_Tully Syndicate	1, 2, 3, 4, 5, 6	WTL Process 'Priority Action'
TR10_Boar, Brick, Michael Creeks	1, 2, 3, 4, 6	WTL Process 'Priority Action'
TR11_Davidson Creek	1, 2, 3, 4, 6	WTL Process 'Priority Action'
TR12_Cherrin Creek	1, 2, 3, 4, 5,	Adjoins but overlooked by WTMIP
TR13_Lower Hull River	1, 2, 3, 4, 6,	WTL Process 'Priority Action'
TR14_Maria Creek	1, 2, 3, 4, 6	WTL Process 'Priority Action'
TR15_North Johnstone River Water Quality	1, 2, 3, 4, 6, 7	WTL Process 'Priority Action'
TR16_Bamboo Ck	1, 3, 4,	Meets WQIP Prioritisation
TR17_Warrina Lakes	1, 3, 4	Urban catchment
TR18_Ninds Creek	1, 2, 3, 4, 7	WTL Process 'Priority Action'
TR19_Babinda Creek Catchment Repair	1, 2, 3, 4, 5, 6, 7	WTL Process 'Priority Action'
TR20_Babinda Swamp Drainage System	1, 2, 3, 4, 5, 7	WTL Process 'Priority Action'
TR21_East Russell Wetlands	1, 2, 3, 4, 7	WTL Process 'Priority Action'
TR22_Russell River National Park to Bellenden Ker Range Riparian Connections	1, 2, 3, 4, 7	WTL Process 'Priority Action'
TR23_Eubangee Swamp Inflow- Outflow Creeks	1, 3, 4, 5, 7	Meets WQIP Prioritisation
TR24_Cattana sub-basin	1, 3, 4, 5, 6, 7	Urban catchment
TR25_Palm Creek	1, 4, 5, 6, 7	Innovation / Co-investment
TR26_Fig Tree Creek	1, 3, 4, 5, 6, 7	Builds on past investment

> Outcomes Regional Workshop Site - Project Prioritisation

Candidate sites identified via regional prioritisation literature review, local manager consultation and independent assessment of prospective areas were presented to stakeholders for review and further scoping at four regional workshops held sequentially at Rockhampton (Fitzroy Basin), Mackay (Mackay – Whitsunday – Isaac Region), Cairns (Wet Tropics Region) and Ayr (Burdekin Dry Tropics Region) through November 2017.

Given the regional consultation and literature review conducted prior to the workshops nominated candidate sites were generally well received and only a few additional nominations were proposed during some of the workshop though following workshop review none were recommended for further project scoping.

Information gained from regional stakeholders during the workshop process was invaluable for distinguishing which candidate sites had limitations including data deficiency that impacted their viability as implementable projects during the term of the current Greening Australia project. Conversely other information gained through the workshops significantly elevated the candidacy of sites toward readily implementable projects.

Much of this information related to project capacity criteria related to landholder and community support for different types of works at specific sites. Most of this information cannot be obtained from literature sources and underpins the importance of the regional consultative process for prioritising wetland management investment. Other information concerned values and threats associated with specific sites, some of which may have been accessible through greater assessment of available data sources though is often not due to the scale or quality of available information. The following nonexclusive headers describes the range of generic workshop contributed findings across regions that were invaluable for prioritising candidate sites toward potential projects worthy of further scoping.

Landholder Engagement Capacity

Landholder engagement capacity emerged as one of the most important prerequisites in the context of identifying potential wetland restoration projects. Regardless of site suitability for such management interventions, the absence of landholder support for proposals means that they will literally fail to get past the front gate. Information gained from the regional workshops regarding landholder engagement capacity fell into three areas including: (1) past experiences of demonstrated landholder support or indicative willingness to be engaged in wetland management, (2) past experiences of landholder hostility or other negative associations toward engagement in wetland management projects and (3) unknown landholders and/or capacity for engagement in proposed wetland management works.

Where candidate sites involve landholders with a known capacity to support proposed works their foundational base as a potentially implementable project is established and further project scoping is warranted. Where the capacity for landholder support in unknown project viability is not discounted but landholder engagement lead time is required to assess if further project scoping is warranted. Subject to the nature of the works under consideration and the reach of project extension staff the time required to facilitate the successful engagement of landholders may discount the candidacy of some sites. Sites with previously unsupportive or hostile landholders cannot always be fully discounted, particularly if proposed works are unlike those associated with previous engagement efforts, circumstances surrounding the management of the targeted property have changed and/or incentives available with current proposals are thought capable of engendering a change in landholder support.

Works Scope

This issue refers to the extent that the scope of identifiable works at a site contributes to its viability as a restoration project. A range of information gained from the regional workshops concerned works scope. The viability of candidate sites was most undermined where there was an absence of definable works either because the site was in good condition or alternatively past investment had already addresses previously identified management needs at the site. The former situation commonly arises where wetlands have been nominated for management investment based on their values including biodiversity and condition. While such sites are a legitimate target for protective management they often have limited scope for investment in restorative works as pursued by this project. Other considerations around works scope include scale of required works and time and resources required to implement them relative to project budget and duration and whether identified management works actually deliver against the Reef Trust Outcomes 1 and 2 sought by this project. Sites where further project scoping was endorsed by the regional workshops were assessed to have readily identifiable works that could deliver against Reef Trust Outcomes 1 and/or 2 within the resource and time constraints of the current project program.

Co-investment Opportunities

The scope of works possible at a site is to some extent defined by available funding resources. Where there are opportunities for additional investment sourced externally from the current Greening Australia program to be contributed to delivering works at a site, significant value can be added to potential project outcomes. Securing co-investment in restorative wetland management outcomes is a stated objective of the current GA project. The regional workshop process identified a range of such opportunities for different project proposals. This included alignment with existing regional NRM body funded programs, industry body or corporate interest in the management of specific areas, expressed local government interest or dedicated budget allocations (e.g. developer storm water management contributions) for improved management of wetland areas or issues. It also included other government funding programs for which wetland management outcomes are not specifically targeted but could be readily included in benefits flowing from proposed works investments e.g. the Mackay region flood disaster funding. Other identified examples included government corporation (i.e. Sunwater) commitments to invest in the management of problems (e.g. groundwater rise) that may present opportunities for improved wetland condition outcomes. Where noted, readily identifiable co-investment opportunities promoted candidate sites for further project scoping.

Site History

Given the regional significance and profile of some high value wetland systems many candidate sites have previously received or been nominated for management investment. Information regarding the success and status of past site investment or reasons it has not transpired is seldom readily available and is invaluable for assessing whether such sites are candidates for further management initiatives. Information provided through the regional workshops helped establish where past investment has successfully addressed identified management issues or has built a sound foundation for further investment that can capitalise on past efforts. Cautionary insights were also recorded where investment had previously been co-opted by landholders for oblique outcomes or management challenges had proven insurmountable.

Community Support

Community engagement and support can be vital for the success of some restoration projects particularly where they involve public lands, cultural change, innovative works, long-term commitments and/or require substantive volunteer effort. Conversely, community opposition to some wetland management objectives due to perceived risks or value conflicts e.g. aesthetics can undermine project proposals that are otherwise technically viable. Most regional NRM bodies and regional stakeholders including local government representatives have a good appreciation of their local community's attitudes and values regarding supporting particular types of wetland management activities. For sites with a history of past management investment knowledge of previously expressed levels of community engagement and support provides a barometer for what future project may enjoy. Community support from different sectors can also influence the likelihood of co-investment opportunities from sponsoring corporations, groups or agencies e.g. those interested in wetland management outcomes or aspirations that serve Traditional Owners, recreational fishers, eco tourists or the educational sector. Perceived levels of likely community support related by stakeholders during regional workshops provided useful input to the prioritisation of candidate sites for further project scoping.

Capacity to Service

The capacity to service proposed wetland restoration projects is dependent upon the location of the site relative to service centres and participating organisation personnel and on the nature of required works relative to available expertise, labour and infrastructure/ machinery resources. Remoteness is an obvious consideration in assessing the viability of wetland management works proposals, but in some instances is not an issue where landholder capacity for the works proposed is high. In general terms the viability of candidate sites as project proposals was downgraded through the regional workshops where sites were not proximally located to service centres and/or machinery or other resources required to implement works could not be readily mobilised or sourced from the immediate project area. The generally more limited capacity to service projects outside the main operational areas accessed by community NRM project officers also reflects a generally lower level of site nomination from such areas related in part to less familiarity of wetland managers with the landscapes and landholders of these areas.

Condition

Wetland condition attributes are critical for determining the need for or suitability of proposed restoration works. Accessible, reliable, current condition data is seldom available for regions or even smaller catchment areas. While remote sensing including aerial images can often be employed to infer the condition status of wetland sites, some condition issues e.g. fish passage barriers, water quality, woody weeds are not always readily interpretable, and imagery is not always current. Wetland condition information gained from the regional workshops helped to reinforce some candidate sites in terms of justifying proposed works and dismissed others

where current condition was so good as to negate the need for works or alternatively so bad that the scale of works required was beyond the scope of the project or inferred values or benefits associated with the restoration of the site misplaced.

Values

Wetland values are a key consideration when justifying investment for their restoration and management. While information on wetland values is often available for larger, better condition and well documented systems, smaller scale and more modified systems often lack value information. As noted in preceding discussion concerning works scope, values by themselves are not a guarantee of site suitability for project works particularly if the site is near natural and lacks obvious targets for restoration activities. Alternatively having high values at a candidate site that has obvious restoration needs helps justify prioritising it for further project scoping particularly if identified values e.g. fisheries, threatened biodiversity, water quality functions helps to engender additional community support or co-investment. Additional information gained through the regional workshop process concerning the values associated with candidate sites helped progress some toward further project scoping.

> Post Workshop Project Scoping

Subsequent to the regional workshops Greening Australia in conjunction with the report author undertook additional prioritisation of regionally endorsed sites to hone the focus on those most suitable for further project scoping. This essentially involved application of the same prioritisation rationale employed in generating the workshop short list but applied to the short list to provide some indication of relative suitability. This generated primary, secondary and tertiary shortlist priorities (see tables in following regional sections). While this exercise is useful for guiding further project scoping efforts, at this stage all sites shortlisted via the regional workshop process (Appendix 2) are being considered in ongoing project scoping engagement with regional stakeholders.

Ongoing engagement with regional wetland management stakeholders is now being undertaken to finalise a list of scoped regional projects to be pursued by Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project. The main approach being employed during this process involves more informed and strenuous assessments using the same types of criteria applied, and information sort through the regional assessment process including:

Landholders: Confirmation via direct extension and communication by Greening Australia project officers or supportive regional stakeholders of site landholder support for the types of wetland management initiatives proposed during site identification (or alternative proposals);

Co-investment: Direct communication with Fund managers, Funded NRM Program officers, Corporations, Local Government, Industry Groups and/or Government Agencies and others identified as potential sources of project co-investment to initiate and/or confirm external funding support for some nominated project proposals.

Community Support: Communication with regional wetland management stakeholders particularly Regional NRM bodies and local Governments to ascertain levels of community support for the types of wetland management works nominated for specific sites. This potentially includes communication with their community membership or rate payer base via mail outs / newsletters etc..

Feasibility: Assessing the feasibility of proposed wetland management works requires more specific site information ideally informed by site visits and direct communication between concerned landholders and potential project managers. Works nominated on spec from remote sensing and published information need to be confirmed against site conditions and the quantum of time, material and other resources required to deliver proposed Reef Trust outcomes be specified in preliminary sites work plans developed in accordance with program capacities. Where discrepancies are found between program capacity and requirements for delivering site management objectives are identified, works proposals should be reviewed and modified and/or proposal viability questioned.

Costings: One of the most obvious constraints on program capacity will be the cost of implementing site management works proposals. During the development of draft site works plans (above) each component of the proposal needs to be subjected to a preliminary costing considering at a minimum the scale and duration of works, material and operational costs including personnel, consumables, vehicles and travel, machinery hire, communication and extension and any post works monitoring needs.

Fitzroy Basin

Tables indicate *Candidate Sites nominated for further project scoping based on Regional Workshop outputs.

Colour codes indicate post regional workshop relative prioritisation of shortlisted projects with **Green indicating sites assessed as highest priority, yellow secondary priority and orange tertiary priority** on the basis of assessed suitability for further scoping.

Wetland Site	Primary Reasons Site Dropped and/or *Prioritised for Project Scoping
FBA1_Glenprarie	Property Ownership (Dept Defence) State of flux
FBA2_Torilla Plain	Property Ownership (Dept Defence) State of flux
FBA3_Waverley & Bar Plains	Property Ownership (Dept Defence) State of flux
FBA4_St Lawrence Wetlands	*Past success community engagement / investment
FBA5_Wumalgi Peninsula	Property Ownership (Dept Defence) State of flux
FBA6_Lower Herbert Creek Wetlands	Property Ownership (Dept Defence) State of flux
FBA7_Iwasaki Wetlands	History of owner engagement failures /difficulty
FBA8_Nankin Plains -Broadmeadows)	Current engagement operating works scope limited
FBA9_Blacks Waterhole / Raglan Ck	*Readily implementable works entry point for further prioritised NCA landholder engagement
FBA10_Neerkol Ck	*High engagement capacity and potential Reef Trust Outcome 2 returns
FBA11_Gavial Ck Corridor & Catchment	Works viability and landholder engagement risks
FBA12_Twelve Mile Creek (Bajool)	*Past success community engagement / investment
FBA13_Eight Mile Creek (Bajool)	*Comparability /extension successful adjoining site
FBA14_Lake Mary Complex	*Iconic site, community incl. Local Govt interest.
FBA15_Green Lake Complex	Definable works and landholder engagement limitations
FBA16_Southern Yamba Aggregation	Scale of works and landholder engagement risks /lead time
FBA17_Generic Cleared Fitzroy Floodplain	Scale of works and landholder engagement risks /lead time
FBA18_Palm Tree and Robinson Creek Wetlands	Limited capacity to service and works viability
FBA19_Perch Creek and Mimosa Creek Complex	Limited capacity to service and works viability
FBA20_Inland Cropping Floodplains	Limited capacity to service and landholder engagement risks /lead time

Mackay – Whitsundays

Tables indicate *Candidate Sites nominated for further project scoping based on Regional Workshop outputs.

Colour codes indicate post regional workshop relative prioritisation of shortlisted projects with **Green indicating sites assessed as highest priority**, **yellow secondary priority** and **orange tertiary priority** on the basis of assessed suitability for further scoping.

Wetland Site	Primary Reasons Site Dropped and/or *Prioritised for Project Scoping
RC1_Gregory River	*Value/integrity of catchment and marine HEV assets
RC2_Myrtle Creek / Borellini Rd	*Demonstration potential, landholder willingness
RC3_Goorganga Plains North	Definable works and landholder engagement limitations
RC4_Calen / St Hellens Creek	*Community interest, system value, demonstration potential
RC5_Goosepond Lagoons Catchment	Level of existing/past investment, community support risks
RC6_Fursden Creek Catchment	Existing investment, landholder engagement risks
RC7_Benholme Lagoons	*Build on past investment, high profile, site representativeness
RC8_McCreadys Creek	Scale of works and landholder engagement risks /lead time
RC9_Lower Bakers Creek - Paget	*Co-investment potential, regional priority action
RC10_Upper Bakers Creek	Definable works and landholder engagement risks
RC11_McEwans Beach	Definable works and landholder engagement limitations
RC12_Sandy Creek Catchment – Orphanage Lagoon – Mirani	*Regional priority action, driving cultural change, Reef Trust Outcome 1 & 2 potential
RC13_Oaky Creek	*Co-investment, Regional priority action, driving cultural change, Reef Trust Outcome 1 potential
RC14_Sandringham Lagoons & Catchment	*Past success community engagement / investment, site representativeness, innovation
RC15_Alligator Creek Catchment	Definable works, landholder engagement risks
RC16_Tedlands	Past investment, works viability /landholder engagement risks
RC17_Carmila	Definable works, landholder engagement risks

Burdekin Basin

Tables indicate *Candidate Sites nominated for further project scoping based on Regional Workshop outputs.

Colour codes indicate post regional workshop relative prioritisation of shortlisted projects with **Green indicating sites assessed as highest priority**, **yellow secondary priority** and **orange tertiary priority** on the basis of assessed suitability for further scoping.

