



SRA Research Project Final Report

Herbert Water Quality Monitoring Project: final Report 2011/003

SRA Project Code	CGH003 (2011/003)		
Project Title	Herbert WQ Monitoring Project		
Key Focus Area in SRA Strategic Plan	Environmental Sustainability		
Research Organisation(s)	TropWater, HCPSL, Terrain NRM, QDAFF, EHP, Herbert River CANEGROWERS		
Chief Investigator(s)	Michael Nash, Dominique O'Brien, Jon Brodie, Lawrence Di Bella		
Project Objectives	<ol style="list-style-type: none"> 1. To obtain relevant scientifically robust data to inform management decisions of industry and community on ways to reduce impacts of identified land uses on catchment and sub-catchment WQ. 2. To implement and validate a tailored WQ monitoring program to support farm management decisions. 3. To improve the validation of P2R modelling and the impacts of management practices on WQ in the Herbert River Catchment. 4. Develop and implement extension strategies to engage landholders and industry to identify and manage WQ issues. 5. Empower industry to drive farm management practice change for improved WQ outcomes based on sound evidence. 6. Provide integrated and comprehensive Range to Reef WQ data and information package to support extension, policy and continuous improvement for improved industry sustainability. 		
Milestone Number	9 – Final Report		
Milestone Due Date	31 st Dec 2014	Date submitted	May 2015
Reason for delay (if relevant)	Due to funding cuts to Terrain NRM and changes in Project Managers duties between March- October 2014, the preparation of the final report was delayed. A draft of the Final document was distributed for comment and review in early 2015, but due to heavy workloads the final document was not complete until April, 2015.		



Milestone Title	Final Report
Success in achieving the objectives	<input checked="" type="checkbox"/> Completely Achieved <input type="checkbox"/> Partially Achieved <input type="checkbox"/> Not Achieved
SRA measures of success for Key Focus Area (from SRA Strategic Plan)	

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PART A

Section 1: Executive Summary

Executive Summary

The Herbert River Catchment is situated in the Wet Tropics Region of Far North Queensland and covers approximately 10,000 square kilometers and unlike many other coastal streams in the wet tropics, the Herbert River has a significant inland component dominated by areas of relatively low rainfall (< 1000mm per annum)

This program aimed to provide scientifically robust water quality (WQ) data to be used in association with previously collected WQ data to estimate loads on a catchment scale for the validation of models, as well as to provide insight into relative concentrations of reef pollutants on a sub-catchment and paddock scale for use by extension staff and catchment managers to improve sustainable land management practices which will lead to improved WQ to the Great Barrier Reef (GBR).

This program aims to address knowledge gaps on water quality issues in the region identified in the Herbert Healthy Waters Management Plan (draft) such as land use specific contributions and pollution hot spots within the catchment. The HWQMP also provided the necessary catalyst for managers and industry to engage and assist landholders in the Herbert in future decision making by identifying specific issues that contribute to WQ degradation within the catchment. Further, the data collected has been a significant contribution to the assessment of actions and priorities identified as part of the new Wet Tropics Water Quality Improvement Plan improved land management practices (BMPs) which will deliver the greatest gains in improved Water Quality flowing to the Great Barrier Reef Lagoon.

Results obtained demonstrate that there are clear differences in the impact of land use on local water quality within the upper and lower catchments. The upper catchment does not contribute significantly to contaminant levels in the water quality observed within the lower catchment. Within the lower catchment sugarcane and urban land use have considerable influence on local water quality that is comparable to that observed in other north QLD catchments. Sediment concentrations measured within the Herbert catchment were low compared to concentrations reported in neighbouring catchments (Burdekin and Tully). Nutrient concentrations were highest in waters draining from sugarcane sites, with urban land use also contributing significantly to the levels of dissolved bioavailable phosphorus within the Herbert River. Overall, the range and average concentrations of nutrients and suspended solids measured in samples discharging from sugarcane sites during event conditions are comparable with those reported in waters sampled in other Australian sugarcane growing regions.

The HWQMP was integrated into a number of other P2R programs, including paddock scale; Rainfall Simulation trials and demonstration sites within the Herbert Catchment. The results from these programs have all been integrated into extension programs to better facilitate the transfer of the knowledge obtained among the local industry representatives.

The project was supported by two Regional Councils (HSC, TRC); Sugar Research Development Corporation (SRDC); and the Queensland Government (DEEDI & DNRM) and was funded to undertake monitoring for a period of three (3) years between July, 2011 and July, 2014. Work has commenced to continue monitoring on a reduced scale within the lower catchment under the direction of the Herbert Cane Productivity Services Ltd.

Section 2: Background

The HWQMP was initiated by stakeholders in the Herbert River Catchment who were dissatisfied with the lack of local data available to validate the proposed Paddock to Reef (P2R) Monitoring and Modelling Program. The Queensland Government's original intention was to use recent data generated from other catchments (Tully) in the Wet Tropics to validate catchment model scenarios for the Herbert Catchment. In order to meet the challenges of the ReefPlan targets geographically specific data is needed to identify hotspots and develop industry (or landscape) specific strategies to address WQ contaminants in these areas which provide considerable relative contributions to total end of catchment loads believed to be affecting the Great Barrier Reef.

Section 3: Outputs and Achievement of Project Objectives

Project objectives, methodology, results and discussion

- 1. To obtain relevant scientifically robust data to inform management decisions of industry and community on ways to reduce impacts of identified land uses on catchment and sub-catchment WQ.**

This project collected well over 1000 WQ samples between July 2011 and June 2014 across 17 monitoring sites in the Herbert Catchment. These samples were collected using approved methodologies under the Australian WQ guidelines and supported by TropWater and QG – DSITIA QA/QC protocols as outlined in the methodology section of the Herbert WQ Monitoring Project Final Report. All samples taken were analyzed for one or more of the major ReefPlan contaminants (namely Total Suspended Solids (TSS), Nutrients (particularly N, P speciation's and totals) as well as a suite of chemicals including PSII herbicides which are believed to be of particular concern to the health of inshore coastal ecosystems.

Once analysed, the data was collated and reviewed by the Technical Working Group which consisted of scientific representatives with WQ expertise from various industry groups and agencies involved, to provide robust discussion on possible/ probable causes and provide interpretation and presentation of these results back to stakeholders including industry groups, landholders, QG extension and policy reps.

- 2. To implement and validate a tailored WQ monitoring program to support farm management decisions.**

The implementation of the WQ monitoring program began with engagement processes in both the lower and upper Herbert Catchment stakeholders, including industries, local government and conservation groups. Understandably, industries (and LG) were nervous about supporting such an intensive WQ monitoring program in their own back yard, but through some persistence and assurance that this project wasn't a witch hunt, but more a tool for understanding where the issues really lie; and a catalyst for providing meaningful and targeted solutions eventually prevailed. Having several landholders involved in training and collection of WQ samples as well as the subsequent discussions on how to address the issues has been a positive for the project and also dramatically increased their level of understanding in ReefPlan and the challenges associated. This landholder buy in, also dramatically increased the acceptance of the data presented with other landholders at industry gatherings, where traditionally this type of data is vigorously challenged or dismissed.

3. To improve the validation of P2R modelling and the impacts of management practices on WQ in the Herbert River Catchment.

Before this project, and currently for almost all other GBR catchments being monitored under the Paddock to Reef Monitoring and Modelling Program (P2R), there is only one WQ monitoring site per catchment that is gauged and able to provide accurate estimates of flow used to develop loads (GBR CLMP) data. It is this measurement of loads derived at that point in the landscape which is used to validate the catchment models on which the Reef Report Cards and various other AG and QG policy and management decisions are generated. Given the QG's original intent of using the Tully data to build the Herbert model and the expected anomalies between the measured and modelled loads in this case, some significant adjustments to the loss coefficients and pathways of various constituents would have had to occur, to pass scrutiny amongst stakeholders.