Wetland Site	Primary Reasons Site Dropped and/or *Prioritised for Project Scoping
NQDT1_MerindaGreenSwampWetlands	Limited capacity to service and landholder engagement risks /lead time
NQDT2_EuriCk Anabranh Wetlands	Limited capacity to service and landholder engagement risks /lead time
NQDT3_Saltwater_Iyah Cks Distributaries	High levels existing investment program operating
NQDT4_Cassidy Creek	*Co-investment potential, site priority, innovation
NQDT5_Stokes Creek	* Site priority, innovation
NQDT6_SeaForth	*Regional works type priority, Reef Trust Outcomes1 & 2
NQDT7_RitalislandBunds	*Regional works type priority, Reef Trust Outcomes1 & 2
NQDT8_Plantation Creek Distributary	*Regional priority action, driving cultural change, co-investment
NQDT9_Kalamia Creek Distributary	High levels existing investment program operating
NQDT10_Lower Sheep Station Creek Connectivity	High levels existing investment program operating
NQDT11_Alva to Lochinvar Bunded Swamps- The Good, the Bad and the Ugly	Landholder engagement / lead time risks
NQDT12_Floodplain Periphery Lagoons - Inkerman Station	Definable works and landholder engagement risks
NQDT13_Floodplain Periphery Lagoons - Swans Lagoon Millaroo	Definable works and landholder engagement risks
NQDT14_Floodplain Periphery Lagoons - 8 Mile Ck Lagoons Dalbeg	Definable works and landholder engagement risks
NQDT15_Floodplain Periphery Lagoons - Gladys Lagoon	Definable works and landholder engagement risks
NQDT16_Hoey's Lagoon - Digeridoo	Definable works and landholder engagement risks
NQDT17_Pink Lily Lagoon - Crooked Ck Catchment	High levels existing investment program operating
NQDT18_Horseshoe Lagoon	Definable works and landholder engagement risks
NQDT19_Healy Lagoon-Reed Beds	*Past investment /engagement, Reef Trust Outcomes 2 within high value linked systems
NQDT20_Barratta Remnant Floodplain Habitat Matrix Mgt	*Regional Priority, past investment /engagement, Reef Trust Outcomes 1 & 2
NQDT21_Brewster Rd Drain erosion	*Subsumed within NQDT20
NQDT22_Sayers Rd Tree swamp & Green Swamp - Highflowboys	*Subsumed within NQDT20
NQDT23_Green Swamp - Highflowboys	*Subsumed within NQDT20
NQDT24_BHWSS Tailwater Drain Flowboy Bioreactors	*Subsumed within NQDT20
NQDT25_Woodhouse Lagoon -Tailwater Treatment Train_Recycle Basin1	*Subsumed within NQDT20
NQDT26_Woodhouse Lagoon -Tailwater Treatment Train_Recycle Basin2	*Subsumed within NQDT20
NQDT27_Mclain Rd Remnant	*Subsumed within NQDT20
NQDT28_Barratta Bifucation Flow Control Structure	*Subsumed within NQDT20
NQDT29_West Houghton Back Levee Bioreactor	*Regional priority works type, innovation
NQDT30_Major's Creek Catchment Management	Definable works and landholder engagement /lead time risks
NQDT31_Bohle Catchment Management	Scale of works and landholder engagement /lead time risks

Wet Tropics

Tables indicate *Candidate Sites nominated for further project scoping based on Regional Workshop outputs.

Colour codes indicate post regional workshop relative prioritisation of shortlisted projects with **Green indicating sites assessed as highest priority**, **yellow secondary priority** and **orange tertiary priority** on the basis of assessed suitability for further scoping.

Wetland Site	Primary Reasons Site Dropped and/or Prioritised for Project Scoping
TR1_ Southern Herbert Coastal Waterway Aggregation_ Coolbie	*Success of past engagement /community support, innovation
TR2_ Southern Herbert Coastal Waterway Aggregation_ EasterCk-Bambaroo	*Success of past engagement /community support, innovation
TR3_ Cattle Creek Wetlands and Tribs	Past investment, works viability /landholder engagement risks
TR4_ Stone River	Landholder engagement / lead time risks
TR5_ Mungalla Wetlands	*Build on past investment, landholder /community engagement support, innovation
TR6_ Mandam wetlands	Past investment, works viability /landholder engagement risks
TR7_ Ripple Creek wetlands	*Past investment, works viability /landholder engagement risks
TR8_ Bellenden Plains Fish Highway	Past investment, works viability /landholder engagement risks
TR9_ Tully Syndicate	High levels existing investment program (WTMIP)
TR10_ Boar, Brick, Michael Creeks	High levels existing investment program (WTMIP)
TR11_ Davidson Creek	High levels existing investment program (WTMIP)
TR12_ Cherrin Creek	Past investment, adjoining system high levels existing investment program (WTMIP)
TR13_ Lower Hull River	High levels existing investment program (WTMIP)
TR14_ Maria Creek	High levels existing investment program (WTMIP)
TR15_ North Johnstone River Water Quality	High levels existing investment program (WTMIP)
TR16_ Bamboo Ck	Works viability /landholder engagement /lead time risks
TR17_ Warrina Lakes	Limited Reef Trust Outcomes
TR18_ Ninds Creek	Scope (cost) of works /landholder engagement /lead time risks
TR19_ Babinda Creek Catchment Repair	*Past investment, cultural change, site value, Traditional Owner engagement
TR20_ Babinda Swamp Drainage System	Works viability /landholder engagement risks
TR21_ East Russell Wetlands	Landholder engagement risks
TR22_ Russell River National Park to Bellenden Ker Range Riparian Connections	Landholder engagement / lead time risks
TR23_ Eubangee Swamp Inflow- Outflow Creeks	Landholder engagement / lead time risks
TR24_ Cattana sub-basin	Works viability /land use state of flux
TR25_ Palm Creek	*Co-investment, community support, innovation
TR26_ Fig Tree Creek	*Co-investment, community support, innovation

> Discussion - Prioritisation of Wetland Sites for Management

The prioritisation of candidate sites for Greening Australia's "Repair and Restoration of Priority Coastal Habitat and Wetlands" project detailed in this report represents a pragmatic approach pursued across a broad area in a short time frame using limited resources. The extent to which nominated candidate sites have been well received by wetland management stakeholders through the regional workshops and subsequent project scoping period is to some degree indicative of their legitimacy. This is attributed to:

- the extensive use of each region's own NRM prioritisation frameworks relating to wetland management investment;
- consultation with regional wetland managers regarding the status of past and current wetland management initiatives and emerging priorities in terms of works and sites; and
- the lead authors personal experience in developing wetland management projects across the regions concerned.

At the onset of this project use of the Great Barrier Reef Catchment Wetland Prioritisation Decision Support System (HLA–Envirosciences 2006) <https://wetlandinfo.ehp.qld.gov.au/wetlands/resources/tools/assessment-search-tool/7/> to short-list and rank candidate wetland restoration sites during regional workshops was considered. However, several constraints identified earlier weighed against its application including:

- Insufficient lead time between the identification of regional candidate sites and the conduction of the regional workshops to enable stakeholders to gain site familiarisation or assemble appropriate expertise;
- The dependence of the DSS on having sufficient experts (in number) and expertise coverage (across sites) to score criteria values;
- The limited capacity to incorporate new sites 'nominated from the floor' during the workshop process;
- The need to review and update DSS criteria to incorporate specific value and capacity criteria identified by regions and/or associated with the Reef V program; and
- The potential need to run separate criteria weighting exercises to assess potentially competing or exclusive project objectives targets for Reef Trust Outcomes 1 or 2.

With greater opportunity to address these limitations the merits of applying the GBR Catchment DSS to prioritise works sites is seen to be good albeit ideally for a list of candidate sites that have already undergone some level of regional stakeholder endorsement and familiarisation.

Although a formal Decision Support System (DSS) was not directly applied to prioritise candidate wetland sites during this assessment, the approach used incorporating assessment and application of regional NRM prioritisation frameworks (which included the GBR Catchment DSS in the Fitzroy Region) and the regional workshop process provided valuable insights that can be applied to future wetland management prioritisation exercises or tool development. These are discussed under descriptive headers below.

Sites versus Projects

An early realisation flowing from the examination of wetland sites identified in available literature and past regional assessments is that not all significant wetlands necessarily constitute potential restoration project sites. Biodiversity conservation objectives have underpinned many of the earlier inventories of regionally significant wetlands included those listed in the National Directory of Important Wetlands in Australia (DIWA). Wetlands identified in such regional assessments usually have outstanding values in terms of biodiversity, fisheries, and ecosystem function (although the later may not be well defined). Where these systems retain good biophysical condition, there can be limited scope for restoration activities within them, although there may be some scope for such works in contributing catchment areas. The main requirements for such high value wetland systems where they remain is protective management (discussed below). Where such systems are already within protected areas there are usually few outstanding management needs that can be served by community based NRM initiatives. The key point to be noted is that wetland site prioritisation needs to be management objective specific. Prioritisation seeking to define the 'most significant wetland' may not serve to identify where a restored 'wetland may be most significant' What constitutes a good or valuable wetland' site does not always translate into a good project' site, particularly when seeking to deliver restorative works. Many existing wetland prioritisations identify regionally significant sites independent of their management needs and the latter need to be known to serve management investment prioritisation.

Restoration versus Protection

NRM investment usually seeks to deliver 'works' that improve natural resource condition and protect biodiversity. The importance of biodiversity conservation as a NRM corollary has led to an emphasis on regional processes that prioritise areas including wetlands that have high biodiversity values as a focus for investment. As discussed above such sites do not always constitute viable project sites for restoration works. However, the repeated identification of such areas in regional prioritisations of important wetland sites to some degree indicates both a recognition that protection is a more cost-effective resource management strategy than restoration and that protective management needs are not being met. Formal protective management including the acquisition and declaration of protected areas and/or negotiated property bound conservation agreements falls largely within the jurisdiction of State conservation agencies. Across the GBR catchment regions examined there was some frustration expressed by regional wetland managers that while State and Federal Government agencies have an expectation on community NRM bodies to deliver wetland protection outcomes their capacity for this is largely constrained to voluntary commitments on the part of landholders. Regionally it is noted that binding formal action by conservation agencies has been conspicuously absent in recent decades despite numerous evaluation tools including some developed by state agencies (e.g. AquaBAMM) consistently identifying sites worthy of protective measures that are beyond the capacity of community NRM. The outstanding need for greater protective management outcomes for wetland systems may also be indicative of the limitations of existing protected area designation options. Options that specifically address the linear nature of riparian systems and the contributing catchment context of wetlands (e.g. Abell *et al.* 2007) may better serve protective management outcomes for wetland systems.

The need to utilise different criteria or at least different criteria weighting when prioritising management investment sites for differing objectives i.e. water quality, biodiversity, protective management, restorative management was recognised in the design and application of the Great Barrier Reef Catchment Wetland Prioritisation Decision Support System (HLA–Envirosciences 2006). Reef Trust Outcomes 1 and 2 sought by the current GA project can also be potentially competing or exclusive objectives for a prioritisation exercise. It is recommended that contrasts between what constitutes suitable sites for water quality, biodiversity and ecosystem resilience restorative management outcomes needs to be recognised in lieu of conducting prioritisation exercises that seek to serve all purposes. In most studied GBR regions the promoted strategy for prioritising system repair was to target catchments where levels of system impact or modification were limited and substantive biodiversity value remains. Adaption and maintenance strategies are promoted for highly modified systems. While the merits of this strategic approach for securing remnant biodiversity values is apparent, a counter strategy that prioritises water quality and ecosystem function outcomes could make the case for prioritising restoration in some of the most modified systems where gains in water quality and/or ecosystem function could be substantial independent of remnant biodiversity protection. This rationale underpinned some of the nominated candidate sites presented to regional workshops.

Classification versus Prioritisation

Biophysical classification and understanding of catchment systems provides an objective information base that can then be applied to interpreting the status of ecosystems services and values and the more subjective exercise of 'evaluating' and prioritising suitable sites for a range of different restorative management outcome objectives. This avoids having to utilise outcome objective rationales inherent and embedded in existing restoration strategies or works prioritisation processes that may not align with specific project objectives. The Whole of System (WOS) catchment management framework approach promoted by the Qld Wetland Program and implemented by GBRMPA in their assessments of coastal sub-catchments of the Mackay-Whitsunday region (GBRMPA 2016) provides an example where biophysical classification and description of catchment management areas are used to build an understanding of the systems biophysical condition, function and associated ecological values. Although some level of catchment and ecological process understanding is required to interpret WOS frameworks their merit for guiding strategic management investment prioritisation is acknowledged and ongoing compilation of such biophysical datasets including biodiversity data (REs, Listed Species) for regional catchments is recommended. A benefit of biophysical data in comparison to other information used to inform prioritisation (e.g. capacity criteria - below) is that biophysical conditions generally change less over time and once data is compiled its currency will remain relevant to planning exercises for some time.

Biophysical versus Capacity Criteria

While biophysical data can establish the likely outcomes and/or suitability of different management interventions at different sites, the capacity to deliver works at a site is often determined by non-biophysical attributes particularly landholder and community support and engagement capacity. This type of information is nominated to be some of the most critical in the determination of suitable wetland restoration project sites. It is

seldom available from published sources and unlike much biophysical information cannot be interpreted from remote sensing. It also needs to be kept current being subject to change through time with different landholders or changes in community attitudes to different types of works. The need to obtain this information to identify viable works projects sites highlights the importance of regional engagement as employed by this project via manager consultation, workshops and field extension.

Site Condition and Management Needs.

For prioritising wetland restoration management sites some of the key information required concerns site condition and associated management needs and restoration activities i.e. 'doable' works. For some more fixed forms of wetland impairment e.g. physical fish passage barriers, many regions have compiled data sets and associated restoration prioritisation schedules. For most other condition impacts information seldomly extends beyond system scale statistics and mapping concerning riparian vegetation condition or remnant vegetation extent. Fortunately, much condition information from which works needs may be inferred can be derived from interpretation of widely available aerial images. However, further development of regional NRM capacity to obtain current wetland system condition data possibly including by use of drone based remote sensing techniques would be invaluable for informing wetland management needs and investment prioritisation processes. Similarly to regional fish passage barrier prioritisation assessments, regional prioritisation assessments for other forms of wetland works investments e.g. revegetation, hydrological manipulations, exclusion fencing, bank stabilisation etc may provide a means of supporting more strategic regional investment when program funds become available.

Greenfield Site Development

Many of the sites prioritised for works through this regional assessment have been previously identified during regional wetland management assessment programs and have landholders with a known engagement capacity. Few 'greenfield' sites were nominated. One of the primary reasons for this has been the short time period over which the prioritisation study was conducted. While promising 'greenfield' restoration sites can sometimes be identified based on available biophysical data including system condition their viability as a works site is determined by landholder willingness, support and engagement capacity. In practice new site landholder engagement involves significant lead time for communication and extension activities that was not available to this prioritisation exercise. While short term NRM funding programs and cycles often result in abbreviated time frames for rolling out restoration activities, there is a need to establish more strategic long-term restorative works game plans. Ideally the Whole of System (WOS) catchment management frameworks being promoted for GBR catchments including the 'Walking the landscape' processes being undertaken by QDIS will ultimately provide the biophysical understanding to identify optimal investment areas for a range of wetland management objectives. Once identified these sites can become the focus for ongoing engagement activities with landholders building their capacity and willingness to participate in works program when funding becomes available through initiatives such as the current GA project.

Summary

Site prioritisation for wetland management is objective specific there is no one 'right answer'. Prioritisations pursued to deliver biodiversity protective management outcomes will provide vastly different outputs to those pursued to identify effective restorative management outcomes. In the context of wetland restoration objectives, past prioritisations that have sought to identify the 'most significant wetland' sites may be failing to identify where a 'restored wetland may be most significant'. While biophysical based classifications and descriptions of wetlands and/or their catchment areas potentially provide the best information for serving the broadest range of wetland management objectives, they often remain blind to capacity criteria such as landholder engagement capacity which has been found to be one of the most significant factors determining a project proposal's viability. Establishing a relevant viable suite of works is critical for a restoration project proposal. Information concerning wetland condition, management needs and landholder support for associated works is integral to establishing works proposals and underpins the need for regional wetland manager engagement and landholder extension as part of the project prioritisation and final scoping process. To pursue new 'greenfield' wetland management sites longer term biophysical based assessments of regional catchments are required to define strategic areas for management investment which can then be targeted for engagement of landholders over the long lead times required to build trust and support for delivering works programs. Ultimately there is no shortage of restorative management needs for wetlands within GBR catchments and prioritisation exercises do not need to define the 'penultimate' project. What is required is that biophysically defensible investments are made in viable 'no regrets' projects that deliver outcomes in accordance with stated program objectives.