Yet through the monitoring and development of loads calculations at several locations along almost the entire (300 km) length of the Herbert River, this project has provided catchment modelers with a step by step means to validate their models at various scales and through very diverse landscapes. From the dryland grazing and cropping areas of the upper Herbert, through expansive woodlands and steep gorges of the national parks, down to the lush tropical rainforest, and intensive sugarcane production systems, which the data has shown, all contribute to the end of catchment loads in various, but differing ways.

AG representatives (Kevin Gale) hailed the HWQMP... "the flagship of industry engagement in the GBR" at the Reef Rescue Conference in Cairns, May 2013. Although this project is now complete, there is little doubt that the legacy of the valuable information generated over the 3 years of this project will be entrenched in catchment modeling scenarios for the Herbert, well into the future, and has been earmarked by senior QG (EHP) staff as something that needs to be replicated in other catchments.

4. Develop and implement extension strategies to engage landholders and industry to identify and manage WQ issues.

Since the first years WQ data was available, meetings with various industries and stakeholders were convened on a regular basis (6-12 monthly) in order to provide insight into the issues apparent (or arising) and to discuss possible extension and education strategies specific to each group and where appropriate, the broader community.

As outlined in the final report, this led to several initiatives in the lower Herbert around sugarcane extension programs, but the data also raised issues in the upper Herbert around heavy metals and sources of sediment, which was subsequently investigated.

During the scope of this project, targeted sugarcane industry extension in the lower Herbert has been developed around issues of surface v subsurface nitrogen application, Diuron and Imidacloprid use, which are outlined in detail in the Final Report, but more importantly, the data generated over the past 3 years has provided the catalyst for significant investment from the QG into improved Nitrogen management in two cane hotspots identified as part of this project and now the cane industry is funding its own WQ monitoring across the lower Herbert Catchment, to measure trends in WQ improvement and continue to engage farmers on the issues specific to these areas.

HCPSL now has dozens of experimental trials and extension initiatives across the district which have been initiated (or least informed) by the data generated by this project; and provides considerable demonstration/extension capacity for the growers in the Wet Tropics and other regions that are looking to the Herbert as leading the way in sugarcane sustainability.

5. Empower industry to drive farm management practice change for improved WQ outcomes based on sound evidence.

Despite the early reservations and some initial shock as to the number and amounts of contaminants found in the WQ data presented, all industry leaders involved have embraced a very mature attitude towards the findings and are working within (and between) stakeholder groups to address the issues and improve WQ for the sustainability of their industry's in the Herbert Catchment and the future of the GBR.

The project provided significantly contribution to the WQIP for the Wet Tropics and as a result provided influence to decisions made by AG and terrain on the rollout of Reef WQ Grants (Reef Rescue 2) associated with grazing and sediment control in the Upper Herbert. Given the Herbert Catchment occupies approximately 1/3 of the Wet Tropics area, and is currently being used to guide sections of the Wet Tropics NRM plan, its influence and legacy have exceeded all original expectations.

As previously mentioned, HCPSL now has dozens of extension/demonstration initiatives aimed at addressing the challenges highlighted by the HWQMP, and although these have been developed and funded locally, the implications for the cane industry are widespread and relevant to many areas in the Wet Tropics and even Mackay.

The project has also highlighted the relative contribution of the urban footprint to WQ, especially to the Dissolved Inorganic Phosphorus loads.

Now that this project is finished, HWQMP Project Manager (Terrain) is initiating similar conversations around the importance of knowing your WQ data as part of a regional coordination effort to translate the learnings from this (and other) project/s to catchments and industries outside the Herbert; resulting in accelerated understanding of WQ implications of farm management practice across the Wet Tropics and through the QDAF Reef Extension & Education Program, GBR wide.

The HWQMP provide an integrated and comprehensive Range to Reef WQ data and information package to support extension, investment, policy and continuous improvement for industry and environmental sustainability in order to support the future of rural communities and the GBR.

Section 4: Outputs and Outcomes

Herbert WQ Monitoring Project Rationale:

Provided the framework for investigation and linkages to the broader Paddock to Reef Program which attracted significant additional funding to expand the scope of the project to include the Upper Herbert Catchment and addition land uses beyond sugarcane. The Project Rationale also includes a synopsis of background information, WQ site selections, sampling procedures, industries/ project partners involved and the intended outcomes for the project. Previously provided to SRDC.

4 Meetings of the Technical Working Group:

Planning, Interpretation, development of presentations and recommendations at these meeting were provided to the Steering (management) Committee for consideration and endorsement by all investment partners to allow adaptive management of the project as it grew, including the inclusion/ expansion of scope when necessary/opportunity arose to increase the value of the data collected.

4 Steering Committee Meetings:

In addition to ensuring that the governance arrangements (Terms of Reference) were adhered to and that the management of the project was tracking accordingly. These meetings provided significant improvement in knowledge and understanding of the WQ issues in the Herbert Catchment to JCU Scientists, Industry Leaders (CANEGROWERS, HCPSL) , Local Government (HSC, TRC) , Queensland Government (QDAF and EHP), and NRM Managers (Terrain, HRCG).

12 Stakeholder Meetings:

Stakeholder meetings were held in both the upper and lower catchments, with government/ industry extension personnel and where appropriate, landholders and other interested folk. The topics and focus of these meetings varied depending on the location and attendees, but generally the purpose was to extend the knowledge; provide some hard facts; allay to rest previous assumptions/ theories and biases that impeded meaningful dialog and discuss the challenges/opportunities to manage the WQ implications either within the industry or across sectors depending on the source and nature of the problem. It was also a great opportunity to acknowledge where contaminants weren't a problem and celebrate success and share ideas to encourage collaboration and instil a 'can do' culture amongst stakeholders. In addition to the formal invitation of the Stakeholder Reference Group meetings, project manager presented at 2 Malanda Beef Day conferences, 2 EHP - Reef Protection Seminars in Townsville and Brisbane, the ISSCT Agronomy and Engineering workshop during their field trip to Ingham, while Dominique O'Brien (co-author) presented HWQMP data at ASSCT twice.

2 ASSCT Papers:

Attached, abstracts below (publications)

1 Earth Smarties Schools Program:

National Award Received (abstract below)

Interim Final Report (EHP):

Milestone requirement after EHP reneged on their 3rd years funding of \$113,000, which is still owed to Terrain. This report includes only TSS, Nutrients and Pesticide data from years 1&2, for which Terrain was contracted to deliver, but this information is included in the SRA Final Report. Final Report has all 3 years data as above and the additional heavy metal and sediment work that was done as 'opportunistic works' for the HWQMP. (Interim Report not attached)

Final Report:

Provided to SRA 15th May, 2015

Section 5: Intellectual Property (IP) and Confidentiality

All WQ Data results have been entered into the QG database (DARTS) for modelling purposes, but may not be used for any other purpose without the permission of Terrain NRM as the custodian of the data.

If SRA requires a copy of the database for its own purposes, Terrain would be happy to provide.

Section 6: Industry Communication and Adoption of Outputs

The Herbert WQ Monitoring Project has been invaluable in engaging industries (leaders, extension staff and landholders) in the Herbert River Catchment into meaningful dialog around water quality contaminants and best land use management practice. The data generated by this project has squashed many long held assumptions and finger pointing between sectors, and through inclusive, proactive, structured and measured engagement, has been highly successful in not only getting industry leaders and landholders to take some responsibility for their relative contribution to “Reef Contaminants”, but has united industry groups across sectors to work together to combat the bigger picture.