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 - c. WTL-HC 3: Rehabilitating Ripple Creek Wetlands
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> Appendix 1 – Generic Potential Works Template

Geomorphic/Earth Works

Reinstate /Excavate Channel
Construction Detention Basins /Water Treatment Trains
Erosion Stabilisation Works
Contour Banking
Terracing and Revegetation of Cleared Sloping Land
Breach / Lower Bunds
Breach / Lower Levees
Rock Armor /Bank Stabilisation
Engineered Structure

Extension /Education

Extension Grazing Regime Management
Extension Practice Change (Cropping, Grazing, Burning)
Install Interpretive Facilities
Community Engagement
Establish Access / Recreational Facilities

Planning

Catchment Management and Works Plan
Riparian Management Agreements
Soil Conservation Plans Urban and Peri-Urban Development
Remnant Vegetation Management Agreement
Property Management Plan
Engagement with Statutory Planners

Pest Control

Controlled Grazing
Controlled Burning
Aquatic Weed Control
Woody Weed Control
Feral Animal Control

Vegetation Management

Riparian Revegetation
Reinstate estuarine vegetation
Broad Acre Corridor /Buffer Revegetation
Fire Regime / Fuel Load Management
Riparian / Wetland Fencing
Promotion Natural Succession
Protective Management Remnant Vegetation
Maintenance of Ground Cover Areas of Erosive Soils

Hydrology

Reinstate Tidal Inflows
Divert Flows
Establish Connective Flows
Wetlands in Upland Areas to Capture Runoff
Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows
Improve Groundcover and Protect Riparian Areas on Porous Soils to Facilitate Recharge
Broad Acre Revegetation to Manage Groundwater Levels
Revegetation and / or Structures to Baffle Overland Flow Velocities
Increase Detention Time of Runoff
Reconfigure Drain Design / Drainage Network

Connectivity

Remove Structural Fish Passage Barriers
Install Fish Passage
Rock Ramped Bund Outlets
Remove Weed Chocks
Address Anoxic Reach Conditions

Monitoring

Vegetation Condition
Bird Counting
Fish Community
Water Quality

mmm

> **Appendix 2 – Regional Workshop Prioritised Candidate Sites**

Table 1. Fitzroy Basin NRM Region

Table 2. Reef Catchments (Mackay- Whitsunday) Region

Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

Table 4. Terrain (Wet Tropics) Region

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
Bunded Coastal Wetlands West of Styx River includes sites: FBA1_Glenprarie FBA3_Waverley & Bar Plains FBA5_Wumalgi Peninsula (Broad Sound) FBA6_Lower Herbert Creek Wetlands	<p>Values:</p> <ul style="list-style-type: none"> • Water bird and Wader Bird habitat value • Size (km2) • Species richness/diversity • Populations of rare or threatened taxa (Incl. EPBC Taxa) • Assimilative capacity for nutrients and sediments • Tidal and non-tidal Fisheries habitat • Role in large-scale ecological functions and ecosystem services • Contribution to supporting migratory species • Role in biological connectivity • Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> • Priority Wetlands in NRM WQIP • Identified in past Regional Wetland Prioritisation • Priority Ecosystem Repair Sub-catchment in NRM WQIP <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> • Outcome 1 (WQ entering GBR) modest benefits • Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Minor fish passage works</p> <p>Attracts Co-investment: Potential from Dept. Defence</p> <p>Demonstration Site/Profile: Out of public eye.</p> <p>Community Support/Engagement: Limited</p> <p>Innovation: Modest, but regionally relevant i.e. managed bund removal, lowering.</p> <p>Landholder Support: Dept. Defence unknown, private landholders moderate.</p>	<p>Geomorphic/Earth Works Erosion Stabilisation Works Contour Banking Breach / Lower Bunds Rock Armor /Bund Stabilisation</p> <p>Extension /Education Extension Grazing Regime Management Planning Catchment Works Plan Property Management Plan Pest Control Controlled Grazing</p> <p>Vegetation Management Reinstate estuarine vegetation Broad Acre Corridor /Buffer Revegetation Promotion Natural Succession Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Hydrology Reinstate Tidal Inflows Establish Connective Flows</p> <p>Connectivity Install Fish Passage Rock Ramped Bund Outlets</p> <p>Monitoring Vegetation Condition Bird Counting Fish Community Water Quality</p>	<p>The majority of these properties are recent Department of Defence acquisitions. Most are being leased back to the original owners for continuing use as pastoral properties. Longer term the sustainable ecological management policies of the Defence Department (including the possibility of reducing the intensity or extent of property grazing use) provide good prospects for their engagement in improved wetland management outcomes. The lead time required to successfully engage with the Department of Defence is considered likely to be too long to occur within the current Greening Australia project. However given the large size, high values and substantive GBR ecosystem gains potentially associated with restorative management of this coastal property suite it is recommended that these prioritised sites be 'parked' as a target for future restorative management and for correspondence between potential management stakeholders to be initiated.</p>

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
FBA4_St Lawrence Wetlands	<p>Values:</p> <ul style="list-style-type: none"> Water bird habitat value Recreational and Aesthetic Values Size (km2) Assimilative capacity for nutrients and sediments Tidal and non-tidal Fisheries habitat Role in large-scale ecological functions and ecosystem services Contribution to supporting migratory species Role in biological connectivity Water Quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Priority Ecosystem Repair Sub-catchment in NRM WQIP Priority Wetland in NRM WQIP Identified in past Regional Wetland Prioritisation <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits (but high demonstration value) Outcome 2 (Coastal habitat health & resilience) modest benefits <p>Build on Past Investment: Significant past investment in fish passage provision, weed management and recreational/interpretive infrastructure</p> <p>Attracts Co-investment: Good opportunity due to local Government (Isacc) support, site profile and popularity including with domestic tourists.</p> <p>Demonstration Site/Profile: High. Supports low profile e.g. 'grey nomad' ecotourism. Issues associated with erosion of riparian corridor regionally relevant and lacking current demonstration site.</p> <p>Community Support/Engagement: High.</p> <p>Innovation: Limited, although some proposed restoration activities (e.g. riparian revegetation and grazing exclusion) have had limited demonstration in this region / community.</p> <p>Landholder Support: High based on past experience, subject to minimal interference with grazing use.</p>	<p>Geomorphic/Earth Works Rock Armor /Bund Stabilisation Extension /Education Extension Grazing Regime Management Install Interpretive Facilities Community Engagement Establish Access / Recreational Facilities Planning Catchment Works Plan Property Management Plan Pest Control Controlled Grazing Weed Control Vegetation Management Riparian revegetation Promotion Natural Succession Maintenance of Ground Cover Areas of Erosive Soils Protective Management Remnant Vegetation Hydrology Reinstate Tidal Inflows Establish Connective Flows Connectivity Install Fish Passage Monitoring Vegetation Condition Bird Counting Fish Community Water Quality</p>	<p>This site has been the target of a range of past and current management investment and is in relatively good condition. Works opportunities are predominantly associated with value adding rather than major restorative transformation. Both woody (prickly acacia and parkinsonia) and aquatic (hymenacne, para grass) weeds present ongoing maintenance costs that would benefit from further management resourcing.</p> <p>The primary new works opportunity lies with the degraded status of the riparian corridor of the main tributary drainage supplying the wetland. Management interventions that addressed the sheet, slope and bank erosion and poor vegetation condition (structural, floristic) of the tributary creek system would provide a great demonstration role for regionally significant issues. While most of the works area would be beyond the primary wetland site and out of the public eye the upper reaches of the system are crossed by the Bruce Highway and works in this reach would be highly visible. Biliban Station lies in the upper catchment of the site and presents an opportunity for project extension. Terrestrial biodiversity values including koala habitat and wildlife corridor connectivity would also be served by riparian rehabilitation.</p> <p>Inclusion of high priority fish passage barrier rectification at the proximal St Lawrence Creek weir in the project would add significantly to the scope of works but also to project dividends.</p> <p>The distance of the site from major centres would present some logistical costs and challenges.</p>

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
FBA9_Blacks Waterhole / Raglan Catchment	<p>Values:</p> <ul style="list-style-type: none"> Unique creek system- limestone catchment, groundwater supplied clear perennial baseflow in highly seasonal environment, aquatic refugia High aquatic macrophyte diversity Recognised recreational fishery and fishery nursery habitat Threatened turtle species (White Throated Snapping) Good aquatic habitat connectivity <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Identified in past Regional Wetland Prioritisation (CWPP) Priority Ecosystem Repair Subcatchment in NRM WQIP High Priority Grazing Subcatchment in NRM WQIP <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits (but high demonstration value) Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment in fish passage provision and aquatic (hymenachne) and riparian (rubbervine) weed control and riparian exclusion fencing.</p> <p>Attracts Co-investment: Limited to potential program overlap with FBA and possible in-kind support from landholders.</p> <p>Demonstration Site/Profile: Wetland site is high profile, though works would be predominantly out of public eye. Issue addressed by works regionally significant and warrant demonstration site.</p> <p>Community Support/Engagement: High level of community support and past engagement with site.</p> <p>Innovation: Limited (gully erosion control) but novel for region and requiring demonstration.</p> <p>Landholder Support: High, based on past experience.</p>	<p>Geomorphic/Earth Works Erosion Stabilisation Works Contour Banking Terracing and Revegetation of Cleared Sloping Land</p> <p>Planning Works Plan Riparian Management Agreements Remnant Vegetation Management Agreement Property Management Plan</p> <p>Pest Control Woody Weed Control- rubbervine</p> <p>Vegetation Management Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Monitoring Vegetation Condition Water Quality</p>	<p>The nature of works required at this site (stabilisation of gully and stream bank scalds /erosion) fall more readily within the scope of the FBA Reef Trust IV project. However, the direct connection between one principle source of sediment and fine colloids (blown out pasture pondage overflow) and water quality impacts to a high value and historically clearwater wetland site (Blacks Waterhole) bring it into the gambit of the current Greening Australia project, particularly for Reef Trust Outcome 2.</p> <p>It is believed that most identified works sites (pasture pondage and Blacks Waterhole bank erosion) lie on Raglan Station (this needs to be confirmed) which has a history of engagement with the FBA. Addressing this type of issue in this subcatchment conforms to FBA prioritisation in its WQIP. Proposed works could play an important role as a demonstration site for a regionally significant issue and funding support to address the issue may provide an impetus for Raglan Station to be more broadly engaged in an erosion/ grazing management plan, which could provide a template for adjoining and regional properties with similar management issues.</p> <p>Inclusion of rectification of two high priority fish passage barriers in the upper catchment of Raglan Creek in the project would add significantly to the scope of works and project dividends.</p> <p>Potential subdivision of land holdings in the project area may present some challenges to the project scope.</p>

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
FBA10_Neerkol Ck	<p>Values:</p> <ul style="list-style-type: none"> Upper catchment includes long reaches of perennial groundwater supplemented clearwater aquatic habitats which function as aquatic refugia in a highly seasonal environment System confluence with the Fitzroy is below the barrage and therefore has potentially high though largely unrealised fishery and fishery nursery habitat values. High aquatic macrophyte diversity Relatively good integrity riparian vegetation communities Valuable waterbird habitat Recreational use <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Identified in past Regional Wetland Prioritisation (CWPP) High Priority Farming Subcatchment in NRM WQIP <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Limited past investment at targeted reach though adjoining tributaries and discharge areas have been the focus of past investment in controlled wetland grazing and fish passage provision respectively.</p> <p>Attracts Co-investment: Potential for co-investment from community NRM (FBA), corporate (Stanwell Power) and local Government (Rockhampton) stakeholders</p> <p>Demonstration Site/Profile: Site peri urban therefore relatively high profile.</p> <p>Community Support/Engagement: Potential for increasing recreational and aesthetic amenity for multiple landholders could engender significant community support and engagement.</p> <p>Innovation: Limited. Although depends upon scope of works proposed. Provision of fish passage connectivity through anoxic seasonal wetland basin would require implementation of innovative methods.</p> <p>Landholder Support: Unknown will require significant extension to multiple small landholders.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Rock Armor /Bank Stabilisation Extension /Education Community Engagement Planning Catchment Management and Works Plan Pest Control Controlled Grazing Aquatic Weed Control Woody Weed Control Vegetation Management Riparian Revegetation Riparian / Wetland Fencing Promotion Natural Succession Hydrology Establish Connective Flows Reconfigure Drain Design / Drainage Network Connectivity Remove Structural Fish Passage Barriers Establish preferential flow path Install Fish Passage Remove Weed Chocks Address Anoxic Reach Conditions Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>Site values have not been documented by past prioritisation processes but are well recognised by local managers and regional experts (e.g. T. Marsden).</p> <p>Successful project implementation will require significant rural residential landholder engagement engendered by local government support. Potential stakeholder support levels need to be assessed as part of further project scoping.</p> <p>The primary focus for works is a 7km reach of weed choked and potentially anoxic stream channel with poor conditioned riparian overstorey vegetation downstream of Fairy Bowen Road. Numerous private stream crossings within this reach are also potential fish passage barriers. A combination of channel reinstatement, weed control, riparian revegetation and fish passage provision works are required in the targeted reach.</p> <p>An additional focus for potential works is the provision of enhanced fish passage connectivity beyond the discharge flood outs of the creek system onto the receiving Fitzroy River / Gavial Creek floodplain. This could potentially be achieved by reinstating channel connectivity to downstream lagoons and/or by formation of a preferential flow path channel through the seasonally anoxic pasture pondage that receives outflows from both Neerkol and Gavial Creek. The latter would deliver fishery benefits to both systems. Channel reinstatement and possible removal / modification of an upstream diversion structure could deliver flood management benefits to riparian landholders.</p> <p>The project site is close to Rockhampton and could be readily serviced from there. The engagement of up to 20+ riparian landholders could present challenges.</p>

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
FBA12_Twelve Mile Creek (Bajool)	<p>Values:</p> <ul style="list-style-type: none"> Threatened species (e.g. Yellow Chat) Waterbird numbers Recreational fishery and nursery habitat Recreational values (bird-watching, fishing). Of concern and threatened alluvial frontage Regional Ecosystems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Priority Wetland in NRM WQIP Identified in past (CWPP) Regional Wetland Prioritisation Priority Ecosystem Repair Subcatchment in NRM WQIP Medium Priority Grazing Subcatchment in NRM WQIP <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment in fish population tagging and monitoring, recreational access and interpretive facilities, weed control, revegetation, fire regime management and grazing control/fencing.</p> <p>Attracts Co-investment: Could draw co-investment from Local Government for crown reserve and potential eco-tourism components and/or fishery stakeholders.</p> <p>Demonstration Site/Profile: Site's popularity with fishing and birdwatching public and proximity to Bruce Highway and potential use as a highway stop for grey nomads provide relatively high profile. Demonstration value of proposed works limited though regionally relevant.</p> <p>Community Support/Engagement: Recreational fishing groups (Suntag) and broader community have been highly supportive of site investment previously. Potential for TO (Darumbal) engagement via developing Land and sea Ranger Program.</p> <p>Innovation: Limited, although some proposed restoration activities (e.g. riparian revegetation and grazing exclusion) have had limited demonstration in this region / community.</p> <p>Landholder Support: Site works have previously enjoyed local government and landholder support.</p>	<p>Geomorphic/Earth Works Erosion Stabilisation Works Contour Banking Extension /Education Extension Grazing Regime Install Interpretive Facilities Community Engagement Planning Catchment Management and Works Plan Remnant Vegetation Management Agreement Pest Control Controlled Grazing Aquatic Weed Control Controlled Burning Woody Weed Control Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation Maintenance of Ground Cover Areas of Erosive Soils Hydrology Establish Connective Flows Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Rock Ramped Bunds Remove Weed Chokes Address Anoxic Reaches Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>Past site investment has been focussed on two separate public tenure sites at the upstream and downstream margins of the current proposal. The current site proposal seeks to include the intervening reaches of 12 Mile Creek and to also extend the focus of wetland management to remnant vegetation assemblages on the adjoining coastal floodplain. This would entail significant engagement and support from the private landholder.</p> <p>Local Govt (Rockhampton regional), Main Roads and Q-Rail support would also be needed to conduct works across the entire site proposal. Engagement of Traditional Owners (Darumbal) for management delivery could serve their aspirations for Land and sea Ranger Program Development.</p> <p>The overall scope of works would be defined by the extent of the proposed site for which landholder support and engagement was possible. Expressions of interest from these stakeholders would be needed to further scope works.</p> <p>Principle potential works include: improvement in riparian and remnant vegetation condition via management of fire, grazing, weeds and erosion /salinity scalds and direct revegetation, improvement in fish passage via control of anoxic reach aquatic weeds and structural works to three pipe culverts and interpretive and recreational facilities for crown reserve areas.</p> <p>Combining this site proposal with the proximal 8 Mile Creek site proposal which has a closely related suite of works needs could provide the opportunity to develop a major regional investment program with some 'economy of scale' benefits.</p>

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
FBA13_Eight Mile Creek (Bajool)	<p>Values:</p> <ul style="list-style-type: none"> Threatened species (e.g. Yellow Chat) Waterbird numbers Recreational fishery and nursery habitat Of concern and threatened alluvial frontage Regional Ecosystems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Priority Ecosystem Repair Subcatchment in NRM WQIP Medium Priority Grazing Subcatchment in NRM WQIP <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits (but high demonstration value) Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Little to no past investment.</p> <p>Attracts Co-investment: Could draw co-investment from Local Government for any potential eco-tourism components and/or fishery improvements. Orica Explosives adjoining site may be interested in corporate sponsorship.</p> <p>Demonstration Site/Profile: Site's proximity to Bruce Highway and Port Alma Road could provide relatively high profile. Demonstration value of proposed works limited though regionally relevant.</p> <p>Community Support/Engagement: Recreational fishing groups highly supportive of proposed fish passage works. Active teachers doing environmental programs at Bajool School could provide avenue for environmental education engagement.</p> <p>Innovation: Limited, although some proposed restoration activities (e.g. riparian revegetation and grazing exclusion) have had limited demonstration in this region / community.</p> <p>Landholder Support: Unknown.</p>	<p>Geomorphic/Earth Works Erosion Stabilisation Works Contour Banking Extension /Education Extension Grazing Regime Community Engagement Planning Catchment Management and Works Plan Soil Conservation Plans Remnant Vegetation Management Agreement Pest Control Controlled Grazing Aquatic Weed Control Woody Weed Control Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation Maintenance of Ground Cover Areas of Erosive Soils Hydrology Establish Connective Flows Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Rock Ramped Bunds Remove Weed Chocks Address Anoxic Reach Conditions Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This site has not previously been prioritised specifically on the basis of wetland values or management needs other than a high profile fish passage barrier on the Port Alma Road. It was chosen opportunistically on the basis of recognised similarities with the proximal 12 Mile Creek site with which it shares many values and physical features.</p> <p>As per the 12 Miles creek site the overall scope of works would be defined by the extent of the proposed site for which landholder support and engagement was possible. Expressions of interest from these stakeholders would be needed to further scope works. Given the lack of past investment in the site and the numerous private landholders within the proposal area it is likely that somewhere in the order of 12 to 18 months engagement would be required before works could commence. This engagement could possibly be run in conjunction with earlier works delivery at the proximal 12 Mile Creek site.</p> <p>Principle potential works include: provision of fish passage at the Bajool weir on 12 mile Creek via construction of a cone fishway and on bunded reaches of the tributary 6 Mile creek system via rock ramping of coastal and instream bunds. Other nominated works include improvement in riparian and remnant coastal floodplain vegetation condition via management of fire, grazing, weeds and erosion /salinity scalds and direct revegetation.</p> <p>Fishway works on the main Port Alma road would require traffic control which increases cost significantly. Legislative requirements for provision of fish passage could see the current barrier rectified as part of any Port Alma Road upgrade.</p>