Through the delivery model developed here in the Herbert, several other industry initiated WQ monitoring programs have been established (Burdekin, Sandy Ck) and there is considerable interest from government and industry sectors, to replicate the Herbert Project in other high priority Wet Tropics Catchments where landholder engagement in best farm practice change is especially challenging.

Results from the project have been presented in several forums across the Wet Tropics and other sugarcane growing regions where SRA staff and former SRDC staff have attended.

Although there is a strong held belief amongst science and policy makers that all sugarcane regions contribute similarly to the pollutant losses found in WQ between regions (and this is largely true on a catchment scale), the HWQMP has highlighted the need for sub-catchment data, since even within the Herbert Catchment measurements revealed, the way in which contaminants like DIN and even PSII’s to some extent, are dictated by site specific conditions, and that loss pathways are not uniform, therefore neither is the most appropriate management intervention for that site. Tailoring extension to these site specific or localised conditions is the next frontier in reducing diffuse pollutant impacts on the GBR. In order to achieve this, support and empowerment of the mechanisms that deliver these services will be an essential part of the LTSP 2050 if improving WQ from intensive agriculture is to be realised.

Given the degree of influence and importance of continuing this project, the HWQMP – extension project (2014-2016) is being funded by local industry and government to continue collecting WQ data in the two identified hotspots from this project. Further funding through DNR&M (project Nemo) is focussed on developing and trialling solutions for farmers to adopt improved management practice change in these high risk areas of the landscape.

Section 7: Environmental Impact

As outlined previously, the primary purpose of this project was to identify land-use specific contributions to the WQ pollutants leaving the Herbert River Catchment and entering the WHA Hinchinbrook Channel and GBR lagoon. This project has contributed to:

- a) Improvements in Catchment Modelling outputs and scenario planning;
- b) Provided sub-catchment WQ data for engagement with industry.
- c) Development of site specific extension to address a myriad of issues to support landholders in adopting better farm management practice in a site specific/relevant manner.

Section 8: Recommendations and Future Industry Needs

As outlined in various paddock to reef reports and modelling analyses, even if all farmers adopted best farm management practice in broader terms (ABCD Framework), the WQ targets set in ReefPlan would still not be achieved. Despite the considerable investment focus on machinery to date to support practice change, there is still a significant disconnect between on-farm decision making and how this tangibly relates to GBR Health.

Since rate and timing of application have the greatest influence over losses for both dissolved inorganic nitrogen (DIN) and chemicals (namely PSII herbicides), tailored extension to demonstrate to growers the alternatives and support for on farm decision making is essential. But without localised WQ data to quantify the losses, and to provide reasonable explanations as to how they got there, many landholders will remain disengaged or only get involved to receive grants for subsidized capital, with little regard for how to use it to achieve the purpose for its intended purpose, which is improved WQ!

Expansion of integrated, locally specific extension and feedback mechanisms, especially in high risk catchments (Tully & Johnstone) will be essential if the sugarcane and banana industries in the WT hope to resist the ever increasing pressure on policy makers to save the GBR.

Section 9: Publications

Title:

Water quality within the Herbert River Catchment associated with specific land use.

Authors:

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Keywords: nutrient, pesticide, sediment, monitoring, sugarcane

Abstract:

Between 1 July 2011 and 30 June 2012 sampling was undertaken at 16 sites within the Herbert Catchment as part of the Herbert Water Quality Monitoring Project (HWQMP). The aim of the project was to identify contaminants in the various sub-catchments with varying land use practices contributing to concentrations and loads within the Herbert River. The 16 monitoring sites covered the dominant land uses within the Herbert Catchment – rainforest, mixed cropping, urban, dairy, mining and grazing in the upper catchment, plus sugarcane, rainforest and urban in the lower catchment. As an industry initiative, the information generated can then be used to inform and assist in tailoring extension activities within each of the commodity groups; this is specifically the case for the cane industry. The cane industry is now developing strategies to address water quality issues that arise from the monitoring project and to inform its growers. The data generated will also provide “land use specific” water quality data to be used in the validation of catchment models for the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef Program). The results show detectable concentrations of sediments, nutrients and pesticides in catchment waterways which at times exceed existing Australian water quality guidelines. Concentrations of suspended sediments were relatively low throughout the catchment compared to results from neighbouring catchments in previous studies. Nutrient concentrations were high in waters draining from sugar sites but similar to concentrations found in streams of other Australian sugarcane growing regions. While pesticides – atrazine and diuron particularly associated with sugarcane production were found to be at concentrations exceeding the national guidelines for freshwater ecosystem protection. This is the first year of monitoring in the project and further data will be made available to industry as it comes to hand. Complete Report Attached