> Prioritised Candidate Sites Table 1. Fitzroy Basin NRM Region

Fitzroy Basin Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
FBA14_Lake Mary Complex	<p>Values:</p> <ul style="list-style-type: none"> Part of DIWA listed Hedlow Wetlands Waterbird numbers Aesthetic and eco-tourism values Recreational fishery and nursery habitat Significant wetland type <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Priority Wetland in NRM WQIP Identified in past (CWPP) Regional Wetland Prioritisation Priority Ecosystem Repair Subcatchment in NRM WQIP <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) limited benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: FBA has long history of engagement/investment in site as one of the original neighbourhood catchments. Focus has been on vegetation, grazing, salinity and weed management.</p> <p>Attracts Co-investment: Potential for co-investment from Local Government (Livingstone) who are seeking to promote eco-tourism values of region and site (Rockhampton's Kakadu). Local eco-tourism operation may be open to in-kind support.</p> <p>Demonstration Site/Profile: Site's popularity with fishing and birdwatching public and use for eco-tourism provide relatively high profile. Demonstration value of most proposed works limited though regionally and relevant to broader wetland site. Successful management approaches for salinity if implemented would be of high demonstration value for regional catchments.</p> <p>Community Support/Engagement: Likely to be favourable given past engagement. Recreational fisher and bird watching groups could potentially be engaged.</p> <p>Innovation: Limited, although some proposed restoration activities (e.g. riparian revegetation and grazing exclusion) have had limited demonstration in this region community. Successful management of salinity issue would require innovative methods.</p> <p>Landholder Support: Unknown. Maybe subject to perceived level of interference with grazing operation. Site includes reserve land.</p>	<p>Geomorphic/Earth Works Bank Erosion Stabilisation Works</p> <p>Extension /Education Community Engagement Establish Access / Recreational Facilities</p> <p>Planning Works Plan/site catchment plan</p> <p>Pest Control Aquatic Weed Control Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Broad Acre Corridor /Buffer Revegetation Controlled Grazing Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Hydrology Broad Acre Revegetation to Manage Groundwater Levels</p> <p>Connectivity Remove Structural Fish Passage Barriers (D/S) Remove Weed Chocks Address Anoxic Reach Conditions Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This site and the adjoining contiguous FBA15_Green Lake Complex comprise the DIWA listed Hedlow Wetlands one of the most significant floodplain wetland complexes in the Fitzroy basin. Despite recognised high values, multiple freehold land tenures and a range of ongoing land uses, and development aspirations continue to thwart delivery of integrated wetland management. Protective management of the site is beyond the capacity of the current program and falls within the jurisdiction of State and Local Government.</p> <p>The current site proposal provides an opportunity to demonstrate useful management techniques relevant to the broader wetland complex and to raise the profile of wetland management with local site and regional stakeholders.</p> <p>Principle potential works include: protective fencing and revegetation of riparian corridors degraded by uncontrolled vehicle access, enhanced recruitment and protective management of remnant vegetation, aquatic weed (Hymenachne) control, demonstration of grazing regime-based wetland management, broad acre revegetation approaches to salinity management, provision of recreational access and interpretative facilities.</p> <p>The viability of these proposed works would be contingent upon landholder and local government support which needs to be assessed as part of any further project scoping.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC1_Gregory River	<p>Values:</p> <ul style="list-style-type: none"> Discharges /Connectivity to HEV assets Condition / Integrity catchment Integrity of fish community. Wetland and vegetation representativeness Assimilative capacity for nutrients and sediments Recreational fishery and habitat Role in large-scale ecological functions and ecosystem services Contribution to supporting migratory species Role in biological connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Highest Priority System Repair CMA <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Very limited past investment (pest and weed/ rubber vine works)</p> <p>Attracts Co-investment: No ready sources identified but could include local government (incl. land acquisition fund), disaster recovery funding or sugar industry sources.</p> <p>Demonstration Site/Profile: The site adjoins the Bruce Highway and Dingo Beach access road and has a relatively high profile. While some individual works have a demonstration role, implementation of an ICM plan has the greatest potential.</p> <p>Community Support/Engagement: Supportive landcare group, previous engagement with graziers.</p> <p>Innovation: Limited for most proposed works. Management of dispersive soil erosion areas will require some innovation.</p> <p>Landholder Support: Largely untested.</p>	<p>Geomorphic/Earth Works</p> <p>Construction Detention Basins /Water Treatment Trains</p> <p>Erosion Stabilisation Works</p> <p>Contour Banking</p> <p>Terracing and Revegetation of Cleared Sloping Land</p> <p>Rock Armor /Bank Stabilisation</p> <p>Extension /Education</p> <p>Extension Grazing Regime Management</p> <p>Extension Practice Change (Cropping, Grazing, Burning)</p> <p>Planning</p> <p>Catchment Management and Works Plan</p> <p>Riparian Management Agreements</p> <p>Remnant Vegetation Management Agreement</p> <p>Property Management Plan</p> <p>Engagement with Statutory Planners</p> <p>Pest Control</p> <p>Controlled Grazing</p> <p>Aquatic Weed Control</p> <p>Woody Weed Control</p> <p>Vegetation Management</p> <p>Riparian Revegetation</p> <p>Broad Acre Corridor /Buffer Revegetation</p> <p>Fire Regime / Fuel Load Management</p> <p>Riparian / Wetland Fencing</p> <p>Controlled Grazing</p> <p>Promotion Natural Succession</p> <p>Protective Management Remnant Vegetation</p> <p>Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Hydrology</p> <p>Establish Connective Flows</p> <p>Wetlands in Upland Areas to Capture Runoff</p> <p>Improve Groundcover and Protect Riparian Areas On Porous Soils to Facilitate Recharge</p> <p>Increase Detention Time of Runoff</p> <p>Connectivity</p> <p>Remove Structural Fish Passage Barriers</p> <p>Install Fish Passage</p> <p>Rock Ramped Bund Outlets</p> <p>Remove Weed Chokes</p> <p>Address Anoxic Reach Conditions</p> <p>Monitoring</p> <p>Vegetation Condition</p> <p>Fish Community</p> <p>Water Quality</p>	<p>This site extends across an entire river catchment which currently represents one of the higher integrity (non-national park) drainage systems in the region but is under threat from ongoing land use intensification.</p> <p>Proposed works would best be encapsulated within an Integrated Catchment Management (ICM) planning context. Implementation of such an ICM plan would provide a highly valuable engagement exercise and demonstration role for other GBR catchments with a similar land use context. The merit of pursuing such a plan for the Gregory River is underpinned by the high ecological value (HEV) GBR ecosystem assets in the immediate receiving environment of its coastal discharge area and the regional prioritisation afforded to the site for system's repair.</p> <p>The scope of potential works within the catchment are broad and represent its diverse range of land uses which include conservation, cropping and grazing. The site would make a legitimate target for a major integrated project. Key management needs include: stabilisation of sheet and bank erosion on dispersive sodic soils, grazing regime management, riparian vegetation management and restoration including woody and aquatic weed management, river bank stabilisation, protective management of remnant floodplain vegetation, revegetation of buffer areas, agricultural runoff detention areas and treatment trains, provision of fish passage at structural (e.g. Patullo Rd priority site) and anoxic reach barriers and property management planning and extension.</p> <p>Reef Catchments (Sel Grey) has done some preliminary management planning for the catchment and has identified some potential works and landholder contacts. There are only a limited number of grazer landholders in the catchment and these have previously been engaged.</p> <p>Government departmental investment in the catchment has included DNRM mapping of waterhole by the Environmental Flow Assessment Program. Canvassing of landholder and industry support for implementing an ICM plan for the catchment is required to support further project scoping.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC2_Myrtle Creek / Borellini Rd	<p>Values:</p> <ul style="list-style-type: none"> Assimilative capacity for nutrients and sediments Role in biological connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> High Water Quality Improvement Priority CMA <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits (but high demonstration value) Outcome 2 (Coastal habitat health & resilience) modest benefits (but high demonstration value) <p>Build on Past Investment: Only that of the private landholder which has been significant in developing a wetland retention basin</p> <p>Attracts Co-investment: Potential from industry sources.</p> <p>Demonstration Site/Profile: Good, high. Site is readily accessible, 2km off Bruce Highway and adjoins a local service road (Borellini Rd). Individual concerned is recognised amongst peers for adoption of BMP.</p> <p>Community Support/Engagement: Within industry high, area has a progressive, supportive productivity board.</p> <p>Innovation: Limited at a state level, but within regional industry significant.</p> <p>Landholder Support: Very High, considered Class A practices individual.</p>	<p>Geomorphic/Earth Works Construction Detention Basins /Water Extension /Education Community Engagement Planning Works Plan Riparian Management Agreements Pest Control Aquatic Weed Control Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Promotion Natural Succession Hydrology Wetlands in Upland Areas to Capture Runoff Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Remove Weed Chokes Address Anoxic Reach Conditions Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This relatively small site provides a good opportunity to engage with the local sugar industry in promoting the water quality management and habitat benefits of constructed wetland basins in a Catchment Management Area (CMA) prioritised regionally for water quality improvement. The landholder concerned is recognised as being an 'early adopter' and current 'BMP' practitioner with good peer standing. The landholder has privately invested in the construction of a farm wetland basin but lacks the capacity to revegetate it.</p> <p>A developed works plan for the site could include: revegetation of the wetland basin riparian zone ideally with an extended focus downstream through the degraded creek corridor to its confluence with Myrtle Creek; facilitation of fish passage past the wetland embankment, weed choked reaches and the Borellini Road crossing to the confluence with Myrtle Creek; aquatic weed management, development of and commitment to a Riparian Management Agreement to maintain habitat benefits, fish community, vegetation condition and water quality monitoring and interpretive material / promotional events to engage the broader cane farming community of the CMA and region.</p> <p>Phillip Trendell, senior project officer (DAF Reef Extension Mackay Whitsundays) has lead engagement with the landholder of this site and provides the most appropriate first point of call for further scoping of this potential project.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC4_Calen / St Hellens Creek	<p>Values:</p> <ul style="list-style-type: none"> Discharges to HEV assets Perennial baseflow system (few) Species richness/diversity Wetland and vegetation representativeness Rec fishery and fisheries habitat 2nd Highest regional fish community health rating Aesthetic and recreational values Role in large-scale ecological functions and ecosystem services Supports migratory species Role in biological connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Highest Priority System Repair CMA Regional Source of Major Sediment Load from Channel Erosion <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Limited, some revegetation.</p> <p>Attracts Co-investment: Potential for partnering with Reef Catchments and local government.</p> <p>Demonstration Site/Profile: High, site adjoins highway and experiences high level of community recreational use, including as site of regional festival.</p> <p>Community Support/Engagement: Not tested, but due to site popularity expected to be high.</p> <p>Innovation: Limited, largely revegetation project.</p> <p>Landholder Support: Untested.</p>	<p>Geomorphic/Earth Works Construction Detention Basins /Water Treatment Trains Erosion Stabilisation Works Rock Armor /Bank Stabilisation</p> <p>Extension /Education Community Engagement Establish Access / Recreational Facilities</p> <p>Planning Catchment Management and Works Plan Riparian Management Agreements Engagement with Statutory Planners Land Purchase</p> <p>Pest Control Non-Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Wetlands on Tributary Areas to Capture Runoff</p> <p>Connectivity Install Fish Passage</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This proposal is for a large-scale riparian revegetation program on a regionally iconic creek system that discharges to high ecological value assets including a declared Fish Habitat Area and near shore seagrass meadows. Additional works opportunities lie in the potential for bank stabilisation works, establishing farm drainage treatment trains/ constructed wetland basins, woody weed control, addressing fish passage needs on tributary systems and establishing recreational access facilities and infrastructure.</p> <p>St Hellen's Creek is one of a few perennial base flowing creek systems in the region. It has a pristine upper catchment within national park and a high integrity estuary within a declared Fish Habitat Area. The intervening creek system has historically been over cleared of its riparian vegetation and has consequently endured bank instability and channel geomorphic impacts. Its perennial clear flows have made it a popular recreational area and also underpin some of its ecological values including a diverse and high integrity fish community.</p> <p>Restoration works on this system are likely to be popular with the community. Alluvium Pty Ltd have already conducted a geomorphic investigation of the system and identified some priority works sites. This work has also confirmed that the creek system is a major contributor of elevated sediment loads.</p> <p>Significant investment and demonstration of restorative management in this high-profile system could pave the way for increased adoption of equivalent practices on other less high profile creek systems within the broader CMA which has received the highest regional priority for systems repair.</p> <p>Reef Catchments and Local Government are potential partners for investment in this system.</p> <p>Phillip Trendell, senior project officer (DAF Reef Extension Mackay Whitsundays) is supportive of investment in this system and has identified some site opportunities for farm drainage treatment trains. Mackay City Council have also proposed a fishway for Niddoe Creek a tributary system.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC7_Benholme Lagoons	<p>Values:</p> <ul style="list-style-type: none"> • Drainage discharges via Pioneer Basin to HEV coastal assets i.e. drying reef and sea grass meadows. • Rare example of Pioneer floodplain deepwater lagoon systems. • Water bird habitat value • Wetland representativeness • Assimilative capacity for nutrients and sediments • Role in large-scale ecological functions and ecosystem services • Role in biological connectivity • Water Quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> • High Water Quality Improvement Priority CMA <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> • Outcome 1 (WQ entering GBR) modest benefits • Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Yes. Has been the site for a significant Green Corps revegetation program previously.</p> <p>Attracts Co-investment: Potential from local Govt (Reserve tenure).</p> <p>Demonstration Site/Profile: High profile site adjoining Mackay – Eungella highway.</p> <p>Community Support/Engagement: Untested but precedents suggest potentially good.</p> <p>Innovation: Limited, though management of lagoon basin aquatic weeds provide opportunities.</p> <p>Landholder Support: Unsure, but past precedents.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Construction Detention Basins /Water Treatment Trains</p> <p>Extension /Education Extension Grazing Regime Management Install Interpretive Facilities? Community Engagement</p> <p>Planning Catchment Management and Works Plan Riparian Management Agreements Remnant Vegetation Management Agreement</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Aquatic Weed Mat Excavation / Mechanical Harvesting</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Establish Connective Flows Increase Detention Time of Runoff</p> <p>Connectivity Remove Structural Fish Passage Barriers (D/S) Install Fish Passage Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This high profile site believed to be on public land (needs to be confirmed) adjoins the Mackay - Eungella Highway and contains a relatively rare wetland type (Pioneer Floodplain lagoon formed as a distributary of Cattle Creek / tributary of MacGregor Creek) which has been the focus of significant past investment in revegetation. Further follow up investment in this site could realise major ecosystem gains and deliver a high-profile demonstration of floodplain lagoon restoration within an agriculture dominated catchment. Combined with site interpretation and promotion this could serve to engender further restoration of these floodplain wetland assets in the region.</p> <p>Ecosystem and water quality benefits potentially associated with site works are tempered by a limited contributing catchment area and downstream fish passage barriers. However, the former also provides a good opportunity to monitor water quality processing by the site and the latter are subject to longer term rectification programs.</p> <p>Site works opportunities depend upon the size and extent of the defined site boundary. Extension downstream via other degraded lagoon basins would improve connectivity to MacGregor Creek and extension upstream could present opportunities for farm drainage water quality interventions.</p> <p>The main site works proposed are riparian revegetation and management. The size of the site could engender the use of broad acre techniques including controlled grazing. Reinstatement of the lagoon basins and management of aquatic weed reinfestation potential would deliver rare floodplain deepwater habitats. Adjoining terrestrial vegetation remnants add to the potential biodiversity conservation dividends of site works. Local government would be a key partner in delivering this project.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC9_Lower Bakers Creek - Paget	<p>Values:</p> <ul style="list-style-type: none"> Discharges to HEV marine assets - drying reef and sea grass meadow. Water bird habitat value Populations of rare or threatened taxa Assimilative capacity for nutrients and sediments Fisheries habitat Role in large-scale ecological functions and ecosystem services Contribution to supporting migratory species Role in biological connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> High Water Quality Improvement Priority CMA Stormwater quality management = Priority Management Action in Regional Plan <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant investment by Reef Catchments, local Government and developers in flood mitigation and water quality treatment train in broader catchment.</p> <p>Attracts Co-investment: Good opportunity for co-investment with local government including via developer contributed levee funds.</p> <p>Demonstration Site/Profile: High. Adjoins highway and populated areas.</p> <p>Community Support/Engagement: Untested.</p> <p>Innovation: High for flood detention basin ecological design.</p> <p>Landholder Support: Untested, some i.e. local government good.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Construction Detention Basins /Water Treatment Trains Erosion Stabilisation Works Breach / Lower Bunds Breach / Lower Levees Engineered Structure</p> <p>Extension /Education Community Engagement</p> <p>Planning Catchment Management and Works Plan Engagement with Statutory Planners Land Purchase</p> <p>Pest Control Aquatic Weed Control Woody Weed Control Non-Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Reinstate estuarine vegetation Promotion Natural Succession</p> <p>Hydrology Reinstate Tidal Inflows Divert Flows Establish Connective Flows Wetlands in Upland / Tributary Areas to Capture Runoff Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage</p> <p>Monitoring Vegetation Condition Fish Community Water Quality Water Flows / Levels</p>	<p>This large site is within Mackay City limits and includes numerous works opportunities that have the potential to deliver significant water quality benefits within a catchment management area (CMA) prioritised for water quality improvement. Proposed works primarily concern the management of stormwater from industrial, urban and agricultural catchment areas that currently discharges with little opportunity for wetland process-based treatment directly to receiving estuarine channels exporting contained contaminant loads to near inshore reefs and seagrass beds.</p> <p>Preliminary, non-exhaustive investigations have identified two sites (Cook's Lane, Council Paget Depot) with potential to form large constructed detention basins that with incorporated wetland habitat features could provide enhanced retention of contaminant loads and additional wetland ecosystem services e.g. fishery and waterbird habitats. In contrast to the lack of detention in the Paget urban drainage network other areas of the proposed site (e.g. Farellys Rd) are comprised of high value remnant paperbark and salt couch wetlands that have artificial intertidal bunds inhibiting stormwater drainage and natural brackish habitat tidal and biological connectivity. Lowering of these bunds and re-instatement of tidal connectivity to these wetlands would provide fishery, water quality and stormwater management benefits.</p> <p>The Mackay City Council is a prerequisite partner for this proposal. They also have significant co-investment funds available via their developer levee scheme that could be used for stormwater management proposals. Reef Catchments also have a history of working in this catchment and have previously developed a conceptual detention basin proposal for the Cook's Lane site.</p> <p>This proposal is very attractive from a demonstration site perspective. Development in low lying wetland areas and associated stormwater management challenges are a key issue in the region. While substantive investment would be required to deliver the types of works proposed for this site the water quality benefits could also be substantial.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC12_Sandy Creek Catchment – Orphanage Lagoon – Mirani	<p>Values:</p> <ul style="list-style-type: none"> Discharges to HEV assets i.e. areas of drying reef and sea grass meadow. Wetland representativeness - Rare intact example of deepwater floodplain lagoon with contiguous floodplain vegetation. Vegetation representativeness - Endangered and of concern regional ecosystem remnants on alluvial soils. Water bird habitat value Species richness/diversity Assimilative capacity for nutrients and sediments Indigenous and Recreational values Role in large-scale ecological functions and ecosystem services incl. biological connectivity Contributes to supporting migratory species Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> High Water Quality Improvement Priority CMA <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Yes, Reef Catchments, Mackay Regional Council, Green Army Corps in weed control and revegetation.</p> <p>Attracts Co-investment: Potentially from Local Government.</p> <p>Demonstration Site/Profile: Yes, medium profile, high within producer community.</p> <p>Community Support/Engagement: Good.</p> <p>Innovation: Limited but high for local catchment.</p> <p>Landholder Support: Good for central site, private landholders untested.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Construction Detention Basins /Water Treatment Trains</p> <p>Extension /Education Extension Grazing Regime Management Install Interpretive Facilities Community Engagement Establish Access / Recreational Facilities</p> <p>Planning Catchment Management and Works Plan Riparian Management Agreements Remnant Vegetation Management Agreement Engagement with Statutory Planners</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Aquatic Weed Mat Excavation Mechanical Harvesting Woody Weed Control Non-Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Establish Connective Flows Wetlands in Upland / Tributary Areas to Capture Runoff Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality Water Flows / Levels</p>	<p>This proposal is centred on a high value floodplain lagoon and vegetation remnant in a local government reserve within one of the most intensively developed and poorest water quality performing Catchment Management Areas (CMA) in the broader Pioneer River floodplain.</p> <p>The central site is already the focus of a Mackay regional Council Management Plan that has seen past investment in weed control and revegetation. Traditional Owners have been engaged in past works and have an active interest in further management initiatives. There are significant further works opportunities at this site including a second lagoon basin requiring weed mat excavation and implementation of best management practices for the floodplain vegetation remnant including woody weed control and potentially controlled grazing and burning regimes. The site also has significant nature education and recreation potential and would be suited to recreational facility establishment.</p> <p>From reserve site, the boundary and scope of potential works radiates upstream (to urban) and downstream (through caneland) across the floodplain limited only by resourcing and landholder engagement.</p> <p>The principal focus would be on establishing riparian vegetation and constructed wetland basins/treatment trains on the farm drainage network which comprises the upper catchment of Sandy Creek which has been long cleared of the majority of its riparian vegetation. Within this drainage network there are remnant natural wetlands requiring reinstatement and excavated basins / pump sumps suited to revegetation.</p> <p>This CMA has one of the (4th) lowest riparian vegetation retention rates and coincidentally poorest water quality in the region. Monitoring of water quality within revegetated and treatment /control drains and communication of results would be an important component of works.</p> <p>A secondary aim of revegetation initiatives would be to provide terrestrial habitat corridors between proximally located floodplain habitat remnants including those to the south adjacent Kinchant Dam and links to the uppermost extent of the existing riparian vegetation corridor on Sandy Creek.</p> <p>Mackay Regional Council and Reef Catchments represent prerequisite partners for this proposal.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC13_Oaky Creek	<p>Values:</p> <ul style="list-style-type: none"> • Broader catchment discharges to HEV assets i.e. areas of drying reef and sea grass meadow. • Assimilative capacity for nutrients and sediments • Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> • High Water Quality Improvement Priority CMA • Regional Source of Major Sediment Load from Channel Erosion <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> • Outcome 1 (WQ entering GBR) significant benefits • Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Limited within this subcatchment, significant within broader system.</p> <p>Attracts Co-investment: System is recipient for disaster funding which could provide works co-investment.</p> <p>Demonstration Site/Profile: Adjoins major (Eton-Homebush) Road, riparian revegetation little implemented in catchment, could provide effective demonstration site.</p> <p>Community Support/Engagement: Local catchment and community NRM potentially good.</p> <p>Innovation: Regionally significant. Opportunity to promote innovative integration hard and soft engineering.</p> <p>Landholder Support: Untested. Reservations held by some re: riparian revegetation.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Erosion Stabilisation Works Rock Armor /Bank Stabilisation Engineered Structures Extension /Education Community Engagement Planning Catchment Management and Works Plan Pest Control Aquatic Weed Control Woody Weed Control Non-Woody Weed Control Vegetation Management Riparian Revegetation Promotion Natural Succession Maintenance of Ground Cover Areas of Erosive Soils Hydrology Establish Connective Flows Revegetation and / or Structures to Baffle Overland Flow Velocities Monitoring Vegetation Condition Channel Stability</p>	<p>The Oaky Creek subcatchment is one of the most degraded within the broader Sandy Creek catchment. It has been historically over cleared of its riparian vegetation and bank and channel degradation including infilling have resulted in stream channel avulsion through adjoining cane land during periods of high flow. The subcatchment is also a recognised source of sediment loads both coarse and suspended that contribute to the overall poor water quality performance of the Sandy Creek catchment.</p> <p>In the Mackay Region floods of March 2017 significant impacts were incurred by local farms and road infrastructure and the system has been targeted as a recipient for flood disaster funding which include proposals to reinstate the channel and bank stability of the creek system.</p> <p>The primary works proposal for this site is a major riparian revegetation program designed to integrate with the 'hard' engineering of the proposed bank stabilisation and channel reinstatement works. There could also be some opportunity to pursue restoration of instream habitat features.</p> <p>The broader Sandy Creek catchment has the 4th lowest rate of riparian vegetation retention in the region and many landholders retain less than supportive views of the functional role and merit of riparian vegetation corridors particularly within the context of revegetation needs. This project could provide a positive demonstration of the system changing benefits or riparian revegetation in the local CMA and region.</p> <p>Preliminary assessment of geomorphic features of the Creek system have been conducted by Alluvium Pty Ltd. Mackay Regional Council, Reef Catchments and Sugar industry bodies would represent good partners for this proposal.</p>

> Prioritised Candidate Sites Table 2. Reef Catchments (Mackay- Whitsunday) Region

Reef Catchments Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
RC14_Sandringham Lagoons & Catchment	<p>Values:</p> <ul style="list-style-type: none"> Discharges to HEV assets i.e. areas of drying reef and sea grass meadow. Wetland representativeness - Rare intact example of deepwater floodplain lagoon with contiguous floodplain vegetation. Vegetation representativeness - Endangered and of concern regional ecosystem remnants on alluvial soils Water bird habitat value Species richness/diversity Assimilative capacity for nutrients and sediments Fishery values and nursery habitat Role in large-scale ecological functions and ecosystem services incl. connectivity Contribution to supporting migratory species Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Priority CMA Water Quality Improvement <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Yes, significant investment (weed mat excavation) during Coastal Wetland Protection Program and ongoing council funded aquatic weed management.</p> <p>Attracts Co-investment: Reef Catchments and Mackay regional Council potential co-investors</p> <p>Demonstration Site/Profile: Potentially for treatment train/detention basin. Medium profile</p> <p>Community Support/Engagement: Good for previous works programs.</p> <p>Innovation: Good, if treatment train implemented.</p> <p>Landholder Support: Supportive landholders distributed across site.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Construction Detention Basins /Water Treatment Trains Breach / Lower Bunds Rock Armor /Bank Stabilisation</p> <p>Extension /Education Extension Grazing Regime Management Community Engagement</p> <p>Planning Catchment Management and Works Plan Riparian Management Agreements Remnant Vegetation Management Agreement Engagement with Statutory Planners</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Aquatic Weed Mat Excavation Mechanical Harvesting Woody Weed Control Non-Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Establish Connective Flows Wetlands in Upland / Tributary Areas to Capture Runoff Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Rock Ramped Bund Outlets Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>The nominal boundary of this works proposal extends upstream and downstream of Sandringham Lagoon which has been the focus of previous wetland management investment at this site. This extended area encapsulates an entire floodplain catchment including drainage depressions within cane lands in the upper catchment, floodplain distributaries leading to a deepwater lagoon which links via more defined creek corridor to tidal estuary complex which includes interface sedge and paperbark swamps. This extended site boundary presents a broad scope of possible works across this representative floodplain catchment.</p> <p>Previous investment under the CWPP recovered the main lagoon from ecosystem collapse associated with weed mat coverage. Sustained aquatic weed management has maintained open water habitats which have been shown to be utilised by migratory fish species.</p> <p>Further management works could capitalise upon these previous ecosystem gains and extend management efforts into the water quality /contaminant load of contributing catchment areas, the connectivity and riparian condition of the stream channel linking the lagoon to the estuary, the management of floodplain vegetation remnants and the connectivity and condition of potential fishery nursery areas and supra tidal swamps adjoining the estuary.</p> <p>A potentially suitable site for a large-scale detention basin/ water quality treatment train has been identified upstream of Sandringham Lagoon. With landholder and sugar industry support this could provide a good demonstration site, for works required more broadly across the regional floodplain.</p> <p>The floodplain and supratidal vegetation remnants (including potential fishery nursery habitat) associated with this site add significantly to its biodiversity conservation value as a proposal.</p> <p>Negotiating public access to the lagoon for nature appreciation / recreation could engender additional community support.</p> <p>Mackay Regional Council, Reef Catchments and Sugar industry bodies would represent good partners for this proposal.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT4_Cassidy Creek	<p>Values:</p> <ul style="list-style-type: none"> Ecological value recognised by AquaBAMM Wetland representativeness – Lower Burdekin River tributary creek with relatively good condition riparian communities; channel hosted perennial deepwater habitats; and contiguous floodplain vegetation remnants. Fishery values and nursery habitat – creek confluence with Burdekin is below regional fish passage barrier (Clare Weir) Fish species richness/diversity Contribution to supporting migratory species Water bird habitat value Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity incl. for terrestrial fauna with links to Stokes Range. Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site recognised as regionally significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Past investment in irrigation method trials and management.</p> <p>Attracts Co-investment: Potential co-investment opportunity with Sunwater</p> <p>Demonstration Site/Profile: Potential high but profile and access limited.</p> <p>Community Support/Engagement: Untested</p> <p>Innovation: Potential high around groundwater, salinity and bioreactor proposals.</p> <p>Landholder Support: Untested.</p>	<p>Geomorphic/Earth Works</p> <p>Reinstate /Excavate Channel Sediment Extraction Construction Detention Basins /Water Treatment Trains Erosion Stabilisation Works Contour Banking Engineered Structure</p> <p>Extension /Education</p> <p>Extension Grazing Regime Management Establish Access / Recreational Facilities</p> <p>Planning / Engagement</p> <p>Catchment Management and Works Plan Riparian Management Property Management Plan</p> <p>Pest Control</p> <p>Controlled Grazing Controlled Burning Aquatic Weed Control Aquatic Weed Mat Excavation Woody Weed Control</p> <p>Vegetation Management</p> <p>Riparian Revegetation Broad Acre Corridor /Buffer Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Hydrology</p> <p>Broad Acre Revegetation to Manage Groundwater Levels Reconfigure Drain Design / Drainage Network</p> <p>Connectivity</p> <p>Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring</p> <p>Vegetation Condition Bird Counting Fish Community Water Quality Groundwater Levels /Quality</p>	<p>The high ecological values of this remnant floodplain creek system have been long recognised. Some of its attributed values i.e. perennial deep-water habitats are associated with the hydrologically modified status of its contributing catchment area which hosts the Elliot Main channel of the Burdekin Haughton Water Supply Scheme. Farm irrigations losses, channel overflow and possibly channel seepage are contributing to local groundwater rise, associated salinity issues and aseasonal discharges to the creek system.</p> <p>These discharges maintain a range of channel hosted wetlands that vary in condition in relation to weediness, depth and riparian forest cover. Salinity and nutrient levels in contributed catchment inflows may also mediate wetland condition.</p> <p>Farm layout in the contributing catchment area results in tailwater discharges being contributed to the creek drainage network via a limited number of areal drains. This configuration and the presence of sandy soils overlying clays, could present opportunities for effective use of constructed wetland bioreactors to mitigate nitrate load contributions.</p> <p>However, the effectiveness of bioreactors could be undermined by salinity levels in tailwater discharges. Sunwater have been looking at opportunities to dewater rising saline groundwater aquifers via accentuated discharge to the creek system.</p> <p>Sunwater are prepared to expend substantive funds in examining such options. Discharge of saline water to the system may not be incompatible with establishing or maintaining high ecological values in the channel hosted wetlands of the system. Combined with additional management efforts addressing catchment nutrient loading, riparian revegetation, aquatic weed management, fish passage, woody weeds, soil erosion and remnant vegetation management the Cassidy Creek system could provide a model example of modified floodplain catchment managed for ecosystem services.</p> <p>David Russell from Sunwater provides a first point of communication for examining co-investment opportunities for some of this project's potential scope. Industry bodies such as Canegrowers and local irrigation committees and local NRM groups such as Lower Burdekin Landcare & BBIFMAC would also represent good project partners.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT5_Stokes Creek	<p>Values:</p> <ul style="list-style-type: none"> Wetland representativeness – Lower Burdekin River tributary creek with relatively intact riparian communities; channel hosted perennial habitats; and contiguous floodplain vegetation remnants. Fishery values and nursery habitat – creek confluence with Burdekin is below regional fish passage barrier (Clare Weir) Assimilative capacity for nutrients and sediments Water quality benefit D/S Systems Terrestrial habitat corridor with links to Stokes Range. <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site recognised as regionally significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits but high demonstration potential. Outcome 2 (Coastal habitat health & resilience) modest benefits <p>Build on Past Investment: No past investment for wetland management.</p> <p>Attracts Co-investment: Limited.</p> <p>Demonstration Site/Profile: Potential high but profile and access limited.</p> <p>Community Support/Engagement: Untested</p> <p>Innovation: Potential high around bioreactor proposals.</p> <p>Landholder Support: Untested.</p>	<p>Geomorphic/Earth Works Construction Detention Basins /Water Treatment Trains</p> <p>Extension /Education Extension Grazing Regime Management</p> <p>Planning / Engagement Riparian Management Property Management Plan</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Woody Weed Control</p> <p>Vegetation Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Hydrology Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This site occurs in relative close proximity (6km downstream along the Burdekin River) to the previous NQDT4_Cassidy Ck site and represents a smaller, lower valued version of that site occurring in an equivalent landscape context (Burdekin tributary stream with channel hosted pool habitats and habitat corridor linkages to Stokes Range) but lacking the Sunwater irrigation scheme modified upper catchment area.</p> <p>Stokes Ck does contain private irrigated caneland development and the tailwater from farm development discharges to the Stokes Ck drainage network via a small number (~3) of drainage depressions that appear to present good opportunities for the development of a constructed wetland treatment train and/or constructed wetland bioreactors that could serve to intercept nitrate and other contaminant loads contributed to the system.</p> <p>The limited, contained nature of farm development would enable the impact of management interventions on receiving wetland condition to be readily assessed. The potential of the site for such a demonstration / trial is the principle reason for its prioritisation. However, pursuing tailwater quality treatment is also proposed as an opportunity to engage catchment landholders in improved management of the tributary creek system's broader ecological values and condition.</p> <p>Steven and Dave Poley and Roger Piva were identified as the landholders believed to be associated with these farms. BBIFMAC were nominated as a suitable local NRM group partner for engaging in land practice change and habitat restoration works at the site.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT6_SeaForth	<p>Values:</p> <ul style="list-style-type: none"> High fishery nursery habitat values Contribution to supporting migratory species Water bird habitat value Cultural values Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site in system prioritised for repair in NQDT WQIP (2017) Site recognised as regionally significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: No past investment in specific site but contiguous system long term history of past investment</p> <p>Attracts Co-investment: Potential co-investment opportunity with Burdekin Water Board? (flooding benefit) or Rec Fishing Organisations (e.g. Oz Fish Unlimited?)</p> <p>Demonstration Site/Profile: Potential high, bund removal and/or modification key regional issue but profile and access limited.</p> <p>Community Support/Engagement: Untested but likely to be high in rec fishing community.</p> <p>Innovation: Landholder Support: Untested, but elderly with limited capacity</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Breach / Lower Bunds Rock Armor /Bank Stabilisation</p> <p>Extension /Education Community Engagement</p> <p>Planning Catchment Management and Works Plan</p> <p>Pest Control Controlled Grazing</p> <p>Vegetation Management Reinstate estuarine vegetation Broad Acre Corridor /Buffer Revegetation Riparian / Wetland Fencing Promotion Natural Succession</p> <p>Hydrology Reinstate Tidal Inflows Establish Connective Flows</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Rock Ramped Bund Outlets</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>Restorative management of the extensive bunded coastal wetland systems in the lower Burdekin Region has long been a nominated regional priority for improved water quality, fishery and coastal ecosystem resilience outcomes. Opportunities to restore bunded wetland systems are confounded by landholder vested interest in the perceived salt water intrusion and/or pasture productivity benefits for which they were originally established.</p> <p>This 'Seaforth' property site proposal lies within the upper tidal reaches of the Plantation Creek estuary a system regionally prioritised for repair. Historically established tidal exclusion bunds within the site have been breached but now only allow limited tidal flushing with upper estuarine reaches that were historically mangrove forests. Aerial photo interpretation of mangroves and other estuarine communities upstream of the breached bund walls suggests that they are being stressed by water quality conditions possibly including hypersalinity and/or excessive freshwater/low salinity associated with poor tidal flushing. Exposed mudflats upstream of the bund walls also suggest that there has been sedimentation within the bunded reaches associated with reduced tidal flushing and flood flows. The reasons underpinning the state of disrepair of the bund walls have not yet been ascertained but it has been suggested that the landholders concerned may have reduced management capacity associated with their elderly status.</p> <p>Complete removal of the breached bund walls would facilitate enhanced tidal flushing, promote channel reinstatement, mangrove regrowth, insitu water quality improvement, enhanced water quality treatment and enhanced fishery nursery functions. Monitoring of restored systems could provide good information for justifying equivalent works on other bunded coastal systems and would be a boon for regional coastal wetland management efforts.</p> <p>Communication with landholders to ascertain interest levels in such management proposals is the first requirement for further scoping this proposal. Management and works proposals that could enhance site grazing productivity and serve as an incentive for landholder engagement should form part of initial discussions with landholders e.g. fencing infrastructure, additional watering points etc.</p> <p>The commercial and recreational fishery benefits of this proposal specifically, and bund removal generally, could provide a strong incentive for engaging recreational fishing organisation (e.g. Oz Fish Unlimited) in project co-investment.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT7_RitalIslandBunds	<p>Values:</p> <ul style="list-style-type: none"> High fishery nursery habitat values Contribution to supporting migratory species Water bird and wader bird habitat value Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site in system prioritised for repair in NQDT WQIP (2017) Site recognised as regionally significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: No past investment in specific site</p> <p>Attracts Co-investment: Potential co-investment opportunity with Rec Fishing Organisations (e.g. Oz Fish Unlimited?)</p> <p>Demonstration Site/Profile: Potential high, bund removal and/or modification key regional issue. Site has high profile and good access adjoining a popular boat ramp.</p> <p>Community Support/Engagement: Untested but likely to be high in rec fishing community.</p> <p>Innovation:</p> <p>Landholder Support: Untested.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Erosion Stabilisation Works Contour Banking Breach / Lower Bunds Rock Armor /Bank Stabilisation</p> <p>Extension /Education Install Interpretive Facilities Community Engagement</p> <p>Planning Catchment Management and Works Plan Property Management Plan</p> <p>Vegetation Management Reinstate estuarine vegetation Broad Acre Corridor /Buffer Revegetation Promotion Natural Succession</p> <p>Hydrology Reinstate Tidal Inflows Establish Connective Flows Wetlands in Upland Areas to Capture Runoff</p> <p>Connectivity Install Fish Passage Rock Ramped Bund Outlets Remove Weed Chocks Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Bird Counting Fish Community Water Quality</p>	<p>The context for this site proposal is similar to the preceding NQDT6_SeaForth. As discussed for that site, opportunities to restore bundled wetland systems are confounded by landholder vested interest in the perceived salt water intrusion and/or pasture productivity benefits for which they were originally established.</p> <p>This Rita Island site proposal lies within the upper tidal reaches of the Burdekin River estuary within a system regionally prioritised for repair. Historically established tidal exclusion bunds within the site have been breached but now only allow limited tidal flushing with upper estuarine reaches that were historically mangrove forests. Rita Island has experienced some of the greatest losses of upper estuary mangrove extent in the region. Aerial photo interpretation of tidal reaches upstream of the breached bund walls suggests that mangroves in these areas were historically cleared and that recolonisation is being impeded by seasonal water quality conditions possibly including hypersalinity and/or excessive freshwater/low salinity associated with poor tidal flushing.</p> <p>The reasons underpinning the state of disrepair of the bund walls have not yet been ascertained but it has been suggested that their legal status may of originally been dubious and/or they occur on public tenure land that has prevented opportunities for their re-instatement.</p> <p>Complete removal of the breached bund walls would facilitate enhanced tidal flushing, promote channel reinstatement, mangrove regrowth, insitu water quality improvement, enhanced water quality treatment and enhanced fishery nursery functions. Monitoring of restored systems could provide good information for justifying equivalent works on other bundled coastal systems and would be a boon for regional coastal wetland management efforts.</p> <p>Clarification of the land tenure and legal status of the structures and communication with landholders to ascertain interest levels in such management proposals is the first requirement for further scoping this proposal. Management and works proposals that could enhance site grazing productivity and serve as an incentive for landholder engagement should (if required to proceed with works) form part of initial discussions with landholders e.g. fencing infrastructure, additional watering points etc.</p> <p>The commercial and recreational fishery benefits of this proposal specifically, and bund removal generally, could provide a strong incentive for engaging recreational fishing organisation (e.g. Oz Fish Unlimited) in project co-investment.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT8_Plantation Creek Distributary	<p>Values:</p> <ul style="list-style-type: none"> Wetland representativeness – Lower Burdekin River floodplain distributary with channel hosted deepwater lagoons and remnant vegetation assemblages. Fishery and fishery nursery habitat values Contribution to supporting migratory species Cultural and recreational values Water bird habitat value Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site in system prioritised for repair in NQDT WQIP (2017) Site recognised as regionally significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits (subject to pursued works) Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment throughout site, primarily aquatic weed management, riparian revegetation and water infrastructure improvements.</p> <p>Attracts Co-investment: Potential co-investment opportunity with Lower Burdekin Water, Shire Council and Rec Fishing Organisations (e.g. Oz Fish Unlimited?)</p> <p>Demonstration Site/Profile: Potential high, subject to works types. Site has high profile and multiple good access locations.</p> <p>Community Support/Engagement: High public use and support at specific sites.</p> <p>Innovation: Landholder Support: Some past engagement. Support subject to type of works.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Rock Armor /Bank Stabilisation</p> <p>Extension /Education Extension Grazing Regime Management Extension Practice Change Burning Community Engagement Planning Catchment Management and Works Plan Riparian Management Agreements Remnant Vegetation Management Agreement Engagement with Statutory Planners</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Establish Connective Flows Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Rock Ramped Bund Outlets Remove Weed Chocks Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>Plantation Creek is a highly modified lower Burdekin River delta distributary that has had a long history of use for conveying pumped flows from the Burdekin River as part of Lower Burdekin Water's aquifer recharge and irrigation water supply scheme operations. Despite high levels of hydrological modification, altered water quality and weed infestation, it retains wetland habitats with high ecological values including deepwater lagoons with fishery and nursery habitat values and rare floodplain forest remnants. Riparian vegetation communities along most of the creek reaches are highly modified and simplified due to historical clearing but also due to invasive pyrophytic grasses that create large fire fuel loads that are exposed to annual burning during or subsequent to sugar cane harvesting/burning season. Aquatic grasses in the riparian zone e.g. para grass also represent an impediment to water flow. The lowermost reach of the creek system is banded and hosts an impenetrable cumbungi infestation that acts as an anoxic weed choke fish passage barrier. There are also a number of other physical fish passage barriers in the system associated with road crossing culverts and water management structure.</p> <p>Plantation Ck has a long-established use by the local community for recreation and nature appreciation. Some recreation use i.e. water skiing and wake boarding has been implicated in bank erosion impacts.</p> <p>Lower Burdekin Water is the principal management body for the system and has a long and currently funded engagement with NQ Dry Tropics in delivering wetland management outcomes. Burdekin Shire Council is also actively involved in the management of the system particularly of aquatic weeds and publicly accessed reaches. The scope of potential management works for this system is only constrained by the quantum of funding resources that can be directed at it. Some longer lead time/term issues would not be suited to GA's current project.</p> <p>The works recommended for this system under the current project are riparian revegetation and remnant vegetation management of selected demonstration /trial reaches using both intensive planting and extensive natural recruitment promotion methods. One of the aims of the trial will be to seek to establish species and overhead canopy structure in less accessible narrower, steeper bank reaches that can shade out aquatic grass weed species, reducing mechanical or chemical weed management requirements while delivering bank stability, shading and other instream habitat benefits. A catchment wide extension initiative concerning appropriate fire regime management for the riparian zone could alone deliver major riparian vegetation management and recruitment benefits.</p> <p>Partnering with Lower Burdekin Water, NQ Dry Tropics and the Burdekin Shire Council would provide significant benefits for the integration of the project with current management initiatives and help insure management gains are sustained into the future. Further project scoping with these partners may also identify other works suited to the current project.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT19_Healy Lagoon-Reed Beds	<p>Values:</p> <ul style="list-style-type: none"> Wetland representativeness – Lower Haughton River floodplain distributary with channel hosted deepwater lagoons, remnant floodplain vegetation assemblages and supra tidal palustrine and lacustrine wetlands. High fishery and fishery nursery habitat values Contribution to supporting migratory species Cultural and recreational values Water bird habitat value Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site previously regionally prioritised for works in Coastal Wetland Protection Program (2007) Site recognised as regionally significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits (subject to pursued works) Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment throughout site, primarily aquatic weed management, riparian revegetation and management agreements, water infrastructure improvements and fish surveys. Conceptual design/planning also undertaken for preferential flow path fish passage.</p> <p>Attracts Co-investment: Potential co-investment opportunity with Sunwater and possibly Main Roads.</p> <p>Demonstration Site/Profile: Potential high, subject to works types. Site has high profile adjoin Bruce Highway.</p> <p>Community Support/Engagement: Good for previous works associated with site. Rec fishing organisation support likely to be strong.</p> <p>Innovation: Landholder Support: Good with past engagement. Support subject to type of works.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Erosion Stabilisation Works Rock Armor /Bank Stabilisation Engineered Structure</p> <p>Extension /Education Extension Grazing Regime Management Extension Practice Change Burning Community Engagement</p> <p>Planning Catchment Management and Works Plan Riparian Management Agreements</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Establish Connective Flows</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Establish preferential flow path Remove Weed Chocks Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This site is comprised of a distributary creek system (Ironbark Ck) of the lower Haughton River, which includes ~10km of channel hosted pool habitats including perennial Deepwater lagoons, which discharge via ~1km of seasonal (para grass infested) drainage depressions to a 3km reach of supra-tidal lacustrine wetland with high fishery nursery values. The value of the system is also heightened by its proximity and contiguous habitat linkages to the Cromarty / Wongaloo wetland complex. This system has long been recognised for exceptional ecological values and was prioritised for works under a previous GBR Coastal Wetland protection program in 2005, which provided significant management gains for the system.</p> <p>One of the key values identified for this system is its potential value in providing fish passage connectivity from lower estuarine areas during times of flood when it is hydrologically connected to the Haughton River above both its weir systems that represent fish passage barriers. For this fish passage to operate fish first need to navigate across the ~1km reach of seasonal (para grass infested) drainage depressions known as Barrs Paddock as well a number of culverted road crossings in the upper reaches of Ironbark Creek. Barrs paddock has been shown to be inundated by anoxic black water during most wet season flow conditions and a preferential flow path fish passage concept has been developed for the site. Implementation of this concept would be the primary works focus for the site under this project.</p> <p>Other key works needs that could be included in a comprehensive program of management investment for the site include: control of aquatic weeds and potential anoxic weed chokes through the upper reaches of Ironbark Ck, improved management of grazing, weeds, salinity regime and associated connectivity of the supra tidal lacustrine habitat of the Reed Beds to maximise its fishery nursery habitat values, addressing structural fish passage barriers throughout the system, rehabilitation and revegetation of the riparian vegetation corridor, improved connectivity at the distributary – Haughton River bifurcation and improved management of remnant vegetation assemblages including those of the coastal plain linking via Palm Ck to Mt Elliot National Park. With an emphasis on water quality constraints to fish passage, monitoring of water quality and fish community would also be an important works component of the project.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
<p>NQDT20_Barratta Remnant Floodplain Habitat Matrix Management</p> <p>Includes subsidiary sites:</p> <p>NQDT21_Brewster Rd drain erosion</p> <p>NQDT22_Sayers Rd Tree Swamp & Green Swamp - Highflowboys</p> <p>NQDT23_Green Swamp - Highflowboys</p> <p>NQDT24_BHWSS Tailwater Drain</p> <p>Flowboy Bioreactors</p> <p>NQDT25_Woodhouse Lagoon -Tailwater Treatment</p> <p>Train_Recycle Basin1</p> <p>NQDT26_Woodhouse Lagoon -Tailwater Treatment</p> <p>Train_Recycle Basin2</p> <p>NQDT27_Mclain Rd Remnant</p>	<p>Values:</p> <ul style="list-style-type: none"> Wetland representativeness – Rare example of an intact floodplain wetland complex incl. deepwater lagoons, seasonal and perennial streams and back levee / off stream palustrine wetlands. Includes 3 DIWA wetland aggregations Floodplain vegetation representativeness (& connectivity) Discharges /Connectivity to HEV assets (Ramsar wetland, National Park GBRWHA) High fishery and fishery nursery habitat values & high integrity fish community Supports EPBC listed fauna incl. migratory species. Cultural and recreational values Water bird habitat value Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site previously regionally prioritised for works in Coastal Wetland Protection Program (CWPP) and Barratta Wetlands Investment strategy (2007) Site recognised as regionally (& nationally) significant floodplain coastal ecosystem asset (GBRMPA 2013) <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits (subject to pursued works) Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment throughout site, including from GBR CWPP, Biodiversity Fund and Sunwater.</p> <p>Attracts Co-investment: Potential co-investment opportunity with Sunwater and corporate sponsors.</p> <p>Demonstration Site/Profile: Potentially high, subject to works types. Site has high profile adjoining Bruce Highway and serviced by numerous public access roads.</p> <p>Community Support/Engagement: Good for previous works. Increased community awareness of site values and organised access arrangements would build significant support.</p> <p>Innovation: Landholder Support: Good, primarily Sunwater, has long history of past engagement. Private landholders and Lessees have also been engaged in past management activities.</p>	<p>Geomorphic/Earth Works</p> <p>Reinstate /Excavate Channel</p> <p>Construction Detention Basins /Water Treatment Trains / Bioreactors</p> <p>Erosion Stabilisation Works</p> <p>Contour Banking</p> <p>Engineered Structure</p> <p>Extension /Education</p> <p>Extension Grazing Regime Management</p> <p>Extension Practice Change Burning</p> <p>Install Interpretive Facilities</p> <p>Community Engagement</p> <p>Establish Access / Recreational Facilities</p> <p>Planning</p> <p>Catchment Management and Works Plan</p> <p>Remnant Vegetation Management Agreement</p> <p>Property Management Plan</p> <p>Engagement with Statutory Planners</p> <p>Pest Control</p> <p>Controlled Grazing</p> <p>Controlled Burning</p> <p>Aquatic Weed Control</p> <p>Woody Weed Control</p> <p>Feral Animal Control</p> <p>Vegetation Management</p> <p>Riparian Revegetation</p> <p>Broad Acre Corridor /Buffer Revegetation</p> <p>Fire Regime / Fuel Load Management</p> <p>Riparian / Wetland Fencing</p> <p>Promotion Natural Succession</p> <p>Protective Management Remnant Vegetation</p> <p>Hydrology</p> <p>Divert Flows</p> <p>Establish Connective Flows</p> <p>Wetlands in Upland Areas to Capture Runoff</p> <p>Broad Acre Revegetation to Manage Groundwater Levels</p> <p>Revegetation and / or Structures to Baffle Overland Flow Velocities</p> <p>Increase Detention Time of Runoff</p> <p>Reconfigure Drain Design / Drainage Network</p> <p>Connectivity</p> <p>Remove Weed Chocks</p> <p>Address Anoxic Reach Conditions</p> <p>Monitoring</p> <p>Vegetation Condition</p> <p>Fish Community</p> <p>Water Quality</p>	<p>The complex of 1000s of hectares of floodplain wetlands and remnant vegetation assemblages retained in habitat corridors along and across the Barratta Ck floodplain within the Burdekin-Haughton Water Supply Scheme arguably represents one of the highest value remnant floodplain wetland assets on Queensland's developed east coast. Not only are the site's insitu values high but it also is the catchment for the Bowling Green Bay Ramsar wetlands and other HEV assets to which it discharges. The intensive irrigation area surrounding and within the site boundary present ongoing challenges for managing site values. Sunwater currently invest significant resources in site management but wetland management is not their core business and any additional resources that can be bought to the task serves to protect site and receiving environment values.</p> <p>This nested works proposal represents a substantive investment program across the site which seeks to secure wetland condition within the site, trial some innovative water quality treatment options and promote transitional management regimes for the area which would lead to greater community involvement, use and benefit from site values.</p> <p>The principal works in this proposed include: stabilisation of dispersive soil erosion in a flood flow path drain (NQDT21), high flow diversion channels to inundate and detain water in hydrologically isolated tree and grassland swamp basins (NQDT22 & 23), treatment train /recycle basins to intercept tailwater impacts currently affecting a high value deepwater lagoon system (NQDT25 & 26) and the development and trialling of off line low flow diversion bioreactors in the areal tailwater drainage network (NQDT27).</p> <p>Engagement and discussion with Sunwater managers are required to scope these proposals beyond conceptual ideas.</p>