HERBERT WATER QUALITY MONITORING PROJECT: 2011-2013 RESULTS

By

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Keywords: Nutrient, Pesticide, Sediment, Monitoring, Sugarcane

Abstract

Herbert Water Quality Monitoring Program (HWQMP) is a three-year monitoring program that began in July of 2011. The HWQMP is an industry initiative that aims to determine the relative contribution of land use to the delivery of reef pollutant loads to the receiving waters of the Great Barrier Reef (GBR). Over the last two years the program has undertaken the monitoring of sediment, nutrient and pesticide concentrations in surface waters collected from various sub-catchments. Surface waters were collected from 16 sites which cover the major land uses within the Herbert Catchment – rainforest,

cropping, urban, dairy, mining and grazing in the upper catchment; and Nation Park, sugarcane and urban in the lower catchment. While the HWQMP will continue for the third and final year of monitoring, this paper will present the data for the first two years and compare the difference between years with regard to rainfall and river discharge profiles at the gauging sites investigated. Further, particle size analysis has been undertaken in an attempt to identify the sources contributing the majority of the sediment end of catchment loads within this system. Initial results demonstrate that pesticides atrazine and diuron regularly exceed the national guidelines for freshwater ecosystem protection, with a significant introduction of diuron to the waters of the Herbert River following the passing of the rain depression associated with ex-tropical cyclone Oswald through the catchment. Upon completion of the three year monitoring program the data generated will assist in informing the community, NRM managers and various industry stakeholders that use and rely on the land in this region of potential issues they may face. Further, the data generated will then provide 'land use specific' water quality data to be used in the validation of catchment models for the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef Program). Complete Report Attached

Ingham *Earth Smarties*:

Using a Curriculum Delivery Model to Engage a Rural Cluster of Schools in a Catchment Water Quality Monitoring Project

By

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Abstract

In 2011, nearly two hundred students at twelve primary schools located in the Herbert River Catchment near Ingham participated in the Herbert Water Quality Monitoring Project. Five of these schools were also involved the Great Barrier Reef Marine Park *Authority's Reef Guardians Schools* program. The Herbert Water Quality Monitoring Project is an ongoing project involving agencies representing primary industries (mostly cane and cattle), local government, scientific and natural resource management bodies, and provides insight to land management practices. The lower Herbert Catchment is mostly cane lands and borders both the Great Barrier Reef Marine Park and the Wet Tropics World Heritage Areas. Conscious management of farm run-off by cane farmers and of stream water quality by the whole community is therefore essential.

The schools section of the Herbert Water Quality Monitoring Project was based on the *Earth Smarties* curriculum delivery model developed in 2010 by teachers working in two Queensland Department of Education programs focused on the teaching of Science and Sustainability at primary school level, and another departmental program aimed at introducing digital technologies to classrooms. The *Earth Smarties* model has "four easy steps":

1. Find partners with synergistic objectives
2. Resource the project
3. Provide professional development & training
4. Celebrate Achievements

This paper documents the implementation of a catchment water quality monitoring project at school level, the engagement of the local stakeholder agencies in the project, and makes recommendations on how the *Earth Smarties* model could be applied to other catchments and with other projects. The intention is to scaffold the future engagement of school communities by other cane growing and natural resource agencies in local projects with global significance.