> Prioritised Candidate Sites Table 3. NQ Dry Tropics (Burdekin- Townsville) Region

NQ Dry Tropics Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
NQDT29_West Haughton Back Levee Bioreactor	<p>Values:</p> <ul style="list-style-type: none"> Vegetation representativeness – Lower Haughton River tributary drainage with relatively intact riparian community and contiguous floodplain / river levee vegetation remnants. Assimilative capacity for nutrients and sediments Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Site not regionally prioritised <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits but high demonstration potential. Outcome 2 (Coastal habitat health & resilience) modest benefits <p>Build on Past Investment: No past investment at site.</p> <p>Attracts Co-investment: Potential from landholder and possibly water management bodies / authorities / agencies and research organisations (QUT).</p> <p>Demonstration Site/Profile: Potential very high but profile and access limited.</p> <p>Community Support/Engagement: Untested</p> <p>Innovation: Very high around bioreactor proposals.</p> <p>Landholder Support: Untested but have expressed past interest re; drainage management at this site.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Construction Detention Basins /Water Treatment Trains /bioreactor Engineered Structure</p> <p>Extension /Education Community Engagement</p> <p>Planning Catchment Management and Works Plan</p> <p>Pest Control Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Riparian / Wetland Fencing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Wetlands in Upland Areas to Capture Runoff Reconfigure Drain Design / Drainage Network</p> <p>Monitoring Vegetation Condition Water Quality</p>	<p>This proposal site was identified opportunistically from aerial photo interpretation as being potentially high suited for the trialling of a constructed wetland bioreactor for denitrification of farm irrigation tailwater.</p> <p>The principle merit of the site is the contained farmed catchment area that discharges to the lower Haughton River via a single drainage line. This presents the opportunity for intercepting, mitigating and monitoring farm tailwater discharges at a single point. The site may also have potentially suitable soil profiles for construction of a bioreactor in terms of alluvial silts and sands overlaying deeper clays.</p> <p>The use of bioreactors for denitrifying farm tailwater is a new and innovative concept in Queensland particularly within the sugar industry. Much trialling and demonstration of these systems is required before they will have a likelihood for broader adoption. This site appears to present a good opportunity for such a trial.</p> <p>Communication with the landholders and site investigation preferable in the company of a bioreactor expert e.g. Fabio Manca from the Queensland University of Technology is required to scope the viability of this proposal.</p>

Terrain Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
<p>TER1_Southern Herbert Coastal Waterway Aggregation_Coolbie & TER2_Southern Herbert Coastal Waterway Aggregation_EasterCk-Bambaroo</p> <p>NB: Two adjacent proposal sites combined to form single major site</p>	<p>Values:</p> <ul style="list-style-type: none"> Discharges to HEV assets i.e. Halifax Bay Wetlands National Park and Marine Park Green Zone Wetland representativeness – Supra-tidal sedge and melaleuca swamps. Endangered and of concern floodplain regional ecosystem remnants and EPBC listed species Waterbird and migratory wader bird habitat values Fishery values and nursery habitat Culturally significant Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Herbert one of the highest priority basins for reducing pollutant loads Site subcatchment classed as moderate value, high threat in WQIP <i>Restoration of the Southern Herbert Coastal Waterway Aggregation</i> which includes site defined as a priority action under the Walking the Landscape Process incorporating WQIP information. <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Moderate past investment distributed across site, weed /feral pig management, revegetation, wetland basins, bank stabilisation.</p> <p>Attracts Co-investment: Existing DAF funded Terrain supported project, Council planning undertaken, Cane Productivity Board interest in farm management aspects.</p> <p>Demonstration Site/Profile: Works suited for demonstration, access and profile limited.</p> <p>Community Support/Engagement: Strong community capacity and support, Traditional Owner interests.</p> <p>Innovation: Potentially significant in management responses to saltwater intrusion areas.</p> <p>Landholder Support: Engaged landholders distributed across site, On-ground works and landholder engagement have already commenced in two of the waterways (Waterview and Insulators Creeks).</p>	<p>Geomorphic/Earth Works Construction Detention Basins Water Treatment Trains Erosion Stabilisation Works Breach / Lower Bunds Extension /Education Community Engagement Planning / Engagement Catchment Management and Works Plan Riparian Management Agreements Remnant Vegetation Management Agreement Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Vegetation Management Riparian Revegetation Reinstate estuarine vegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation Hydrology Reinstate Tidal Inflows Wetlands in Upland / Tributary Areas to Capture Runoff Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network Connectivity Remove Weed Chokes Address Anoxic Reach Conditions Monitoring Vegetation Condition Fish Community</p>	<p>This site lies within the southern extremity of the Wet Tropics Region within the Herbert River Basin one of the highest priority target basins for reducing pollutant loads. The site has high ecological values underpinned by relatively well-connected remnant coastal ecosystems that maintain landscape ecology. These include short coastal creek catchments with undeveloped and protected upper catchment areas, relatively intact riparian corridors, linked remnant floodplain vegetation assemblages and a largely protected coastal estuarine wetland complex.</p> <p>Works proposals seek to improve the area's, condition and connectivity of these remnant areas and to consolidate their protection from pervasive threats within (weeds, feral animals, fire regime) and external (edge effects, non-point source contaminant loads) to them.</p> <p>The area is characterised by highly erodible and dispersive soils and gently sloping land forms. Constructed wetland basins have been constructed west of the highway. Their further use is seen as an appropriate management focus subject to site soil (e.g. ASS) constraints.</p> <p>Supra tidal wetland remnants (sedgeland, paperbark swamps) adjoining tidal areas within the site are not common regionally and have high catchment function and fishery values.</p> <p>Salt water intrusion is affecting agricultural production. The site would lend itself to demonstration of a sea level rise coastal adaption strategy that provided for the planned retreat of production areas and landward migration of coastal wetland complexes.</p> <p>There is an existing network of engaged landholders across the site (Michael Bennato, Steve Accerero, Michael Bacaro). The Herbert Wetland Alliance (Jacqui Richards - Terrain) and DAF have an existing coastal wetland management project (Insulator Ck) within the site. A feral pig program is operating. Traditional Owners (Nyawaygi? Jerry Barry) affiliated with the area are also interested in its management and could be engaged. Laurence Di Bella (Cane Prod Services) has good contacts in this area</p>

Terrain Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
TER5_Mungalla Wetlands	<p>Values:</p> <ul style="list-style-type: none"> Discharges to HEV asset i.e. Palm Creek Conservation Park Wetland representativeness – Supra-tidal sedge and melaleuca swamps. Waterbird numbers and habitat values Fishery nursery habitat Culturally significant Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Herbert one of the highest priority basins for reducing pollutant loads Site subcatchment classed as moderate value, high threat in WQIP <i>Rehabilitating Allingham Wetlands</i> which includes site defined as a priority action under the Walking the Landscape Process incorporating WQIP information. <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: High levels of past investment in site, tidal bund removal, aquatic and woody weed /feral pig management, fencing grazing regime management, water salinity manipulation.</p> <p>Attracts Co-investment: Existing GAQ funded project with sponsor support.</p> <p>Demonstration Site/Profile: Works suited for demonstration, access and profile limited.</p> <p>Community Support/Engagement: Good community capacity and support.</p> <p>Innovation: High around issues of tidal incursion / salinity regime-based management of aquatic weeds.</p> <p>Landholder Support: Traditional Owner landholders very supportive, but actions need to operate through prism of commercial grazing operation run by lessees.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Breach / Lower Bunds</p> <p>Extension /Education Extension Grazing Regime Management Extension Practice Change (Cropping, Grazing, Burning)</p> <p>Planning / Engagement Catchment Management and Works Plan Incentive Payments Property Management Plan</p> <p>Pest Control Controlled Grazing Controlled Burning Aquatic Weed Control Aquatic Weed Mat Excavation Woody Weed Control Non-Woody Weed Control Feral Animal Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession Protective Management Remnant Vegetation</p> <p>Hydrology Reinstate Tidal Inflows Introduce Saline groundwater Establish Connective Flows Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Rock Ramped Bund Outlets Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality Water Flows / Levels Groundwater Levels /Quality</p>	<p>This site has been the focus of a multiyear wetland management investment program and is currently undergoing management works lead by Greening Australia funded by Reef Trust III. While significant gains have been made engaging and empowering traditional land owners and implementing major management actions, a range of new challenges and opportunities have also emerged. Significant further work is required to fully achieve wetland condition and function goals that were the motivation underpinning the original management investment program.</p> <p>Given the size of the wetland system and its long history of degradation under chronic and still active catchment-based pressures, the need for additional resources and management initiatives is understandable. Justification for further investment lies in: the high existing and potentially much higher rehabilitated site values; the adaptive management based learning and innovative technique development occurring through the implementation of the project; the need to demonstrate the viability of rehabilitating this type of coastal wetland complex with this suite of management issues which is representative of many other wetland sites in the basins and greater region; and, the flow on of site benefits (e.g. increased fish recruitment) to linked systems (e.g. Palm Creek) and the catalyst such benefits can provide for investing in linked and adjoining wetland systems.</p>

Terrain Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
TER7_Ripple Creek wetlands	<p>Values:</p> <ul style="list-style-type: none"> Significant high value wetland complexes (Terrain H1 value system) Wetland representativeness – Floodplain lagoons, treed swamp forests Endangered and of concern floodplain regional ecosystem remnants and EPBC listed species Waterbird habitat values Fishery and nursery habitat values Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Herbert one of the highest priority basins for reducing pollutant loads HWQMP data suggests high losses of N and PSII's in this area. <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment in water management infrastructure, less in environmental outcomes but has included some aquatic weed / management and revegetation.</p> <p>Attracts Co-investment: Potential to increase detention function of system could attract co-investment from industry bodies and/or water management boards.</p> <p>Demonstration Site/Profile: Works suited for demonstration, access and profile limited.</p> <p>Community Support/Engagement: Long standing recognition in community of need for improved management, support would be conditional upon nature of proposed works.</p> <p>Innovation: Some innovation required in responding to drain and integrated sediment trap design.</p> <p>Landholder Support: Landholders have previously been engaged in water management works, less so in environmental but concerns re: sedimentation of functional detention area motivates some support.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Sediment Extraction Construction sediment Basins /Water Treatment Trains Erosion Stabilisation Works Terracing and Revegetation of Cleared Sloping Land Rock Armor /Bank Stabilisation</p> <p>Extension /Education Extension Grazing Regime Management Extension Practice Change (Cropping, Grazing, Burning) Community Engagement</p> <p>Planning / Engagement Catchment Management and Works Plan Remnant Vegetation Management Agreement Land Purchase</p> <p>Pest Control Controlled Burning Aquatic Weed Control Woody Weed Control Non-Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Promotion Natural Succession Protective Management Remnant Vegetation Maintenance of Ground Cover Areas of Erosive Soils</p> <p>Hydrology Divert Flows Establish Connective Flows Wetlands in Upland / Tributary Areas to Capture Runoff / Sediment Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage</p> <p>Monitoring Vegetation Condition Fish Community Water Quality Water Flows / Levels</p>	<p>This site has exceptionally high biodiversity conservation and catchment functional value due to its rare representation of a floodplain lagoon system connected to both protected upper catchment areas and downstream to major rivers. It is also surrounded by intact floodplain vegetation and due to its role as a detention area locally known as the Ripple Creek 'sump' which serves both flooding and water quality management.</p> <p>The site has been the focus of several private and public water management infrastructure developments in past years and the design, function and maintenance of these have contributed to some of its current management needs.</p> <p>Soil erosion within the highly erodible drainage network has generated significant sedimentation within the wetland and has reduced its volume capacity and role as a floodwater and water contaminant detention area.</p> <p>Given the multitude of private and organisation players in the management of the area including the Local Water Management Board and the sites role in flood mitigation there is a great deal of sensitivity associated with management proposals for the site and consequently it has tended toward the 'too hard basket' for previous wetland management programs.</p> <p>However, site values and the potential water quality and biodiversity conservation gains and demonstration potential associated with delivering a successful management outcome at this site underpin its nomination as a priority site.</p> <p>The principle nominated works are water /sediment detention areas / treatment trains that don't impact run off hydrology upstream of the site. Fish passage (lower Ripple Ck), aquatic weeds remnant vegetation management and revegetation of drainage lines are additions works needs. Local Government and the Water Management Board would be prerequisite partners for this proposal.</p>

Terrain Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
TER19_Babinda Creek Catchment Repair	<p>Values:</p> <ul style="list-style-type: none"> Drains Protected World Heritage listed upper catchment via hydrologically connected high base flow perennial stream providing half of the catchment runoff to the Russell River Basin Culturally significant Recreational and aesthetic values. Fishery and nursery habitat values Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Russell - Mulgrave one of the highest priority basins for reducing pollutant loads Site subcatchment classed as moderate value, high threat in WQIP with management objective <i>Targeted investment to arrest further deterioration of assets, services and processes.</i> <i>Investigation of Catchment Repair Options – Babinda Creek</i> defined as a priority action under the Walking the Landscape Process incorporating WQIP information. Also ties into Russell Catchment Plan. <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Previous riparian revegetation programs conducted in some reaches lead by Jaragun NRM who are also currently delivering a large constructed/revegetated wetland for water quality treatment at the bottom of the system. Geomorphic investigation of stream restoration priorities is also being compiled in report by Alluvium Pty Ltd (due Feb 2018).</p> <p>Attracts Co-investment: Some potential for co-investment from Green Collar, Local Government, and possibly tourism associated organisations given the profile and recreational use of the system. Prioritisation of site within Region could also garner some Terrain NRM co-investment.</p> <p>Demonstration Site/Profile: Main revegetation works not highly innovative but site proximity to highway will provide demonstration profile. Instream habitat or bank /engineering works could provide regionally useful demonstration.</p> <p>Community Support/Engagement: Creek system has had relatively long running riparian revegetation program. Changes in local economy (mill closure) has changed local public's position toward greater support for environmental works.</p> <p>Innovation: Potential for innovation in delivery of instream habitat or bank restoration /engineering works.</p> <p>Landholder Support: Some previous landholder engagement and ongoing support. Some cultural reservations remain regarding revegetation.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Sediment Extraction Erosion Stabilisation Works Rock Armor /Bank Stabilisation Extension /Education Community Engagement Establish Access / Recreational Facilities Planning / Engagement Catchment Management and Works Plan Riparian Management Agreements Incentive Payments Engagement with Statutory Planners Land Purchase Pest Control Aquatic Weed Control Woody Weed Control Non-Woody Weed Control Vegetation Management Riparian Revegetation Promotion Natural Succession Hydrology Revegetation and / or Structures to Baffle Overland Flow Velocities Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Monitoring Vegetation Condition Fish Community</p>	<p>This site proposal is essentially for large scale riparian corridor restoration involving revegetation, bank stabilisation and potentially instream habitat restoration works. The Babinda Creek system has a near pristine upper catchment protected within the Wet Tropics World Heritage area. High rainfall and granite geology means it delivers a large clear perennial, baseflow to caneland dominated lowlands and that it contributes up to half of the Russell River basin's runoff. Within the caneland lowlands riparian vegetation has historically been extensively cleared to the point that stream channel morphology and stability and instream habitat quality have been severely compromised and water quality buffer functions for adjoining production areas lost.</p> <p>While there has been some revegetation of Babinda Creek reaches in the past it has been limited and not co-ordinated within an overall catchment context that identifies where geomorphic issues present risks to revegetation and/or the need for engineered bank stabilisation works in conjunction with revegetation. Significant sediment slugs within the system have also impacted instream habitat quality which could be served by restorative management.</p> <p>A geomorphic investigation of stream restoration priorities being reported by Alluvium Pty Ltd early this year will provide the context for progressing catchment wide restoration efforts. General findings suggest that the upstream reaches to the highway are relatively stable and suited to broad revegetation. Downstream reaches are more unstable. However, landholders in the lower section have a greater history of willing engagement. Jaragun a Traditional Owner associated NRM organisation are involved in revegetation in this area and have trusteeship of surrounding state land.</p> <p>Large scale restoration of the Babinda Creek riparian corridor would provide a high-profile change in the condition of the creek system and create a lasting regional legacy and promotion of riparian revegetation benefits. It would also serve biodiversity conservation and enhanced recreation / tourism values. Water quality benefits would also be delivered to the receiving Russell River system</p> <p>Trop Water and the Drainage Board have had past management involvement in the system and along with Jaragun Pty Ltd represent potential project partners.</p> <p>Extension of the project to include Jaragun's artificial wetland could expand its scope and potential water quality management benefits substantially.</p>

Terrain Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
TER25_Palm Creek	<p>Values:</p> <ul style="list-style-type: none"> Major floodplain distributary of the lower Herbert River Wetland representativeness – floodplain lagoons poorly represented in post development landscape Waterbird habitat values Fishery and nursery habitat values Public amenity and recreation values Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Herbert one of the highest priority basins for reducing pollutant loads Low value high threat subcatchment with management objective <i>Adaptation to enable or facilitate essential assets, services and processes or maintain isolated assets</i> <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) significant benefits Outcome 2 (Coastal habitat health & resilience) significant benefits <p>Build on Past Investment: Significant past investment in aquatic weed management. GA currently engaging in co-investment with shire in aerial weed spraying.</p> <p>Attracts Co-investment: Significance of system to Victoria Mill (Wilmar Pty Ltd) and Ingham township could attract corporate and local government (Hinchinbrook Shire) co-investment.</p> <p>Demonstration Site/Profile: Works suited for demonstration, access and profile high.</p> <p>Community Support/Engagement: Site occurs in close proximity to significant proportion of regional community and there is long standing interest in site's restoration amongst Herbert River Catchment and Landcare groups.</p> <p>Innovation: High level of innovation required in responding to chronic water quality conditions associated with historical organic loading and anoxic reach conditions.</p> <p>Landholder Support: Variable along creek system and subject to nature of proposed works and perceived risks to creek flood flow performance. Good in Victoria Mill reach.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Sediment Extraction Construction Detention Basins /Water Treatment Trains</p> <p>Extension /Education Community Engagement</p> <p>Planning / Engagement Catchment Management and Works Plan</p> <p>Pest Control Aeration of water Aquatic Weed Control Aquatic Weed Mat Excavation Mechanical Harvesting</p> <p>Vegetation Management Riparian Revegetation Fire Regime / Fuel Load Management Riparian / Wetland Fencing Controlled Grazing Promotion Natural Succession</p> <p>Hydrology Establish Connective Flows Wetlands in Upland / Tributary Areas to Capture Runoff Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows Increase Detention Time of Runoff</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality</p>	<p>This site is highly degraded but has been nominated as a priority for works on the basis of: strong community interest; good opportunities for co-investment: the opportunity to develop and trial innovative restoration and management techniques that could have application to many other equivalently disturbed agricultural floodplains; the high potential value of the site's wetland habitats once restored; and the site's catchment connectivity to another system undergoing restoration (Mungalla) which value adds to the potential restoration outcomes for both sites.</p> <p>Within the regional Water Quality Improvement Plan (WQIP) high threat but low (existing) value sites such as Palm Creek are nominated as areas for <i>adaptation to enable or facilitate essential assets, services and processes or maintain isolated assets</i>. Developing such adaptive management outcomes requires significant investment in innovation.</p> <p>Palm Creek has high groundwater connectivity to adjoining intensive agricultural areas and also receives water inputs from Ingham town, a STP and Victoria Mill. It is eutrophic, anoxic and has chronic floating and emergent aquatic weed infestations, a structural fish passage barrier and degraded riparian vegetation.</p> <p>Previous weed management programs and natural flood (2009) flushing events have delivered good condition outcomes for the site but it has reverted to a poor state in time due to the chronic operating pressures.</p> <p>Innovative management measures potentially involving mechanical aeration of the mill reach and its anoxic organic bottom sediments to facilitate load digestion and processing could facilitate a progressive condition outcome beyond the current impasse, and then justify investment in other more standard riparian, weed control and fish passage works programs.</p> <p>The project would be contingent on securing co-investment from corporate and local government partners and strong landholder and community group endorsement.</p>

Terrain Site No. & Name	Primary Justifications	Indicative Works	Engagement Notes
TER26_Fig Tree Creek	<p>Values:</p> <ul style="list-style-type: none"> Connected perennial tributary and swamp forest remnant of the lower Mulgrave River Wetland representativeness –good condition floodplain lagoons Endangered and of concern floodplain regional ecosystem remnants and EPBC listed species Fishery and nursery habitat values Assimilative capacity for nutrients and sediments Role in large-scale ecological functions and ecosystem services incl. connectivity Water quality benefit D/S Systems <p>Regional Prioritisation:</p> <ul style="list-style-type: none"> Russell - Mulgrave one of the highest priority basins for reducing pollutant loads Site subcatchment classed as moderate value, high threat in WQIP with management objective <i>Targeted investment to arrest of further deterioration of assets, services and processes.</i> <p>Reef Trust Outcomes:</p> <ul style="list-style-type: none"> Outcome 1 (WQ entering GBR) modest benefits (but high demonstration value) Outcome 2 (Coastal habitat health & resilience) modest benefits <p>Build on Past Investment: Site of past Mulgrave Landcare revegetation works. ML and greening Australia currently engaged in co-investment with corporate sponsor (Accor Hotels) in developing bioreactor wetland treatment train and revegetation project on site.</p> <p>Attracts Co-investment: Existing co-investment (Accor Hotels) has potential to be expanded and new partners possible in Terrain NRM and Local Govt.</p> <p>Demonstration Site/Profile: Innovative works a priority for regional demonstration, site close to highway but access limited to private road.</p> <p>Community Support/Engagement: Creek system has been a long term focus for Mulgrave Landcare. General public have been engaged in site works (tree planting) and commitment to site is still strong.</p> <p>Innovation: High level of innovation in design of bioreactor treatment wetland within abandoned caneland.</p> <p>Landholder Support: Previous landholder engagement and ongoing support.</p>	<p>Geomorphic/Earth Works Reinstate /Excavate Channel Sediment Extraction Construction Detention Basins /Water Treatment Trains Erosion Stabilisation Works</p> <p>Extension /Education Community Engagement Planning / Engagement Catchment Management and Works Plan Riparian Management Agreements</p> <p>Pest Control Aquatic Weed Mat Excavation Woody Weed Control Non-Woody Weed Control</p> <p>Vegetation Management Riparian Revegetation Promotion Natural Succession</p> <p>Hydrology Establish Connective Flows Wetlands in Upland / Tributary Areas to Capture Runoff Increase Riparian Vegetation and In-stream Structures in Upland Areas to Slow Flows Revegetation and / or Structures to Baffle Overland Flow Velocities Increase Detention Time of Runoff Reconfigure Drain Design / Drainage Network</p> <p>Connectivity Remove Structural Fish Passage Barriers Install Fish Passage Remove Weed Chokes Address Anoxic Reach Conditions</p> <p>Monitoring Vegetation Condition Fish Community Water Quality Water Flows / Levels</p>	<p>This site has been prioritised because of the opportunity it presents to capitalise on past and current investment in site works, community support and landholder engagement to deliver maximum return of further investment in an expanded site works program.</p> <p>Proposed works include extending riparian revegetation to the tributary McDonald Creek system, consolidating corridor connectivity to the adjoining foothills, delivering woody weed control and revegetation within the floodplain forest remnants adjoining Mulgrave river and additional revegetation, wetland basin and treatment train works in the drainage networks of contributing caneland catchment areas.</p> <p>One of the primary merits of the site is its potential for demonstrating the innovative use of a constructed wetland bioreactor in the treatment of farm nutrient loads. Given the small size of the catchment targeted works across the whole drainage system will also presents the opportunity to demonstrate a 'whole of catchment' system restoration outcome with demonstrative works all in relatively close proximity.</p> <p>Terrestrial fauna habitat and wildlife corridor connectivity including for EPBC listed fauna such as the cassowary are additional benefits to the wetland management outcomes associated with this proposal.</p> <p>Endorsement of landholder and community group support for an extended site boundary and works program, and confirmation of co-investment would be needed to secure this proposal's viability.</p>

- > Appendix 3 – Google Earth .KMZ files Regional Sites (separate)**
- > Appendix 4 – Regional Workshop Candidate Sites - SitesCombined2018.xlsx (separate)**